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Programs and Majors

Strong programs in business, the humanities, education, arts and sciences, and human services compliment our well-known strength in engineering. Lehigh students can choose from an array of courses and enjoy the resources and facilities of a major research university and the atmosphere and personal attention of a small college.

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- Anthropology (p. 395)
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- Art (p. 73)
- Art History (p. 73)
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- Astrophysics (p. 87)
- Behavioral Neuroscience (p. 96)
- Biochemistry (p. 90)
- Bioengineering (p. 91)
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- Chemical Engineering (p. 125)
- Chemistry (p. 132)
- Chinese (p. 336)
- Civil Engineering (p. 144)
- Classical Civilization (p. 156)
- Classics (p. 156)
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- Computer Engineering (p. 165)
- Computer Science (p. 172)
- Design (p. 73)
- Earth and Environmental Sciences (p. 184)
- Economics (p. 193)
- Electrical Engineering (p. 203)
- Engineering Mechanics (p. 323)
- Engineering Physics (p. 213)
- English (p. 217)
- Environmental Engineering (p. 144)
- Environmental Studies (p. 184)
- French and Francophone Studies (p. 336)
- Finance (p. 237)
- German (p. 336)
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- History (p. 253)
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- Journalism/Science Writing (p. 291)
- Management (p. 300)
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- Music (p. 348)
- Music Composition (p. 348)
- Pharmaceutical Chemistry (p. 132)
- Philosophy (p. 353)
- Physics (p. 359)
- Political Science (p. 367)
- Psychology (p. 375)
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- Science, Technology, and Society (p. 390)
- Sociology and Anthropology (p. 395)
- Spanish and Hispanic Studies (p. 336)
- Statistics (p. 314)
- Supply Chain Management (p. 408)
- Theatre (p. 418)
- Women, Gender, and Sexuality Studies (p. 422)

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- Computer Science and Business (CSB (p. 166))
- Elementary and Secondary Education (5-year program) (p. 53)
- Integrated Business and Engineering (IBE) (p. 280)
- Integrated Degree in Engineering, Arts and Sciences (IDEAS) (p. 261)

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- Biology (p. 96)
- Chemical Engineering (p. 125)
- Chemistry (p. 132)
- Civil Engineering (p. 144)
- Comparative and International Education (p. 162)
- Computer Engineering (p. 165)
- Computer Science (p. 172)
- Counseling and Human Services (p. 202)
- Counseling Psychology (p. 179)
- Earth and Environmental Sciences (p. 184)
- Economics (p. 58)
- Educational Leadership (p. 199)
- Education and Human Services (p. 202)
- Electrical Engineering (p. 203)
- Elementary Counseling (p. 60)
- Energy Systems Engineering (p. 214)
- Engineering Mechanics (p. 323)
- English (p. 217)
- Environmental Engineering (p. 144)
- Environmental Policy Design (p. 237)
- Environmental Studies (p. 184)
- Finance (p. 58)
- Globalization and Educational Change (p. 60)
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- School Psychology (p. 392)
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- Special Education (p. 404)
- Statistics (p. 314)
- Structural Engineering (p. 144)
- Supply Chain Management (p. 58)
- Teaching, Learning, and Technology (p. 411)
Mission Statement

To advance learning through the integration of teaching, research, and service to others.

Excellence is the hallmark of a university of distinction. Excellence requires a total quality commitment, which must characterize every activity of Lehigh University.

Lehigh is an independent, coeducational university with programs in the arts and humanities, business, education, engineering, and the natural and social sciences, offering bachelor’s degrees primarily to full-time, residential students and graduate degrees through the doctorate for both full-time and part-time students. Lehigh is small enough to be personal, yet large enough to provide stimulating diversity and to play important national and international roles.

Since Lehigh’s founding in 1865, the faculty has emphasized the integration of the academic disciplines, combining the cultural with the professional, the theoretical with the practical, and the humanistic with the technological in a modern, liberal education that serves as preparation for a useful life. Lehigh is an intellectually unified community of learners, and in this sense Lehigh is an integral university.

Lehigh strives to earn international prominence as a university of special distinction through its integration of teaching, research, and service to society. The integrating element of teaching, research and service is learning, which is the principal mission of all members of the Lehigh community. Our mission of advancing learning has three aspects:

**Teaching.** The development of future leaders in our global society is first among Lehigh’s purposes and first among our achievements. Preparation for leadership requires the best of teaching, in which both mentor and student are so deeply engaged that they become joint owners of the learning process.

**Research.** Lehigh is deeply committed to the creative search for new understanding of nature and human society as an essential element of the learning process. The scholarly inquiry and research of Lehigh faculty and students add value to instruction on our campus, and contribute to the distinction of our university.

**Service.** The special commitment of the Lehigh community to experiential learning through service to others imbibes the entire university with a sense of purpose and value in the larger society. Lehigh is extensively involved in developing partnerships with industry, government and others in education and human services to meet the needs of our society. In a societal sense, Lehigh is devoted to the concepts of unity, community, and cooperative achievement.

Lehigh believes that its graduates must develop critical thinking and effective communication as their habit; they must have both a broad understanding of human affairs and a domain of true competence; they are expected to live by a set of mature cultural and personal values, accept the virtue of work as a vehicle of service, and have the will to live and work with exceptional self-discipline.

Respect for human dignity is very important at Lehigh, a caring community deeply committed to harmonious cultural diversity as an essential element of the learning environment. In order that all members of the Lehigh community might develop as effective and enlightened citizens, the University encourages physical, social, ethical, and spiritual development as well as rigorous intellectual development.

Lehigh on the Web

www.lehigh.edu

Admissions information:

www.lehigh.edu/admissions

Parents & family:

www.lehigh.edu/parents

Other hot links

Catalog:

www.lehigh.edu/catalog

Academic programs:

www.lehigh.edu/programs

Lehigh at a glance:

www.lehigh.edu/lufacts

Campus visits, interviews and open houses:

www.lehigh.edu/visitinglehigh

Maps and Directions

www.lehigh.edu/maps
Academic Calendar

Lehigh University defines a semester as 14 weeks and 70 individual days of instruction to be followed by 2 days of a reading-consultation and study period in preparation of 9 consecutive calendar days of final examinations with four periods per day of 3 hour exam blocks. The summer term is 12 weeks with measured sessions. The academic year consists of one summer and two regular terms.

**FALL 2016**

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<td>First Year Student Check In</td>
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<td>August 29</td>
<td>Monday</td>
<td>First Day of Class/Registration day</td>
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<td>September 4</td>
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<td>Last day for Web registration</td>
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<td>September 4</td>
<td>Sunday</td>
<td>Last day to add courses without instructor’s signature</td>
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<td>September 4</td>
<td>Sunday</td>
<td>Degree awarding date</td>
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<td>September 5</td>
<td>Monday</td>
<td>Labor Day - Classes held</td>
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<td>September 9</td>
<td>Friday</td>
<td>Last day of registration</td>
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<tr>
<td>September 9</td>
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<td>Last day to add or drop a course without a “W”</td>
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<td>September 16</td>
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<td>Last day to select OR cancel pass/fail grading</td>
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<td>September 27</td>
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<td>Four o’clock exam Day 1</td>
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<td>September 28</td>
<td>Wednesday</td>
<td>Four o’clock exam Day 2</td>
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<td>September 29</td>
<td>Thursday</td>
<td>Four o’clock exam Day 3</td>
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<td>October 3</td>
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<td>Applications for January degree due</td>
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<td>October 3</td>
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<td>Rosh Hashanna</td>
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<td>October 5</td>
<td>Wednesday</td>
<td>Four o’clock exam Day 4</td>
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<td>October 6</td>
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<td>Four o’clock exam Day 5</td>
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<td>October 12</td>
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<td>Yom Kippur</td>
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<td>October 14</td>
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<td>Mid-term grades due</td>
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<td>October 17-18</td>
<td>Monday- Tuesday</td>
<td>Pacing Break - no classes</td>
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<td>November 2</td>
<td>Wednesday</td>
<td>Four o’clock exam Day 1</td>
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<td>November 3</td>
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<td>Four o’clock exam Day 2</td>
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<td>November 8</td>
<td>Tuesday</td>
<td>Four o’clock exam Day 3</td>
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<td>November 9</td>
<td>Wednesday</td>
<td>Four o’clock exam Day 4</td>
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<td>November 10</td>
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<td>Four o’clock exam Day 5</td>
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<td>November 7-18</td>
<td>Monday-Friday</td>
<td>Reserved registration period for Spring. Specific dates to be determined.</td>
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<td>November 15</td>
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<td>Last day to withdraw from a course with a “W”</td>
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<td>November 15</td>
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<td>Last day for January doctoral candidates to deliver dissertation drafts to dean</td>
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<td>November 23-25</td>
<td>Wednesday-Friday</td>
<td>Thanksgiving vacation</td>
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<td>December 2</td>
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<td>Last day for hourly exams</td>
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<td>December 9</td>
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<td>Last day of classes</td>
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<tr>
<td>December 9</td>
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<td>Last day to drop a course with WP/WF grades</td>
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<tr>
<td>December 9</td>
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<td>Last day for January master’s degree candidates to electronically upload thesis and deliver final paperwork to the Registrar’s Office</td>
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<td>December 10</td>
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<td>Review-consultation-study period for Tuesday classes</td>
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<td>Review-consultation-study period for Monday classes</td>
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<td>December 13</td>
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<td>Final exams begin</td>
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<td>December 21</td>
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<td>Final exams end</td>
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**SPRING 2017**

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<td>Sunday</td>
<td>Degree awarding date</td>
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<tr>
<td>January 23</td>
<td>Monday</td>
<td>First day of class/Registration day</td>
</tr>
<tr>
<td>January 29</td>
<td>Sunday</td>
<td>Last day Web registration</td>
</tr>
<tr>
<td>January 29</td>
<td>Sunday</td>
<td>Last day to add courses without instructor’s permission</td>
</tr>
<tr>
<td>February 1</td>
<td>Wednesday</td>
<td>Last day for filing applications for May graduation</td>
</tr>
<tr>
<td>February 3</td>
<td>Friday</td>
<td>Last day for registration</td>
</tr>
<tr>
<td>February 3</td>
<td>Friday</td>
<td>Last day to add or drop a course without a “W”</td>
</tr>
<tr>
<td>February 10</td>
<td>Friday</td>
<td>Last day to select OR cancel pass/fail</td>
</tr>
<tr>
<td>February 22</td>
<td>Wednesday</td>
<td>Four o’clock exam Day 1</td>
</tr>
<tr>
<td>February 23</td>
<td>Thursday</td>
<td>Four o’clock exam Day 2</td>
</tr>
<tr>
<td>February 28</td>
<td>Tuesday</td>
<td>Four o’clock exam Day 3</td>
</tr>
<tr>
<td>March 1</td>
<td>Wednesday</td>
<td>Four o’clock exam Day 4</td>
</tr>
<tr>
<td>March 2</td>
<td>Thursday</td>
<td>Four o’clock exam Day 5</td>
</tr>
<tr>
<td>March 10</td>
<td>Friday</td>
<td>Mid-term grades due</td>
</tr>
<tr>
<td>March 13-17</td>
<td>Monday-Friday</td>
<td>Spring Break</td>
</tr>
<tr>
<td>March 20</td>
<td>Monday</td>
<td>Classes resume</td>
</tr>
<tr>
<td>April 4</td>
<td>Tuesday</td>
<td>Four o’clock exam Day 1</td>
</tr>
<tr>
<td>April 5</td>
<td>Wednesday</td>
<td>Four o’clock exam Day 2</td>
</tr>
<tr>
<td>April 6</td>
<td>Thursday</td>
<td>Four o’clock exam Day 3</td>
</tr>
<tr>
<td>April 7</td>
<td>Friday</td>
<td>Honors Convocation</td>
</tr>
<tr>
<td>April 10-21</td>
<td>Monday-Friday</td>
<td>Reserved registration period for Fall and Summer. Specific dates to be determined.</td>
</tr>
<tr>
<td>April 11</td>
<td>Tuesday</td>
<td>Passover - classes held on weekdays</td>
</tr>
<tr>
<td>April 12</td>
<td>Wednesday</td>
<td>Four o’clock exam Day 4</td>
</tr>
<tr>
<td>April 13</td>
<td>Thursday</td>
<td>Four o’clock exam Day 5</td>
</tr>
<tr>
<td>April 14</td>
<td>Friday</td>
<td>Good Friday - classes held</td>
</tr>
<tr>
<td>April 14</td>
<td>Friday</td>
<td>Last day for May doctoral candidates to deliver dissertation drafts to dean</td>
</tr>
<tr>
<td>April 18</td>
<td>Tuesday</td>
<td>Last day to drop a class with a “W”</td>
</tr>
<tr>
<td>April 28</td>
<td>Friday</td>
<td>Last day for hourly exams</td>
</tr>
<tr>
<td>May 5</td>
<td>Friday</td>
<td>Last day of class</td>
</tr>
<tr>
<td>May 5</td>
<td>Friday</td>
<td>Last day to drop a class or withdraw with WP/WF grades</td>
</tr>
<tr>
<td>May 5</td>
<td>Friday</td>
<td>Last day for May master’s candidates to electronically upload thesis and deliver final paperwork to the Registrar’s Office</td>
</tr>
<tr>
<td>May 5</td>
<td>Friday</td>
<td>Last day for May doctoral candidates to complete all degree requirements</td>
</tr>
<tr>
<td>May 6</td>
<td>Saturday</td>
<td>Review-consultation-study period for Tuesday classes</td>
</tr>
<tr>
<td>May 8</td>
<td>Monday</td>
<td>Review-consultation-study period for Monday classes</td>
</tr>
<tr>
<td>May 9</td>
<td>Tuesday</td>
<td>Final exams begin</td>
</tr>
<tr>
<td>May 17</td>
<td>Wednesday</td>
<td>Final exams end</td>
</tr>
<tr>
<td>May 22</td>
<td>Monday</td>
<td>University Commencement Day</td>
</tr>
<tr>
<td>July 3</td>
<td>Monday</td>
<td>Deadline to apply for September degree</td>
</tr>
<tr>
<td>July 21</td>
<td>Friday</td>
<td>Last day for September doctoral candidates to deliver dissertation drafts to dean</td>
</tr>
<tr>
<td>August 4</td>
<td>Friday</td>
<td>Last day for September masters candidates to electronically upload and deliver paperwork to the Registrar’s Office</td>
</tr>
<tr>
<td>August 4</td>
<td>Friday</td>
<td>Last day for September doctoral candidates to complete all degree requirements</td>
</tr>
</tbody>
</table>
Information of General Interest

ACCREDITATION
Lehigh University is accredited by the Middle States Commission on Higher Education, 3624 Market Street, Philadelphia, PA 19104-2680 (telephone 267-284-5000). The Middle States Commission on Higher Education is an institutional accrediting agency recognized by the U.S. Secretary of Education and the Council for Higher Education Accreditation.

The College of Business and Economics business and accounting programs are accredited by the Association to Advance Collegiate Schools of Business (AACSB) International. AACSB International is a specialized accrediting body for business schools that offer undergraduate, master's, and doctoral degrees in business and accounting, and is recognized by the Council for Higher Education Accreditation.

The Commonwealth of Pennsylvania approves for educational certification various programs within the College of Education. The counseling psychology doctoral program and the school psychology doctoral program are accredited by the American Psychological Association, Commission on Accreditation. The APA:CoA is a specialized accrediting agency recognized by the U.S. Secretary of Education and the Council for Higher Education Accreditation.

The engineering programs that are accredited by the Engineering Accreditation Commission or the Computing Accreditation Commission of ABET, http://www.abet.org are listed under the Undergraduate Studies section, P.C. Rossin College of Engineering and Applied Science, Major Programs. The bachelor of science in computer science in the College of Arts and Sciences is also accredited by the Computing Accreditation Commission of ABET, http://www.abet.org. ABET is a specialized accrediting agency recognized by the Council for Higher Education Accreditation.


The department of theatre is accredited by the National Association of Schools of Theatre, Commission on Accreditation, which is recognized by the U.S. Department of Education as the accrediting body for the field of theatre.

The bachelor of science degree in chemistry is certified by the American Chemical Society.

POLICY OF EQUALITY
Lehigh University provides equal opportunity on the basis of merit without discrimination because of race, color, religious creed, ancestry, national origin, age, handicap, sex, sexual orientation or union membership.

Entrance Examinations

SAT/ACT: Each candidate for admission to the first-year class is required to take either the Scholastic Assessment Test (SAT) or the American College Test (ACT). Students are not required to sit for the writing component of either exam. Students are required to submit their scores directly to Lehigh through the College Board (CEEB code 2365). It is not the responsibility of the high school guidance office to forward the results.

The Committee on Admissions recommends that students take the exam in the junior year and again as early as possible in the senior year. In the evaluation process, the highest score in each category for the SAT and/or ACT will be used regardless of the test date. In cases where students have taken both the "old" and the "redesigned" SAT, tests will be super-scored within the respective exams but not across them, i.e. "old" with "old" and "redesigned" with "redesigned" but not "old" with "redesigned."

It is recommended that students who plan to study a foreign language take the SAT Subject Test or Advanced Placement Test for the language they intend to study. Students interested in advanced placement and/or receiving college credit in Chemistry, English, or a Foreign Language should take the SAT Subject Tests or the SAT Writing Section. Please read the Advanced Placement section (p. 8) for specific requirements.

Test information and applications may be secured from high school guidance offices, ACT, or the College Board. Additional information can be found online at www.collegeboard.com (http://www.collegeboard.com) or www.act.org (http://catalog.lehigh.edu/informationofgeneralinterest/entranceexaminations/www.act.org).

Candidates should register for the tests no later than one month prior to the test date (two months for candidates who will be tested in Europe, Asia, Africa, Central and South America, and Australia).

For applicants whose first language is not English, Lehigh additionally requires the results of the TOEFL IBT (Test of English as a Foreign Language Internet-Based exam) or the IELTS (International English Language Testing System). The Committee on Admissions looks for a minimum composite score of 90 on the TOEFL IBT or a minimum of 7.0 on the IELTS. Students whose composite score or sub-scores are lower than Lehigh’s minimums are still considered for admission but may be required to take additional English courses during their first-year and/or during the summer semester prior to fall matriculation. Official score reports should be sent to Lehigh by the testing agency. The most up-to-date information on requirements for non-US citizens can be found on the Lehigh Admissions website: www1.lehigh.edu/admissions/undergrad/intl

Recommendations

The Office of Admissions requires, as part of a candidate’s file, a letter of recommendation from the guidance counselor, principal, or headmaster from the candidate’s school. One teacher recommendation is also required. In addition to academic qualifications, recommendations should address the candidate’s personal qualifications such as character, intellectual motivation, participation in school activities, and established habits of industry and dependability.

Admission and Deposit

Lehigh University accepts the Common Application, so please follow the procedures on the Common Application Website (https://www.commonapp.org/) to complete your application. To see all of our requirements and forms, visit the Application Requirements page (http://www1.lehigh.edu/admissions/undergrad/apply/requirements). To submit any additional or missing documents please utilize the LU FileSender (https://filesender.lehigh.edu/custom.php?Instance=esc). If you are running into any issues or have questions please check our FAQs (http://www1.lehigh.edu/admissions/undergrad/apply/faq) first and then reach out to the Office of Admissions at admissions@lehigh.edu or 610-758-3100.

Once your application is submitted, a confirmation email will be sent to the email address you designated on your common application within one week. If it has been more than seven business days since you submitted your application and you have not received a confirmation email, please contact the Office of Admissions at admissions@lehigh.edu or (610) 758-3100. In your email, please include your full name, address and date of birth you provided in your application.

The course work or units required for admission represent the equivalent of the usual four-year college preparatory curriculum. Minimum course work requirements can be misleading since most students who gain admission to Lehigh University exceed the minimum course work.

MINIMUM SUBJECT MATTER REQUIREMENTS

English: 4
Foreign Languages¹: 2
Social Science: 2
Laboratory Science: 2
College Preparatory Mathematics: 3
Elective Subjects: 3

Total Credits: 16

¹ Only in exceptional cases, and for otherwise well-qualified candidates, will the Committee on Admissions waive the Foreign Language.
requirement for admission to any one of the three undergraduate colleges.

While there are many elements that go into Lehigh’s holistic application review, the Committee on Admissions will be aware of things such as (in no particular order):

- Rank or relative rank in class
- The student’s grades within the context of the school environment
- Evidence of improvement or deterioration in grades during the secondary school career with particular attention paid to performance in senior year courses
- The quality of performance in courses that relate to the student’s anticipated area of study
- The difficulty of courses taken with special attention given to courses recognized as accelerated by national academic organizations
- Comments and recommendations from the principal, headmaster, guidance counselor, teachers, or other professional educators within the school system
- Extra-curricular/work experience with particular emphasis placed on demonstrated leadership
- Demonstrated interest in Lehigh University

Admissions decisions are final and will be posted online via the Applicant Student Portal for each student. An admitted student, in the Regular Decision round, may secure a place in the entering class by notifying the university that he or she intends to enroll at Lehigh and by submitting the appropriate non-refundable enrollment deposit via the Admitted Student Portal or postmarked through the US Postal Service by May 1. A student admitted through the Early Decision rounds must send notification and deposit by the date indicated in his or her acceptance letter. This fee is applicable towards the fall-term bill. Students who do not attend will forfeit their deposit.

Transfer Students

Each August, students who have attended another college or university are admitted with advanced standing. Candidates for transfer admission must meet the high school subject matter requirements prescribed for incoming first-year students, and are required to have at least one year of full-time study (a minimum of 24 credits completed prior to time of enrollment at Lehigh) at another institution. Exceptions to fulfilling high school requirements will be granted following the review of a college level transcript. The academic performance at the college level is the primary focus when giving consideration to admission.

Candidates who have been dropped for poor scholarship, who are not in good standing, or who have been released for disciplinary reasons are not eligible for admission.

Each candidate must submit an official transcript and course descriptions from each institution attended. An admissions decision cannot be made without this information. Applicants for the fall semester should have their application submitted by March 1. Information regarding transfer applications may be found at www.lehigh.edu/tapply. Each application must be accompanied by an application fee of $70.

Students are encouraged to take an active role in seeing that the various components of their admission application have arrived at the university. Students will be notified by the Office of the Registrar as to the total credits Lehigh will grant to the student in advanced standing.

HOUSING

Every effort is made to accommodate transfer student housing needs. All students are required to live on-campus through the end of the sophomore year. Contact the Office of Residential Services, Rathbone Hall, Lehigh University, 63 University Drive, Bethlehem, PA 18015 or call (610) 758-3500. This office also can provide information about off-campus housing. Fraternities and sororities often have room for members or boarders. Information on this option may be obtained through the Assistant Dean for Fraternity and Sorority Affairs (http://studentaffairs.lehigh.edu/ofsa/contact).

Advanced Placement

The university offers capable students who have superior preparation an opportunity for advanced placement and/or college credit. Many secondary schools, in association with the College Board, offer college-level work. Students participating in these courses should sit for the Advanced Placement Tests offered by the College Board. Entering first-year students that request the College Board to send their Advanced Placement Test scores to Lehigh are considered for advanced placement.

Some departments noted below offer examinations during Freshman Orientation to students who studied college-level subjects in secondary school but did not sit for the Advanced Placement Tests. Entering first-year students wishing to sit for an examination in any Lehigh course should notify the Office of the First-Year Experience via email at fye@lehigh.edu by the date given on the First-Year Student Portal. The student should specify the number and title of the course. Students who receive credit on the basis of Advanced Placement Test grades need not sit for the Lehigh tests to confirm the credit granted.

Current practice at Lehigh is as follows:

Art, Architecture and Design
Eight credit hours for ART 001 and ART 002 are granted to students who earn a grade of 5. Three credit hours for Art Elective in Art History are granted for those students who earn a grade of 4. Those students who earn grades of 5 on the Advanced Placement Studio Art Examination receive four credit hours for ART 003.

Biology
Four credit hours for BIOS 001 Biology For Non-Majors, given to those who earn grades of 4 or 5.

Chemistry
Four credit hours for CHM 030 are granted to students who earn a grade of 5 on the Advanced Chemistry Placement test.

Computer Science
Students who receive a grade of 4 or 5 on the AP exam will receive two credits for CSE 001 and two credits for CSE 002.

Economics
Students will receive two credit hours of Economics Elective for a score of 4 or 5 on the microeconomics or macroeconomics exam. Students receiving a score of 4 or 5 on both the microeconomics and macroeconomics exams will receive four credits for ECO 001 and two credits of Economics Elective and satisfy the College of Business and Economics degree requirements.

English
Students who earn a score of 5 on one of the College Board Advanced Placement Tests in English (either in English Language and Composition or in English Literature and Composition) who achieve a score of 750 or higher on the writing section of the SAT receive six hours of Lehigh credit for freshman English (and exemption from the requirement). Students who receive a score of 4 on either of the Advanced Placements Tests in English or who have a score of 700-749 on the writing section of the SAT or a score of 5 on the IB High Level Examination will receive three hours of credit in freshman English; these students must complete the six-hour requirement by taking an English course ENGL 011. No credit is awarded for ACT scores.

Environmental Science
Students scoring a 4 or 5 on the environmental science exam will receive three credits for EES 002 and one credit for EES 022.

Government and Politics
Four credits for POLS 001 are awarded to those students that score a 4 or 5 on the American Government test, and four credits for POLS 003 are awarded to those that score a 4 or 5 on the Comparative Politics exam.

History
Students earning a grade of 5 in the American History Advanced Placement examination will receive four credits of History elective for use as Social Science credit. Students earning a grade of 5 in the European History and the World History exam will receive four credits of History elective for use as Social Science credit.

Latin
Students receive four semester hours of credit for a grade of 4 or 5 in the Virgil examination; those who successfully write in more than one area (e.g. Virgil and lyric poetry) receive eight hours of credit. Credit
will be awarded for LAT 099 Latin Elective. Students receiving credit for Latin and who wish to continue their study of Latin must consult with the Director for proper placement.

**Mathematics**

Four semester hours of credit for MATH 021, Calculus I, are granted to those who earn grades of 4 or higher on the Calculus AB examination. To those who earn a grade of 4 or higher on the Calculus BC examination, eight hours of credit are granted for MATH 021 and MATH 022, Calculus I and II. Credit for MATH 021 and MATH 022 or both may also be earned by passing the examination offered by the Mathematics Department during Freshman Orientation. Students regardless of whether they have taken the advanced placement examination may take this examination or not.

**Modern Languages and Literature**

Students receive four semester hours of credit at the intermediate level I for grades of 4, and eight hours of credit at the intermediate level I & II for grades of 5 on the advanced placement tests. Those who write the SAT II subject tests and score 600 to 699 receive four hours of credit; 700 and above receive eight hours of credit. The maximum number of credits given is eight. Those students receiving grades of 4 or higher on the Spanish language examination will receive four credits for SPAN 151.

**Music**

Two credit hours of Music elective are given to those students who earn a grade of 5 on the Advanced Placement test in Music, Listening/Literature of Music: Theory. Students wishing to pursue theory at Lehigh must still take a placement exam.

**Physics**

Five hours of credit are given for PHY 011, PHY 012, for a score of 5 on the "Physics 1: Algebra-Based" examination (or, "Physics B" examination, for those who took the exam prior to 2015) or a score of 4 or higher on the "Physics C: Mechanics" examination. If a student receives this advanced placement credit for PHY 011, five hours of credit will additionally be given for PHY 021, PHY 022, for a score of 4 or higher on the "Physics C: Electricity and Magnetism" examination. Alternatively, Anticipatory Exams for PHY 011 and PHY 021 are offered to incoming students during Freshman Orientation.

**Psychology**

Four credit hours of PSYC 001 are granted to students who earn a grade 4 or 5.

**Statistics**

Students scoring a 4 or 5 will receive four credits; for MATH 012 if enrolled in the College of Arts & Sciences or the College of Engineering & Applied Science, or three credits for ECO 045 if enrolled in the College of Business & Economics.

**International Baccalaureate**

Students who earn the international baccalaureate may be granted credit in higher-level or advanced subjects with scores of 5 or better or "B" or better. All students will have their credentials evaluated on an individual basis for specific course equivalency. Lehigh must receive the Official IB transcript before credit will be assigned.

**Estimate of Expense for Undergraduates**

Principally three areas of income support the operating expense of Lehigh University: tuition and fees, endowment earnings, and gifts and grants. The university is conscious that educational costs are significant and it strives to maintain a program of high quality instruction while recognizing that there are limitations on what families can afford to pay. Costs will vary somewhat from student to student depending upon the various options chosen.

**TUITION, ROOM, AND BOARD**

There are three major plans that cover the major expense associated with university attendance. These are as follows:

**The Tuition Plan**

The university provides comprehensive academic and student services under its tuition plan. The tuition sum is inclusive of most athletic events, basic treatments in the Health Center, libraries, and laboratory services. A technology fee of $400 is charged to all full-time students. An additional $500 fee is charged to all students enrolled in the College of Engineering and Applied Science or with a declared major in natural science. The full-time tuition rate is charged to students enrolled in twelve or more credit hours per semester. For students enrolled in less than twelve credit hours, tuition is charged on a per-credit-hour basis.

**University Housing Plan**

A variety of living arrangements are available. The university provides housing for approximately 2,500 students on campus in a wide selection of residence facilities and approximately 900 students in fraternity and sorority housing. The housing arrangements are grouped within four basic categories, with rates associated with the category level. First and second year students are required to reside in university housing. Second year students may choose residence hall or Greek housing options.

**University Meal Plan**

Nine meal plans are available. First year residents are required to participate in the Category 1A Meal Plan or one of the Category I Meal Plans. Upper-class students living in a traditional or suite-style residence hall are required to participate in the Category 1A Meal Plan or one of the Category I or II Meal Plans. Students residing in a fraternity or sorority are expected to participate in their house meal plan but also have the option to choose any of the university plans offered. Students residing in campus apartments or any off-campus facilities are not required to participate in a meal plan but have the option to choose any of the plans offered.

Each meal plan includes Dining Dollars. This pre-paid declining balance account was designed for maximum flexibility and convenience and can be used at most dining locations on campus to further increase your purchasing options.

**Cost of Attendance**

Tuition, Room, and Board charges are listed for the academic year (fall and spring semesters) with one-half charged for each semester. Other Fees are typically charged per occurrence.

**Tuition, 2016-2017**

- Technology Fee: $400
- University Housing:
  - Category I (Dravo, Drinker, Centennial I & II, McClinticMarshall, Richards, Taylor College): $7,320
  - Category II (All Greek Houses, House 104, UMOJA, Warren Square): $7,850
  - Category III (Brodhead House, Trembley Park Suite Singles): $8,150
  - Category IV (Farrington Square, Sayre Park Village, Trembley Park Apartments): $8,520

**NOTE:** The above University Housing rates are based on multiple occupancy.

**MEAL PLANS**

The number of meals specified is per week.

<table>
<thead>
<tr>
<th>Category (Meal Plans)</th>
<th>Meals per semester including $200 Dining Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA (Unlimited)</td>
<td>$5,910</td>
</tr>
<tr>
<td>I (19 meals including $100 Dining Dollars)</td>
<td>$5,370</td>
</tr>
<tr>
<td>Block Plan any 225 meals per semester including $100 Dining Dollars</td>
<td>$5,370</td>
</tr>
<tr>
<td>Block Plan any 200 meals per semester including $300 Dining Dollars</td>
<td>$5,370</td>
</tr>
<tr>
<td>Block Plan any $150 meals per semester including $300 Dining Dollars</td>
<td>$4,730</td>
</tr>
<tr>
<td>Block Plan any $500 Dining Dollars</td>
<td>$2,870</td>
</tr>
<tr>
<td>Block Plan any $500 Dining Dollars</td>
<td>$2,240</td>
</tr>
<tr>
<td>Block Plan any $50 Dining Dollars</td>
<td>$920</td>
</tr>
<tr>
<td>Block Plan any $700 Dining Dollars</td>
<td>$700</td>
</tr>
</tbody>
</table>

Based upon the above charges, most first-year students are normally billed the tuition rate and technology fee along with the Category I or II
room fee and a Category I meals board plan. The total cost for the four areas would be $61,010 to $61,540 for the 2016-17 academic year.

**OTHER FEES**
(applied to prevailing circumstances)

- Tuition charge per credit for part-time status or audit $2,000
- Engineering and Science Fee per year (for specified students) $520
- Application fee (for undergraduate admission consideration) $70
- Late preregistration (assigned to all fulltime students who do not select their full class load during the designated period) $100
- Late registration $100
- Late application for degree $50
- Examination makeup (after first scheduled makeup) $25
- Late payment (after announced date) $200
- Returned check fine $35
- Key/lock change (lost or non-return), room door, residence halls/sorority $35
- Identification card (replacement) $30

The university reserves the right at any time to amend or add charges and fees, as appropriate, to meet current requirements.

**OTHER EXPENSES**
A student should plan to meet various other expenses. These expenses include the purchase of books and supplies from the Lehigh University Bookstore located in Campus Square. Necessary purchases supporting one’s academic program should average approximately $1,200 per year. The Bookstore carries basic goods for students’ needs. A student should also plan an allowance to handle personal and travel expenses.

**Billing and Payments**
Billing statements are available online for both the student and any person the student authorizes. Semester billing statements are available approximately six weeks prior to the start of each semester. Payments are due as follows: Fall semester by the first business day of August, Spring semester by the first business day of January, and all Summer Sessions five days prior to the start of classes. If registration occurs after bills are issued, payment is still due prior to the start of classes. Accounts not settled by the due date are subject to a late payment fee.

Persons desiring a payment plan can elect participation in the university’s educational payment plan which provides for the payment of tuition, room, and board over four months per semester. Deadlines to participate are July 1st for Fall Semester and December 1st for Spring Semester.

The university also offers a plan under which enrolled undergraduate students can pre-pay more than one year of tuition. Enrollment period is through June to lock in the following academic year tuition rate. Complete information is available from the Bursar’s Office.

Students attending the university under a provision with a state board are eligible to be refunded as a credit transaction to the bank card by the student’s authorized person the student authorizes. Semester billing statements are available approximately six weeks prior to the start of each semester. Payments are due as follows: Fall semester by the first business day of August, Spring semester by the first business day of January, and all Summer Sessions five days prior to the start of classes. If registration occurs after bills are issued, payment is still due prior to the start of classes. Accounts not settled by the due date are subject to a late payment fee.

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**Refunds of Charges**

**TUITION AND ACADEMIC FEES**
An undergraduate student in good standing who formally withdraws or reduces his or her course enrollment below twelve credit hours before 60% of the semester has been completed during the fall and spring semesters will be eligible for a tuition refund. An undergraduate student in good standing who formally withdraws or reduces his or her course enrollment before 60% of a session has been completed during the summer sessions will be eligible for a tuition refund.

A graduate student in good standing who formally withdraws or reduces his or her course enrollment before 60% of the semester has been completed during any semester will be eligible for a tuition refund. The tuition refund for a student who withdraws or drops a course(s) is calculated on a daily basis. No refunds for tuition can be made for courses or workshops with five class sessions or less after the first day of class. Additional penalties may apply to withdraw from special programs or courses held at off-campus locations, such as Study Abroad or Geology Field Camp.

The date used to calculate refunds is based on when a properly authorized withdrawal or drop/add is received by the Registrar’s Office. Academic fees (such as Technology Fee, Engineering and Science Fee, course associated fees, etc.) are generally non-refundable after the first day of classes.

In the event of a medical withdrawal or death of a student, certified by the Dean of Students, tuition will be refunded in proportion to the semester remaining.

**Tuition Credit/Refund for a Disciplinary Suspension or Expulsion**
A student who is suspended from the University during the semester in which the incident occurred is eligible for a tuition credit that will be applied to the semester immediately following the period of suspension. The amount of tuition credited will be based upon the tuition refund schedule for a voluntary withdrawal and the tuition rate in effect during the semester in which the incident occurred less any required financial aid adjustments and any outstanding balance on the student’s account. The date used to calculate the tuition credit will be the date of the incident that resulted in the suspension. Tuition credit not utilized in the semester immediately following the period of suspension is forfeited.

A student who is expelled from the University forfeits all payments for tuition and fees incurred for the semester the incident occurred. If the decision to suspend or expel a student is made in a semester subsequent to the semester in which the incident occurred, the student is eligible to receive a 100% tuition refund less any required financial aid adjustments and less any other outstanding balance on the students’ account for any courses that the student is unable to complete as a result of the suspension/expulsion. Refunds will not be distributed until all disciplinary procedures including the appeals process are complete.

The University may, in its sole discretion, place a hold on the student’s academic records at the time of the incident, which will limit access to transcripts and other educational records until the disciplinary process is complete.

Please note that financial aid is not guaranteed for students who exceed 8 semesters of enrollment because of a disciplinary suspension.

**REFUND SPECIFICS**
Credit balances resulting from an overpayment with a bank card are eligible to be refunded as a credit transaction to the bank card by contacting the Bursar’s Office.

Credit balances resulting from an overpayment with a check drawn on a domestic bank require a minimum two week waiting period before a refund check will be issued.

Credit balances resulting from loans, grants, scholarships, and other forms of financial aid are eligible for refund after the 10th day of class.

All refund checks will be payable to the student unless
1. the student has authorized in writing a parent or guardian listed in the Banner Student System to receive the refund, or
2. the check payment on the account was clear that the payment was from an unrelated organization or institution, such as a sponsoring corporation.

Refund checks are mailed to the student’s university post office address or, if none, to the student’s “home address” listed in the Banner Student System. Any exception to this policy must be authorized in writing by the student.

Students receiving financial aid that drop below full time status must have their financial aid package re-evaluated by the Office of Financial Aid prior to the issuance of any refund check.

**RESIDENCE HALL/HOUSING REFUNDS**
Residence hall rooms are rented on an annual basis only. A student who signs a housing contract is expected to reside in and be financially responsible for residence hall housing for both the fall and spring
Any other Title IV program
Federal SEOG
Federal Pell Grant
Federal Direct Subsidized Stafford Loan
Federal Direct Unsubsidized Stafford Loan
will be refunded in the following order:

state and institutional policies. Any refunds due to the Title IV programs

ADJUSTMENTS TO FINANCIAL AID
The Office of Financial Aid is responsible for determining the appropriate
redistribution of charges and refunds when students receive any
financial assistance. These decisions are made on the basis of federal,
state and institutional policies. Any refunds due to the Title IV programs
will be refunded in the following order:

Federal Direct Unsubsidized Stafford Loan
Federal Direct Subsidized Stafford Loan
Federal Perkins Loan
Direct PLUS Loan
Federal Pell Grant
Federal SEOG
Any other Title IV program

Financial Aid
The mission of the Office of Financial Aid is to reduce the financial
barriers to a Lehigh education for those families whose resources alone
would make it impossible to meet the cost of attendance. The university
is deeply committed to providing need-based financial aid.

Lehigh expects each family to make every effort to pay tuition and other
educational expenses. Our aid program is designed to measure the
difference between our costs and the amount of money your family
can be expected to contribute towards those costs. That difference
is called “financial need” and represents financial aid “eligibility.” The
majority of Lehigh’s funds are awarded on the basis of financial need.

Students must file on time and meet academic progress requirements to
be eligible for consideration. Our merit-based aid program is explained
below.

The basic components of financial aid consist of gift aid (grants and
scholarships) and self help (employment and loan assistance). Gift aid
is generally not repayable. The majority are awarded on the basis of
“need” and are renewable on the basis of continuing “need”, satisfactory
academic progress criteria and on time filing. Employment provides
money for books and personal expenses, and is paid through biweekly
payroll checks based on hours worked. Loans are repayable funds from

one or more sources, repayable after the student ceases to be enrolled on
at least a halftime basis.

Additional sources of aid include, but are not limited to: state
agencies, employers, and various clubs, churches, religious and
fraternal organizations, and foundations. High school guidance
counselors are able to provide information about local aid programs.
There are also database scholarship search organizations that can
be accessed via the World Wide Web. Some examples are
(http://www.collegeboard.org), www.collegenet.com (http://
gocollege.com). (Caution: there are many scam operations that
promise great things if you send them a check. It is better to limit your
efforts to the proven sites referenced above.) You are expected to take
maximum advantage of any outside financial assistance for which you
may qualify, including Federal Grant and state grant programs to enable
Lehigh to spread its own funds further and to limit student borrowing.

The financial aid office website carries complete information:
www.lehigh.edu/financialaid

Application Procedures

APPLICATION PROCEDURES FOR 2016-2017
Students who are applying for institutional need-based aid are required
to submit the Free Application for Federal Student Aid (FAFSA –
online www.fafsa.ed.gov (http://www.fafsa.ed.gov)), the College
Scholarship Service CSS PROFILE (online www.collegeboard.com
(http://www.collegeboard.com)), Federal tax forms (student, parent and
business tax returns if applicable) and non-custodial parent application
(CSS Profile and Federal tax forms), if applicable. For more detailed
information such as deadlines and links to forms, please visit the
financial aid website at www.lehigh.edu/financialaid.

INTERNATIONAL CANDIDATES
International students may be eligible for university-funded financial
aid. Opportunities are limited. Two forms are required: the International
Student Financial Aid Application and the Certificate of Finances. The
forms can be found on the Admissions website under “Applying to
Lehigh.” Students who do not receive financial aid as a first year student
are not eligible for aid in future semesters.

RENEWAL OF AID
Financial need is reviewed annually to ensure aid eligibility as
determined by the Office of Financial Aid, in conjunction with federal,
state and university guidelines, reflects current financial and household
information. In order to maintain federal and institutional grant eligibility
from one academic year to the next, students must continue to
demonstrate financial need. Changes in circumstances such as
sibling(s) enrollment in undergraduate college, changes in household
size or changes in income may result in a change in financial aid
eligibility. Completed renewal applications are due to our office by April
15 of each year.

All students receiving financial aid must maintain satisfactory academic
progress. Satisfactory academic progress for Federal financial aid
eligibility differs from the academic progress policy for institutional aid.
To maintain eligibility for Federal aid, students are expected to maintain
satisfactory academic progress based on both qualitative (cumulative
GPA) and quantitative standards (pace of progression). Students must
achieve a minimum cumulative GPA of a 1.70 after their freshman year
(earning between 0 and 22 credits) and a minimum cumulative GPA
of 2.0 for all other grade levels (23 credits and above). Per Federal
Guidelines, students have a maximum of 12 semesters of Federal Aid
to complete their graduate requirements (aggregate loan limits apply as
well). Students must successfully complete a minimum of 67% of their
attempted coursework.

In order to maintain eligibility for Institutional financial aid, students
must 1.) Earn 12 new credits each semester, 2.) Earn a minimum grade
point average of 2.0 for each semester, and 3.) Maintain a minimum
cumulative grade point average of 2.0. Eligibility for institutional aid
at Lehigh University is limited to 8 consecutive semesters (unless
you are enrolled in a bona-fide 5-year program such as IBE or Art
Engineering). NOTE: Institutional aid is provided to assist students in
obtaining a bachelor’s degree. Additional aid will not be available to
students who choose to enhance their bachelor’s degree with additional credentials (i.e. second major/minors) and are unable to do so during the 8 consecutive semesters.

For both Federal and Institutional aid purposes, academic progress will be checked annually, at the end of each payment period, unless a student is on Financial Aid Probation, in which case SAP will be checked at the end of each semester.

Sources of University Aid

Several forms of university-funded aid, based on need and merit, are available.

LEHIGH UNIVERSITY GRANTS [ENDOwed AND SPONSORED SCHOLARSHIPS]
Lehigh Grants are need-based awards funded through university funds and endowments established by generous alumni and friends of the university. The general Lehigh Grant fund is originally awarded to act as a “placeholder” until we are notified of the amounts we are able to award for each of the named scholarship funds. The general Lehigh Grant may be swapped with an endowed or sponsored Lehigh scholarship, established by a donor.

LEHIGH UNIVERSITY MERIT SCHOLARSHIPS
Merit-based awards are gift aid awarded to students solely on a merit basis. When awarding merit aid, we take a holistic approach, looking beyond the numbers related to academic talent alone and reviewing what a student contributes outside the classroom as well as considering recommendations and personal essays. Selection for Lehigh merit-scholarship recipients is made by the Admissions Office – all students are considered for these awards during review of admission applications. Merit awards can be given in the amounts of full-tuition (Founders Scholarship), half-tuition (Trustees Scholarship) and $12,000 (Deans Scholarship). Awards are renewable for four years of undergraduate study and require a 3.0 average and satisfactory progress toward a Lehigh degree.

CUTLER-SAMETZ CHORAL ARTS SCHOLARSHIPS
Several merit scholarships of $5,000 are available for gifted students in the Choral Arts who maintain at least a 2.8 grade point average. Talented singers are eligible for these scholarships, renewable for four years, and recipients also receive free vocal lessons. Scholars are expected to join the University Choir. A separate application from the music department is required.

SNYDER FAMILY MARCHING SCHOLARSHIPS
Established by alumnus Joseph Snyder and family, these scholarships are for students who demonstrate musical talent and leadership skills. The scholarship provides awards of $1,500. Recipients of this scholarship agree to participate fully in the Marching Band. Recipients must maintain at least a 2.8 grade point average. A separate application is required.

PERFORMING ARTS SCHOLARSHIPS
Open to students in any academic major or program, these scholarships recognize students with exceptional musical and theatrical (including performance, design, technical, and playwriting) talent. These scholarships are valued at $5,000 and are renewable for four years. Recipients must maintain at least a 2.8 grade point average and remain active in the performing arts at Lehigh. A separate application is required.

ARMY ROTC LEADERSHIP AWARDS
In certain instances, the university may supplement an Army ROTC scholarship with a leadership award that is equal to the cost of room and board. These are highly competitive and require a 2.5 average for renewal.

NATIONAL MERIT SCHOLARSHIP CORPORATION AWARDS
Lehigh is a collegiate sponsor of the National Merit Scholarship program. Scholarships ranging from $1,000 to $2,000 per year may be awarded to Merit finalists selecting Lehigh as their first choice college, and who are not also receiving another form of National Merit scholarship.

ATHLETIC AWARDS
Athletics scholarships are available for students with exceptional athletic ability.

PRESIDENT’S SCHOLARS PROGRAM
This scholarship recognizes outstanding academic achievement by undergraduate students by providing a fifth year (i.e., a 9th and 10th semester) of study free of tuition. This benefit is intended to give students an opportunity to (1) pursue a second undergraduate degree, (2) pursue a graduate degree, or (3) undertake an advanced project of a scholarly or creative nature (e.g., a thesis, a portfolio of artwork, a design project, a field or laboratory research project) that does not lead to a degree. For more information and to learn about other restrictions please visit the Registrar's website (http://www.lehigh.edu/registrar/students/pres_scholar.html).

Availability of Jobs

Work-study jobs are available throughout the university and are funded through federal and university sources. If you are offered work-study as part of your aid package, the Office of Financial Aid maintains a listing of available on-campus jobs. Pay rates range from the federal minimum wage to $10.00 per hour. You are paid on a bi-weekly basis, as you work and submit timesheets. Your work-study earnings are not deducted from your billed expenses.

The Job Locator Development Program is designed to assist you if you do not qualify under the Federal Work-Study program to find employment off-campus or with a number of incubator companies located on the Mountaintop Campus. This program is coordinated through the Office of Career Services.

Aid from the Government

Lehigh University is an eligible participant in federally funded student aid programs. Campus-based programs, where the university makes the awards based on the dollars available, include:

- Federal Supplemental Educational Opportunity Grants
- Federal Perkins Loans
- Federal Work Study

Direct entitlement programs (where the government directly, or through commercial lenders for loan programs, provides the necessary funds) include:

- Federal Pell Grants
- Federal Direct Subsidized Loans
- Federal Direct Unsubsidized Loans
- Direct Parent Loan for Undergraduate Students (PLUS)

Please visit our website at www.lehigh.edu/financialaid for more detailed information on any of these programs.

Information for All Financial Aid Applicants

The Office of Financial Aid determines your financial aid award based solely on your family’s demonstrated financial need. We consider many factors, such as your family’s income, assets, size and unusual expenses, and our program is designed to help families across the economic spectrum. Please note the following important items regarding the need-based financial aid process:

- **Family Responsibility:** Lehigh’s philosophy behind financial aid eligibility is that a student and his or her parents are first and foremost responsible for the expenses related to obtaining an undergraduate degree. Furthermore, our expectation is that both parents, regardless of marital status, have a responsibility to participate in the financial aid process.

- **Expected Family Contribution:** Lehigh financial aid counselors carefully review the information your family provides in the financial aid application, including any additional circumstances brought to our attention, in order to determine the Expected Family Contribution (http://www1.lehigh.edu/financialaid/glossary), also known as the “EFC.” It is important to understand that the Expected Family Contribution is not what we think a family has “left over” after other expenses have been covered, and we do not necessarily expect that the parent contribution will be paid from current income. Rather, the level of contribution reflects our analysis of what parents can afford to absorb in education costs over time. Parents may choose to provide their contribution from savings, current income, future income (through borrowing), or some combination.
• Determining Need-Based Financial Aid Eligibility: Need-based eligibility is calculated per academic year and is determined using the following formula:
  Cost of attendance for one academic year - calculated EFC = financial need

• Merit-Based Financial Aid: All students are considered for merit aid at the time of admission. Students who are selected to receive a merit-based scholarship will be notified when they are admitted to the University. The Office of Financial Aid does not determine eligibility for merit scholarships (academic, athletic or otherwise), and the application process described on our website is not related to these resources. View more information on Lehigh merit scholarships >> (http://www1.lehigh.edu/admissions/undergrad/tuition)

If a student has demonstrated financial need (http://www1.lehigh.edu/financialaid/glossary), this financial need will be covered with a combination of gift-aid (http://www1.lehigh.edu/financialaid/glossary) and self-help (http://www1.lehigh.edu/financialaid/glossary).

Student Rights and Responsibilities

STUDENT RIGHTS
Students have the right to know

• the cost of attendance;
• the refund policy for students who withdraw;
• the financial assistance available from federal, state and institutional sources;
• procedures and deadlines for submitting applications for financial aid;
• how financial aid recipients are selected;
• how eligibility was determined, including all resources the aid office considered available to the student;
• how and when funds will be disbursed;
• an explanation of each type of award received;
• for any student loan received: the interest rate, total amount to be repaid, when repayment begins, the length of the repayment period, and the cancellation or deferment provisions of the loan;
• for any Federal Work-Study or university-funded job: a description of the job, the hours to be worked, the rate of pay, and how and when the student will be paid;
• the criteria used to determine satisfactory academic progress for financial aid purposes; and
• how to appeal a decision by the Office of Financial Aid concerning any aid award.

STUDENT RESPONSIBILITIES
It is the student’s responsibility to:

• read directions thoroughly, complete all application forms accurately, and to comply with any deadlines;
• provide any supplemental information or documentation required by the Office of Financial Aid or other agency if applicable;
• read, understand, and keep copies of any forms the student is required to sign;
• repay any student loans received;
• attend an entrance interview and an exit interview if federal, state or university loans are received while in attendance at Lehigh;
• notify the Office of Financial Aid of any change in enrollment status or financial status (including any scholarships or grants received from outside sources); changes of address and enrollment status must also be reported to lender(s) for any loan(s);
• satisfactorily perform the work agreed upon in a Federal Work-Study or university-funded work program; and
• know and comply with all requirements for continuation of financial aid, including satisfactory academic progress requirements.

For additional information write to the Office of Financial Aid, Lehigh University, 27 Memorial Drive W, Bethlehem, PA 18015; telephone (610) 758-3181; FAX (610) 758-6211, email financialaid@lehigh.edu or visit our website www.lehigh.edu/financialaid.

Lehigh University Theatre

In Spring, 1997, the department of theatre moved to the Zoellner Arts Center, Lehigh’s impressive performing arts facility. Three theaters, scene and costume shops, a dance studio, music practice rooms, classrooms and more enhance the department’s curricular activities. The department of theatre’s annual production program includes four productions in the three hundred-seat Diamond Theater and multiple lab productions in the one-hundred seat Black Box Theater. The plays range from classics to world premieres and recent mainstage seasons have included: Bad Jews, Tartuffe, Clybourne Park and 25th Annual Putnam Spelling Bee.

Shows directed and produced by students as class projects or independent work occur regularly in the Black Box Theater. Recent lab theatre productions have included: The Complete Works of Shakespeare, The Bald Soprano, I Can’t Imagine Tomorrow and Wanda’s Visit. Many events are sponsored by the Mustard and Cheese Drama Society, the country’s second oldest collegiate drama club. Auditions and production crews are open to all members of the university community. Production opportunities exist in performance, choreography, set and costume construction, properties management, lighting, sound, house management and publicity. Advanced students have opportunities to direct or design, under faculty supervision.

Outstanding work in the Diamond or black box theaters may be recognized with Williams Prizes and theatre department prizes in acting, directing, design, playwriting and technical production.

Professional guest artists – directors, playwrights, designers, and actors – frequently visit the Lehigh campus to work on productions, teach classes, and conduct seminars and workshops for all interested students. The department also sponsors artists-in-residence, guest lecturers, workshops, and touring performances.

Musical Organizations

The music department offers students an array of ensembles in which to perform and develop leadership skills. The choruses, bands, orchestra, and ensembles are conducted by members of the faculty and managed by elected student leaders. Nearly all performances except Christmas Vespers are held in Baker Hall in the Zoellner Arts Center.

Students earn one credit per semester for each ensemble or lesson course in which they are registered, but they may register for zero credit to avoid overloading.

LEHIGH UNIVERSITY PHILHARMONIC ORCHESTRA

The Lehigh University Philharmonic Orchestra, directed by Eugene Albulescu, is a body of 60-70 players from diverse backgrounds. Though primarily a student orchestra, faculty and community members also participate, creating an ensemble that contains unique intersections between students of all majors and professionals, campus and community. Students bring the great works of orchestra repertoire to life in four pairs of concerts a year in Baker Hall, Zoellner Arts Center. Membership is by audition.

JAZZ ENSEMBLES

The Jazz program, directed by Bill Warfield, consists of a number of groups large and small, including the Jazz Ensemble, the LU Jazz Repertory Orchestra, the LU Funk Band, and a number of combos. The ensembles perform contemporary literature as well as the music of the more traditional bands such as Basie, Ellington, Goodman and Herman. A distinguished faculty of jazz musicians teaches private lessons and coaches the combos. Membership is by audition.

MARCHING 97

The Marching 97 meets during the fall semester and plays at each Lehigh home game, as well as several away games. Made up of students from all of the colleges at Lehigh, the band is a student-run organization dedicated to building a positive Lehigh spirit at games and off the field. Band camp is held three days during the week prior to the start of classes. No audition is required.
SYMPHONIC BAND
The Symphonic Band meets and performs only in the spring semester of each year. The ensemble consists of students, faculty and staff who are interested in playing music. No audition is necessary.

WIND ENSEMBLE
The Wind Ensemble, under the direction of David B. Diggs, is a select group of students dedicated to performing music for woodwinds, brass and percussion. These students represent many diverse majors. In 1999 the Wind Ensemble was honored by Downbeat Magazine, receiving the award for the most outstanding college classical symphonic band.

LEHIGH UNIVERSITY CHORAL ARTS
The Lehigh University Choral Arts, directed by Steven Sametz, is the umbrella organization for a number of vocal ensembles:

LEHIGH UNIVERSITY CHOIR
The Choir is an active force in campus life. The 60 mixed voices of the Choir, drawn from all majors of the University, are auditioned at the beginning of the academic year. They give four major concerts on campus and tour internationally. The Choir frequently performs with orchestra and regularly performs new music, including many works written especially for them. They have been heard five times on National Public Radio. The Choir has toured to Austria, China, France, Germany, Korea, Portugal, Russia, Thailand, Taiwan, and has performed in Carnegie Hall and Avery Fisher Hall at New York’s Lincoln Center.

LEHIGH UNIVERSITY CHORAL UNION
The Lehigh University Choral Union, composed of students, faculty, staff, and Lehigh Valley community members performs three a year with internationally known soloists and a full symphony orchestra. The 200 singers of the Choral Union bring major works such as Beethoven’s Ninth Symphony, Mahler’s Second Symphony, and the Brahms Requiem to a broad audience. No audition is required.

LEHIGH UNIVERSITY GLEE CLUB
The recently revived Glee Club sings traditional and new music for male voices under the direction of Steven Sametz. Enthusiastically welcomed by alumni and the university community, the Glee Club has thrilled audiences on campus, on tour in China, and at Lincoln Center, where they performed with the University Choir.

DOLCE
Dolce – Lehigh University’s Women’s Ensemble under the direction of Sun Min Lee begins a new tradition of women’s music on campus. They perform on campus and in the community. This group sings a variety of music written especially for female voices as well as music adapted for the group. Members of Dolce also sing with the University Choir.

Club Sports
A Club Sport is formed when a group of students voluntarily organize in the aim of seeking structured and often competitive sport opportunities in an area of common interest. Club sports are structured and guided by the principles and obligations of other student organizations, and are not formally recognized until they are fully compliant and meet required expectations. The initiative, organizational commitment and personal investment required for club sports participation fosters an extraordinary learning and leadership experience.

Competition can range from a club varsity status such as Men’s Ice Hockey and Men’s Rowing to competitive sports such as Cycling, Equestrian, Men’s and Women’s Rugby, Ultimate Frisbee, Water Polo or non competitive sports that includes Badminton and Gymnastics just to name a few. In total, there are 32 recognized club sports that are active.

Intramural Sports
Intramural sports are organized, structured, and competitive activities that are played within the University. At Lehigh, members form teams from IFC, Pan-Hellenic, off campus houses and dorms. These teams and individuals accumulate trophy points in sporting contests for an overall All University Champion in one of four divisions: Upper-class Greek, Upper-class Independent, Women and Freshmen. Intramural sports, which varies from 11 to 15 activities, offers our students a high degree of physical fitness, helps establish habits of regular and healthful exercise, fosters the development of self confidence, good sportsmanship, and a spirit of cooperation.

Fitness
The Fitness Programming initiatives at Lehigh exist to promote the development of a physically educated person. Opportunities are provided for all members of the Lehigh community to learn skills necessary to perform a variety of physical activities and acknowledge the implications of and the benefits from involvement in physical activities. We teach the value of physical activity and its contribution to a healthful lifestyle. Our programs focus on activities in which a person can participate over the course of a lifetime, and contribute to the development of health-related components of physical fitness through sport.

Recreation
The entire Lehigh community is invited to participate in the annual Turkey Trot, compete in organized leagues such as summer softball and others during the academic year or informal activities such as lap swimming in our pool, playing pickup basketball, refining your dance moves in the Dance Studio which are all located in Taylor Gym. The Goodman Campus provides a vast green space, to throw a Frisbee, kick a soccer ball or play a friendly game of touch football.

You can run on our nationally known cross country course, hit a tennis ball at the Lewis Tennis Center or drive a bucket of golf balls at the Mulvihill Golf Learning Center. The opportunities are endless!

Student Code of Conduct
Intellectual honesty and mutual respect are not accidental values in a university. They are, for students and professors alike, a presupposition of the pursuit of truth, which brings universities into existence. It is essential that an academic community uphold these values. The student code of conduct and the student conduct system are mechanisms by which the university endeavors to develop in all students a sense of responsibility to the Lehigh University community.

The Lehigh University Student handbook (http://studentaffairs.lehigh.edu/handbook) contains information relevant for the student members of our community. All students have an obligation to read and be familiar with the Student Handbook, the Code of Conduct, and the other policies contained therein.

In Bethlehem, An Educational Tradition
Lehigh University shares in the historical heritage of Bethlehem, even though, having been founded in 1865, it is a relative newcomer. The fact that Lehigh was established in Bethlehem reflects the tradition of education established by the community’s first settlers thirty years before the founding of the nation.

The first Moravians were among the many German religious sects that came to the New World, and especially to Pennsylvania, during the early 1700s. But unlike William Penn, who established his sylvania as a new land where he might hold his Quaker beliefs away from England’s oppression, the Moravians came as missionaries with the intent of converting the Indians to Christianity. For this purpose they settled the Lehigh Valley.

The early Moravians were industrious. Their first building, the Gemein Haus (community house) was completed in 1741. This building stands today, one of thirty-nine remarkably preserved pre-Revolutionary War buildings constructed by the Moravian settlers and in continuous use ever since by the Moravian community. Many of these buildings are located on Church St., west of the City Center; industrial buildings are located in the 18th Century Industrial Area in the Monocacy Creek valley west of the business district.

The leader of the Moravians was Count Nicholas von Zinzendorf of Dresden. He arrived in the settlement in time for their observance of Christmas Eve in 1741 and gave the settlement the name Bethlehem—“house of bread”.

The settlers built high-quality structures of stone, demonstrating principles of engineering that were not generally used elsewhere. They were interested in music, and established the first symphony orchestra
in America. In 1748, the settlement had a fourteen-man orchestra. The community’s first organ was built in 1757 by John Gottlob Klemm. The musical tradition, including the trombone choir, continues today, perhaps most visibly in the Bach Choir of Bethlehem, whose yearly Bach Festival is held in the university’s Packer Memorial Church. In 1985, the 300th anniversary of the birth of Johann Sebastian Bach was observed.

Zinzendorf envisioned Bethlehem as the center for manufacturing; outlying Moravian settlements, such as Nazareth, Pa., would be primarily devoted to agriculture. On October 15, 1742, a large barn was “raised” with the help of most of the residents. Three months later a grist mill at the community spring produced the first flour. In 1758, the Sun Inn was built along Main St., a haven for travelers. Reconstruction of the picturesque inn was completed in 1982, and it now operates as a community center and restaurant.

Zinzendorf’s determination that Bethlehem would be a major industrial center was assisted by the completion in 1755 of the water works, the first public utility in the New World.

The Moravian dedication to education was an extension of the philosophy of John Amos Comenius, who had written, “Everyone ought to receive a universal education.” The Moravian educational institutions that continue today, including Moravian Academy and Moravian College, stem from this tradition.

The Moravians, although avowedly opposed to war, found their community pressed into service as a hospital when Washington’s troops bivouacked at Valley Forge during the winter of 1777-78. Washington came to the community once, and many other Continental Army officers were visitors.

The Sun Inn was also used as a hospital during the war; among its patients was an aristocratic renegade from France, Marie Joseph Paul Ives Gilbert Motier, the Marquis de la Lafayette. Lafayette had come to assist the Continental Army aboard his own ship, the “Victory.” Fifty years later a college in Easton was named in his honor and it became Lehigh’s traditional football rival.

The first bridge across the Lehigh River was built in 1794. It was replaced in 1816, but the latter was destroyed by a flood in 1841. In 1759, the turnpike (toll road) over South Mountain, generally along the route of the present Wyandotte St. hill, was opened. The present Hill-to-Hill Bridge was built some fifty years ago.

“Black gold.” During the late 18th century, anthracite was found in the mountains north of the Lehigh Valley. In 1818, the Lehigh Coal Co. and the Lehigh Navigation Co. were formed, one to mine the anthracite on the upper Lehigh River, the other to transport it down river to metropolitan markets.

The Lehigh River was difficult to navigate. Consequently, in 1829 the Lehigh Canal was completed from Mauch Chunk (now Jim Thorpe), through Bethlehem to Easton, where it connected with the Delaware Canal. During the 1840s, iron mines were opened in the area, and several blast furnaces, fueled by coal, were in operation. Zinc ore, was found in neighboring Upper Saucon Township. In the 1850s Asa Packer built the Lehigh Valley Railroad. These origins eventually led to the heavy industry that continues in the Lehigh Valley today.

When Asa Packer founded Lehigh University in 1865, one of his objectives was to make possible broadly based education for young people of the region, combining the technical skills needed to run the flourishing industry of the Lehigh Valley with a liberal education.

In addition to its role as a steel-making center, Bethlehem today is a major tourist attraction. The Moravian community sets up an elaborate nativity scene and the entire city is decorated with lighting during the holiday period. The Moravian tradition of a single candle (now electric) in each window is widely observed.

Atop South Mountain is a steel tower known as the Star of Bethlehem. During the holiday period, the star’s hundreds of bulbs create a 95-foot-high star that can be seen for many miles. The star was the gift to the community of Marion Brown Grace, wife of Eugene Gifford Grace, the steel magnate and president of the university board of trustees.

The community of Bethlehem has a population of approximately 78,000 persons with segments from a variety of nations who retain traditions of their country of origin.

There are five principal independent colleges in the Lehigh Valley besides Lehigh. They are Lafayette, DeSales University, Moravian, Muhlenberg, and Cedar Crest. A cooperative program is maintained that allows cross-registration for courses as well as shared cultural events. There are also two community colleges in the area.

In August 1984, Bethlehem held its first Musikfest, a 10-day annual festival that features a variety of musical performances and ethnic foods. An instant success, Musikfest was the brainchild of Jeffrey A. Parks, a lawyer and 1970 Lehigh graduate.
Lehigh University offers a variety of resources to support the campus community.

**Library and Technology Services**

The exponential growth and increasing sophistication of information technology offer new and exciting opportunities for enhanced teaching, learning, and research. At Lehigh University, one merged organization called Library and Technology Services (LTS) delivers communications, computing, distance education administration, enterprise systems implementation, faculty development, library, and media services to capitalize on these new opportunities. Additional information about Library and Technology Services can be found at www.lehigh.edu/lts.

**Libraries**

Lehigh University has two major library facilities, the Linderman Library and the Fairchild-Martindale Library. The Lehigh University library collection comprises over one million volumes. Subscriptions to periodicals are mostly in electronic format, and the collection of ebooks is growing at a rapid rate.

The historic Linderman Library reopened after an extensive renovation as a showcase for humanities programs and collections, as well as an intellectual center for the campus at large. The 1878 high Victorian rotunda and the 1929 grand reading room were retained in all their magnificence. Among the new features are: seminar rooms, a computer classroom, exhibition space, group studies, a cafe, and wireless throughout. Linderman houses books and journals in the humanities and Lehigh’s impressive collection of rare books including Darwin’s Origin of Species and John James Audubon’s four-volume elephant folio edition of Birds of America. Digital library projects highlight various aspects of the collection from “Digital Bridges” (books on 19th century bridge construction) and “Beyond Steel” (materials examining the social and cultural impact of the Lehigh Valley’s industrial past) to the Brown and White student newspaper archive. In addition, Special Collections holds numerous archival collections that focus on industrial and regional history.

The Fairchild-Martindale Library contains electronic and print books and journals in all branches of science, engineering, mathematics, and the social sciences, including business and education. It provides collaborative learning spaces, wireless connectivity, a small cafe, and comfortable lounge areas.

The Libraries offer students, faculty, and staff a full range of electronic journals, full text and image databases easily accessible from on and off campus. The library web page library.lehigh.edu serves as a gateway to these resources, as well as encompassing news items, a blog, library hours, and an invaluable set of library research guides (Libguides). The web page also provides quick access to most library services and to research assistance. Interlibrary loan via ILLiad or PALCI (Pennsylvania academic libraries) allows for rapid and easy borrowing from collections in other libraries. There is also desktop delivery of scanned articles in Lehigh’s print journal collection. Students and faculty may also borrow books directly from other academic libraries in the Lehigh Valley Association of Independent Colleges (LV Academic Libraries). Instructional Media Services

Lehigh also provides secure wireless connectivity in many campus settings – see http://lts.lehigh.edu/services/faq/wireless-networking-faq. Through Lehigh’s enterprise systems, convenient interactive services such as online course registration and online grades are offered to students. There is also a parent portal configured to parent’s needs and interests. Library and Technology Services supports a telephone system.

**Computing**

Providing technology and consulting services to support classroom teaching, laboratories, and other aspects of the academic and research programs is a strategic priority for Lehigh University. About 600 Windows and Macintosh personal computers are distributed across campus for convenient use by students at more than 27 computing sites. Students and faculty have access to site-licensed software applications and central file storage from on and off campus. LTS provides software at public sites for general word processing and spreadsheets, mathematical and statistical packages, and specialized applications for scientific and engineering work.

Lehigh provides access to a variety of computing systems suitable for large scale computation and compute-intensive applications. These systems contain over 2000 processing cores and over 4 terabytes of memory available to tackle the most complex and demanding research projects. For more information, see http://researchcomputing.lehigh.edu. University computing capacity and Internet bandwidth are continuously being increased to meet escalating demand.

The Center for Innovation in Teaching and Learning supports faculty innovation – see the Faculty Development section of this catalog for details. Library and Technology Services provides technical support for the many computer classrooms, suitable for individual “hands-on” instruction. 85% of all Lehigh University classrooms are equipped with permanently-installed computer projection systems. Equipment is available through the Digital Media Studio to enable faculty or students to give computer-based presentations in any space.

**Instructional Media Services**

Library and Technology Services offers an extensive media collection and streaming video services for courses. Videos and DVDs and available for viewing (all users) and for shot-term loan (faculty and graduate students) from Fairchild-Martindale Library Lending Services.

The Digital Media Studio offers students and faculty consulting assistance, a video editing lab, and a wide range of technology to support the creation of professional audio, graphic, and video materials for classroom presentations, projects, and portfolios. Students can scan and edit text, and these images can be output to printers or to computer files for further manipulation. Digital still and video cameras, a video and photography studio, and editing software facilitate the production of audio and video material to support the academic program. Loaner projectors, laptops and audio recorders are also available.

A third media facility, the International Multimedia Resource Center (IMRC), is located in nearby Maginnes Hall.

**Student Services**

The library, computing center, and most distributed computing facilities are open seven days per week and for evening hours during the fall and spring semesters. During final exams the Fairchild-Martindale Library is open 24 hours. For most of these hours, a help desk located at the Fairchild-Martindale Library provides general help for students and faculty onsite and for telephone inquiries relating to both library research and computing. Help desk staff refer more specialized questions to experts as needed.

Students may also take advantage of virtual help desks where they enter the questions or problems relating to library research, computing hardware or software, or telecommunications at any hour of the day or night for response at a later time, usually within one working day. Most library and computing services are available electronically, for example,
interlibrary loan and seminar registrations. “Live chat” library reference and computing help services are also available during many hours.

Each semester Library and Technology Services offers an extensive program of seminars and course-based instructional sessions for students. Attendees learn how to use software applications, library resources, and the Web-authoring tools. LTS professionals work closely with faculty to integrate library, computing and media resources into the curriculum. They facilitate the use of course management software, online courses of various kinds, and course projects in a wide range of disciplines using interactive Web sites created by faculty and students.

Through seminars and policies on the use of print and electronic resources, students are taught computer ethics, recommended computing practices such as frequent backup and password changes, and an understanding and respect for state and federal laws governing copyright, privacy, security, and intellectual property. The University's campus computer systems, networks, databases or software. A free electronic newsletter, LTS Digest, with quick tips and updates is published throughout the year and is available to students who subscribe. There is also a newsletter, the LTS Connection.

Library and Technology Services maintains a variety of facilities for printing, scanning, copying, and duplicating within the constraints of copyright and yearly paper consumption restrictions. In the Libraries are public scanners, and microform printers. The Digital Media Studio can duplicate audio and video resources. There are printers at most computing sites. Students are strongly encouraged to print responsibly by using the duplex feature, never printing multiple copies, and examining documents to eliminate unneeded sections before printing.

**Student Employment**

Student assistants are essential for the operation of most Library and Technology Services functions. Working for LTS, graduate and undergraduate students gain valuable skills and good work habits. At the job fair, held each fall, there are opportunities to learn in-depth about the jobs available.

**Lehigh University Art Galleries – Museum Operation (LUAG)**

Lehigh University Art Galleries – Museum Operation’s (LUAG) central educational resource is viewed as a multifaceted integrated classroom in which education is approached in the following ways: Museum and Curatorial Studies; Collections Care and Management; Exhibitions and Interpretation; and Partnership with the Community. Courses are taught across-the-disciplines using the University’s world-class teaching collection, which represents a diverse and broad cross-section of art and culture. Students and faculty are engaged in direct experiential learning within the Integrated Teaching Collection and Visual Laboratory. Exhibitions, lectures, panel discussions, and videos in eight campus locations are planned specifically to function as teaching tools for exploring diverse topics in visual literacy and the humanities.

**Museum Education and Community Engagement**

As a university museum, LUAG is a well-established, evolutionary and progressive program within the broader institutional mandate of Lehigh University. Our educational and cultural mission is advanced through firsthand observation and hands-on training. Faculty from all disciplines is encouraged to seek opportunities for teaching through our Collection. Students develop skills to respond critically to a rapidly changing world through problem-based learning and collaboration, ultimately preparing them to become well-informed consumers of visual culture in the broadest sense. We create educational opportunities for the entire student body, and enrich the cultural life of the campus and the community at large. LUAG works in conjunction with Art|Architecture|Design, History, and Curatorial and Museum Studies, as well as other departments on campus to increase involvement in the arts and humanities.

During the past few years, we have expanded our Gallery activities to include more docent-guided tours, greater volunteer engagement, and special programs. One of our current initiatives is to create an atmosphere of “accessible art” for visitors with vision loss or limited vision. With the assistance of internal and external writers, we provide audio descriptions and tactile diagrams of select artwork in the Teaching Collection. The descriptions will enable visitors the ability to “see” with their mind’s eye, encouraging a more relaxed and accessible viewing of the collection for all visitors.

University museums invite exploration and the traversing of boundaries, both between and within curricular disciplines and across cultures. LUAG has an established reputation for being a unique institution on the college campus, and are a vital resource within the liberal arts environment.

**Faculty Development**

The Center for Innovation in Teaching and Learning aims to foster excellence in teaching and learning by providing faculty with tools, development opportunities, workshops, and consultation services.

Faculty Development works closely with the other divisions of Library and Technology Services to provide a coordinated array of support for faculty. Faculty seeking help developing effective writing assignments to teach disciplinary subject matter and communication skills are encouraged to meet with Writing Across the Curriculum Coordinator. The TRAC (Technology, Research and Communications) Writing Fellows Program trains students to serve as peer tutors in discipline-based courses and consult with faculty on developing effective writing assignments.

Faculty Development offers confidential, voluntary consultations with faculty about their teaching, which may include discussions of effective approaches to teaching, classroom observation visits, informal mid-semester evaluations of classes, assistance with course development questions, and advice on the effective incorporation of academic technology into courses.

Dr. Gregory Reihman, Associate Vice Provost and Director of the Center for Innovation in Teaching and Learning, may be contacted at 610-758-6840 or grr3@lehigh.edu. Dr. Gregory Skutches, Writing Across the Curriculum Coordinator, may be contacted at 610-758-4932 or gss206@lehigh.edu. The Faculty Development web site is accessible at http://lts.lehigh.edu/services/faculty-development. Writing Across the Curriculum website is at http://trac.web.lehigh.edu

**Lehigh University Press**

Lehigh University Press represents a clear expression of faculty and institutional commitment to the advancement of scholarship. Press management rests with a Director, Katherine Crassons (English), and with an Editorial Board comprised of university faculty.

The Press is interested in all fine scholarship and has four series: Studies in Eighteenth-Century America and the Atlantic World; Studies in Christianity in China; Perspectives on Edgar Allan Poe; and New Directions in African Studies. By linking the name of the university to a list of exemplary work by scholars across the nation, the Press reinforces the value of excellence in scholarship for faculty, graduate, and undergraduate students alike. Recent publications by the Press have won national awards, including Patricia D’Antonio, *Founding Friends: Families, Staff, and Patients at the Friends Asylum in Early Nineteenth-Century Philadelphia* (2006: The American Journal of Nursing’s Book of the Year) and Sarah Fatherly, *Gentlewomen and Learned Ladies: Women and Elite Formation in Eighteenth-Century Philadelphia* (2010: The Philip S. Klein Prize for the best book on a topic that illuminates the history of Pennsylvania).

For more information, contact:

Lehigh University Press
Lehigh University, B040 Christmas-Saucon Hall
14 East Packer Avenue
Bethlehem, PA 18015
Phone: 610-758-3933
Fax: 610-758-6331
Email: ilup@lehigh.edu
Website: https://lupress.cas2.lehigh.edu/

**Resources for Students**

The Student Affairs division is dedicated to fostering student success by providing a balanced, rich and integrated living and learning environment. Virtually every student enrolled is touched by Student
Resources for Students

Affairs, beginning with orientation through the Office of First-Year Experience, and continuing through programs devoted to leadership development, community service, residential life, activities, academic support, a vibrant campus life and diversity and inclusion programs. Students are supported through the Health and Wellness Center and Counseling and Psychological Services which collectively work to ensure a safe and healthy living environment. I encourage you to visit our departmental websites to learn more about each of these areas.

To learn more about all the resources for students Lehigh University please view the following:

Student Handbook Resources http://studentaffairs.lehigh.edu/content/university-resources
Student Affairs http://studentaffairs.lehigh.edu/
Dean of Students http://studentaffairs.lehigh.edu/dos
Counseling and Psychological Services http://studentaffairs.lehigh.edu/counseling
Health and Wellness Center http://studentaffairs.lehigh.edu/health
Lehigh University Police Department http://studentaffairs.lehigh.edu/police

DISABILITY SUPPORT SERVICES
In accordance with the federal legislation, specifically Section 504 of the Rehabilitation Act of 1973 and the recently amended Americans with Disabilities Act (2008), Lehigh University is committed to ensuring equal access to students who are substantially limited by a disability. Services for students with a documented disability who are in need of academic support services are coordinated by the Dean of Students Office (610-758-4152). Services for students with physical disabilities who require assistance with nonacademic needs are coordinated by the Dean of Students Office, in conjunction with Facilities Services. Students requesting accommodations must present the University with current and comprehensive documentation. For more information refer to our website at: http://studentaffairs.lehigh.edu/disabilities

HEALTH & WELLNESS CENTER
The university offers health services to all students at the Health and Wellness Center in Johnson Hall. Clinicians including physicians and nurse practitioners see patients by appointment Monday to Friday. A registered nurse is present to see patients on Saturday 10:00 a.m. to 2 p.m. with a provider always on call. Saturday clinics are for urgent issues only. During breaks and summers, hours are shortened.

Nurses and providers treat a variety of illnesses and injuries. Gynecologic care is available, and allergy injections can be administered. Some laboratory studies can be done at the Health Center; students are referred to local facilities for X-rays. Patients are referred to local medical and surgical specialists when indicated. More seriously ill students are sent to a local hospital Emergency Department.

Incoming students must comply with immunization requirements. There is no charge for most of the care provided to students. Exceptions include referrals to physicians, labs, hospitals or other medical facilities outside the student Health and Wellness Center. A low-cost university-sponsored insurance plan is available, which complements the services of the Health Center. Families are urged to review existing insurance coverage and to consider purchasing the university sponsored plan if they are not adequately covered. Students should carry their insurance cards with them and know which lab they can utilize to facilitate outside lab testing.

For more information, please consult our web page at www.lehigh.edu/health.

Counseling and Psychological Service
The University Counseling and Psychological Service, at 610-758-3880, is located on the fourth floor of Johnson Hall. The office is open from 8:00 - 5:00, Monday through Friday with reception service available from 8:15am to 4:45pm. Most services are free of charge. Counselors are available for 24-hour emergency consultations (see Crisis Intervention Services below).

1. Philosophy & Mission
The University Counseling and Psychological Service (UCPS) is dedicated to the belief that a person’s college years are a time of challenge, inquiry, experimentation, productivity and change. Services are designed to help students not only manage crises, but to thrive in meaningful ways – to grow in self-understanding in order to make more satisfying and better use of their personal and interpersonal resources. Individual contacts, group therapy, faculty and staff consultation, and numerous outreach activities are some of the primary means by which the mission is accomplished. UCPS staff members are committed to providing assistance to all registered Lehigh students interested in personal, social, and academic growth and discovery, and to serving the larger campus community through consultation, teaching, research, and various other types of involvement.

2. Direct Services
To accomplish its mission, and while upholding the established state and APA (American Psychological Association) ethical principles and code of conduct for psychologists, the UCPS provides a variety of services to the Lehigh University community including:

- Crisis Intervention Services
- Group and Individual Psychotherapy
- Peak Performance
- Outreach Programming
- Assessment and Evaluation
- Consultation Services
- Training
- Advocacy

More information can be found at: http://studentaffairs.lehigh.edu/counseling

Career and Professional Development
One function of a college education is to foster the growth and development of the student to prepare for a meaningful and satisfying life after college. Lehigh provides career planning services for undergraduate and graduate students as an integral part of the career development process.

Career planning can best be described as an educational process through which students

1. identify and develop their abilities, aptitudes, and interests;
2. learn the relationship between their capabilities and interests, their university experiences, and professional opportunities outside the university; and
3. prepare for those opportunities.

The office is open throughout the year. The main phone number is (610)-758-3710 and the website is www.lehigh.edu/careerservices.

OFFICE OF FELLOWSHIP ADVISING
The Office of Fellowship Advising (OFA) assists Lehigh students who are applying for competitive national fellowships and scholarships. It publicizes opportunities, oversees the selection of candidates for awards that require university nomination and, with the assistance of fellowship advisors, guides students through the frequently complicated application procedures.

The OFA web-site (https://ofa.lehigh.edu/) contains a searchable database of a wide variety of fellowships and scholarships for students research The database includes inks to the foundations’ official sites, deadlines, and a general descriptions. Other resources and information on the application process are provided on the website as well.

Students who are interested in applying for awards and faculty members working with motivated, well-qualified students are encouraged to email the Office of Fellowship Advising at ofa@lehigh.edu.

CENTER FOR COMMUNITY ENGAGEMENT
The Lehigh University Center for Community Engagement (CCE) supports Lehigh’s faculty, staff, and students to undertake ethical, reciprocal, and sustainable academic service learning and community-engaged learning and research. The CCE is a central hub which all faculty, staff, students, and community partners should feel engaged with and supported by in order to conduct community-engaged learning projects, and research.

The Center for Community Engagement offers a variety of resources from one-on- one consulting on service-learning additions for their
courses to faculty development workshops on community-engaged research to support for evaluation and assessment. SOAN 197: Ethics and Values of Community-Engaged Research is also offered in partnership with the Sociology and Anthropology department as more formalized student training in the field. Finally, the center can be a sounding board in the early stages of any project to ensure reciprocal, ethical, and meaningful experiences for our community and our institution. A yearly community-engaged learning and research symposium is held to highlight exceptional academic learning and research collaborations.

The Center for Community Engagement is located in Williams Hall 020 and has space for meetings, informal discussion, and computer workstations. Dr. Sarah Stanlick, Director of the Center for Community Engagement and Professor of Practice, Sociology and Anthropology, can be contacted with any questions or requests for support at 610-758-1081 or at ses409@lehigh.edu or inengage@lehigh.edu. The website is accessible at: http://www.lehigh.edu/~inengage.

Office of International Affairs

Dr. Cheryl Matherly, Vice President/Vice Provost Office of International Affairs
global.lehigh.edu

To further globalize Lehigh’s mission of advancing learning through the integration of teaching, research and service to others through a systematic and sustained engagement between the Lehigh Community and the World-At-Large. (Mission Statement, Lehigh’s International Portfolio, December 2009)

The Office of International Affairs coordinates and leads international activities at Lehigh, including English as a Second Language, the Fulbright program for incoming researchers and Lehigh faculty, the Iacocca Institute, the international internship program, international student services, the Lehigh-United Nations Partnership, and study abroad.

We are dedicated to further globalizing Lehigh’s mission of advancing learning through the integration of teaching, research and service to others through a systematic and sustained engagement between the Lehigh community and the world at large. Our overall goals are to make the Lehigh community international and to expand Lehigh’s footprint abroad.

Iacocca Institute

IACOCCA INSTITUTE®
111 Research Drive; 758-6723

Richard Brandt, Director, Iacocca Institute and Director, Global Village; Trisha Alexy, Curriculum Director, Global Village; Mary Frances Schurtz-Leon, Candidate Manager, Global Village; Diana Q. Shepherd, Director, Pennsylvania School for Global Entrepreneurship. Iacocca Professors: Peter Zeitler, professor, earth and environmental sciences; David Griffith, professor, College of Business and Economics, and George White, professor, College of Education.

Over the years, Lehigh University has developed an impressive ability to forge university-industry-government partnerships. These partnerships are critical not only to the future of universities but, also to improve U.S. competitiveness. It is primarily through partnerships — with companies, schools, government agencies and other universities — that the Iacocca Institute pursues its mission of preparing current and future leaders for a globally competitive marketplace. One of these partnering activities is the Global Village for Future Leaders of Business and Industry® (GV).

The Global Village provides young adults from around the world the chance to experience a total-immersion leadership program. Its purpose is to provide personal and organizational change needed to thrive in the emerging global economy. During the GV program, participants who share the dream of a leadership career in business and industry focus on developing knowledge of business and industry, enhancing leadership and entrepreneurial skills, and establishing a powerful global network. To date, more than 1941 interns representing 134 countries have graduated from the program and are now part of the growing list of GV alumni. GV participants are diverse in culture and background.

They represent students of undergraduate and graduate institutions, and managers from global corporations and family-owned businesses. Global Village on the Move was established through a growing interest among our partner institutions to deliver the Global Village in their own countries, regions and territories. While GV is not a mobile program, the Iacocca Institute determined that shorter seven-to-ten day versions could be delivered in collaboration with existing recruitment partners outside of North America. Qualified partners will have visited and provided attendees to the GV flagship program. The opportunity to provide a collaborative immersion learning experience, cultural experience, and similar curriculum pattern in other countries has allowed us to work with partners in Peru 2000, Spain 2003, Australia 2005, United Arab Emirates 2006, Malaysia 2010, Peru 2011, Italy 2012, China 2013, Russia 2014, and India 2015. Future programs are scheduled for Luxembourg 2016, Croatia 2017, and Puerto Rico in 2018.

The Iacocca Institute fulfills its mission for leadership development of the next generation in the Pennsylvania School for Global Entrepreneurship (PSGE). PSGE is designed as a unique learning program to educate top high school students from the U.S. and around the world on global entrepreneurship. The four-week residential program focuses on challenging students as they develop greater cultural awareness, leadership skills, and learn business practices with other students, faculty, and entrepreneurs. To date, PSGE has trained over 1009 students from 62 countries and 18 states.

The Iacocca Institute was established in 1987 with the support of Lee A. Iacocca, former chairman and chief executive officer, Chrysler Corporation, and a member of Lehigh’s Class of 1945.

For more information, contact Richard M. Brandt, Director, Iacocca Institute®, and Director, Global Village for Future Leaders of Business and Industry®, Iacocca Hall, Lehigh University, 111 Research Drive, Bethlehem, PA 18015.

Lehigh University’s Fulbright Program Office

Bill Hunter, Director, International Outreach
32 Sayre Drive, Coxe Hall, Room 215, Bethlehem, PA 18015-3123
(610) 758-4505
wdh3@lehigh.edu

Kathryn Novogratz, Coordinator
(610) 758-3193
ken213@lehigh.edu
global.lehigh.edu/fulbright

The Fulbright Program Office serves as a facilitator between the various Fulbright offices nationwide and the Lehigh faculty and graduate coordinators. In this capacity, the Office regularly publicizes scholarship opportunities for faculty seeking to research or lecture overseas. Conversely, the Office notifies Lehigh faculty of opportunities to host Fulbright Outreach Lecturers or Scholars in Residence on campus. The Office also works directly with the Fulbright Placement Officers, encouraging them to send Fulbright student applications to Lehigh for consideration. Once admitted, the Office provides Fulbright students, as well as Fulbright Scholars coming to Lehigh, with orientation and assimilation programs, local familiarization tours, and coordinates the Fulbright Association on campus.

For more information, contact Bill Hunter at 610-758-4505 or wdh3@lehigh.edu. To learn more about Lehigh’s commitment to the Fulbright Program, please visit the following web site: global.lehigh.edu/fulbright

Global Union

Bill Hunter, Director, International Outreach
32 Sayre Drive, Coxe Hall, Room 215, Bethlehem, PA 18015-3123
(610) 758-4505
wdh3@lehigh.edu

Kathryn Novogratz, Coordinator
(610) 758-3193
ken213@lehigh.edu
global.lehigh.edu/globalunion
The Global Union, located in Coxe Hall Room 215, is a collaboration of more than 40 student clubs and organizations that promote global awareness and cultural understanding within the Lehigh community. Students involved in the Global Union hail from all corners of the globe, including nearly half from the United States.

The Global Union hosts panel discussions on world issues, a large International Education Week celebration, dinners and cultural festivals, and musical performances. All events at the Global Union are free and open to the Lehigh community.

The Global Union lounge is open from Monday-Thursday from 4-9 p.m. for student meetings and program presentations. To reserve the space, visit global.lehigh.edu/reserve-lounge.

For more information regarding the Global Union, see the website at global.lehigh.edu/globalunion.

International Internships

Carol S. Ham, Director of International Internships
32 Sayre Drive, Coxe Hall, Room 100A, Bethlehem, PA 18015
(610) 758-3467
csh205@lehigh.edu
Kathryn Novogratz, Coordinator
(610) 758-3193
ken213@lehigh.edu
global.lehigh.edu/internships

IACOCCA INTERNATIONAL INTERNSHIP PROGRAM

There are many opportunities for Lehigh University students to gain hands-on experience in an international setting. For a complete listing, please refer to the Study Abroad website (http://www.lehigh.edu/\%7Eincis). Lehigh University’s Iacocca International Internship Program, as referenced here, specifically relates to a program that provides students with fully-funded fellowships to participate in internship, research, or practicum experiences in organizations around the world. The program provides full-time, non-credit bearing experiences that run for six to twelve weeks over the summer, allowing for a true cultural immersion. For more information, please visit global.lehigh.edu/internships

Lehigh University/United Nations Partnership

Bill Hunter, Director, International Outreach
32 Sayre Drive, Coxe Hall, Room 215, Bethlehem, PA 18015-3123
(610) 758-4505
wdh3@lehigh.edu
Kathryn Novogratz, Coordinator
(610) 758-3193
ken213@lehigh.edu (ken213@lehigh.edu)

Lehigh University is the sixth university in the world to be certified as a Non-Governmental Organization affiliated with the United Nations (UN) Department of Public Information. Through this partnership, Lehigh students, staff, and faculty attend private briefings with ambassadors and UN officials, take tours of UN headquarters, and attend conferences, workshops and symposia at the UN. Lehigh also hosts a UN Speaker Series on campus and places interns each semester at the UN.

For more information about the Lehigh University/United Nations Partnership, see the website at: global.lehigh.edu/un

Study Abroad Office

Katie Welsh Radande, Interim Director; Lorraine Roth, Advisor; Jodeen Gemmel, Advisor; Katy Rene, Advisor; Janet Zapata, Coordinator; Karen Weaver, Administrative Clerk
32 Sayre Drive, Coxe Hall, Room 110, Bethlehem, PA 18015
(610) 758-3351; Fax (610) 758-5156
studyabroad@lehigh.edu
global.lehigh.edu/studyabroad

Lehigh University recommends international study. We support programs that offer rigorous academic environments, immersion in host cultures, and opportunities for personal growth. Students should return to Lehigh with an enhanced ability to appreciate global concerns.

Every student who studies abroad has different reasons and goals. High priorities for many students include developing sophisticated perspectives on global economic, social, and political issues, seeing the theoretical come to life in a real-world context, learning a new language, engaging with people and cultures different from their own, developing valuable career skills, and earning academic credit toward a Lehigh degree. Many students find that study abroad is a catalyst for intellectual and personal growth.

The Study Abroad Office conducts extensive advising activities, guiding students through the process of identifying programs that fit personal and academic goals; group and individual advising sessions take place regularly. Study Abroad options exist for all majors and can take place Freshman through Senior year. Students should start discussing study abroad options with their academic advisor and the Study Abroad Office as early as Freshman year.

SEASON/TERM

Lehigh offers several faculty-led summer and winter term study abroad programs. Past programs have included: Business and Music in Belgium; Business in Prague; Microfinance Abroad in various locations; Art and Architecture in Vicenza; History in Paris; Internships and Language in Shanghai; Sustainable Development in Costa Rica; French and Africana Studies in Martinique; Architecture in Munich; Research Practicum in Ireland. Several programs include internship opportunities for credit in addition to coursework. Lehigh credit and grades are applied to a student’s transcript and are factored into the student’s GPA. Semester study abroad may include a combination of traditional coursework along with credit-bearing internships, research, or service learning.

SUMMER AND WINTER TERM STUDY ABROAD

Lehigh offers several faculty-led summer and winter term study abroad programs. Past programs have included: Business and Music in Belgium; Business in Prague; Microfinance Abroad in various locations; Art and Architecture in Vicenza; History in Paris; Internships and Language in Shanghai; Sustainable Development in Costa Rica; French and Africana Studies in Martinique; Architecture in Munich; Research Practicum in Ireland. Several programs include internship opportunities for credit in addition to coursework. Lehigh credit and grades are applied to a student’s transcript and are factored into the student’s GPA.

OTHER INTERNATIONAL EXPERIENCES

Lehigh offers other short-term international experiences such as International Internships, ServeAbroad Antigua, Choir, Engineers without Borders (EWB), Philharmonic, Interfaith Dialogue: Lehigh in Rome, Athletics Leadership in Croatia, and others.

To view all program options and begin planning for a Study Abroad Experience, visit global.lehigh.edu/studyabroad.

Office of International Services

ENGLISH AS A SECOND LANGUAGE

Timothy Cauller, Ed.D.
Director
Coxe Hall
32 Sayre Drive
Bethlehem, PA 18015
Phone: (610) 758-6099
Email: esl@lehigh.edu (inesl@lehigh.edu)
global.lehigh.edu/esl

The English as a Second Language (ESL) program at Lehigh offers academic semester and summer courses for undergraduate and graduate students and their families. Additional academic and cultural instruction is provided to international students through ESL’s International English Language Center, conversation groups, and other language enrichment courses.

Credit Instruction

English as a Second Language (ESL) credit courses are offered to both undergraduates and graduates who wish to increase their English proficiency in the areas of writing, reading, speaking, and presentation skills. All credit courses are at an advanced level of English study. Graduate students should contact their departments regarding acceptance of credit towards residency requirements. ESL credit
courses are open to regularly enrolled students or General College Division students with placement or permission by the ESL Director.

**StepUp Intensive English Program**
The non-credit StepUp intensive English program is open to graduate and undergraduate international students who have been accepted to Lehigh but whose English fluency skills as measured by the TOEFL IBT exam do not meet the minimum requirement of an applicant’s intended program of study. The StepUp program is also open to advanced level students who are preparing for study at another American university or who wish to improve their English fluency skills for professional purposes.

**International English Language Center (IELC)**
The International English Language Center at Coxe Hall provides private English language tutoring for international students and their spouses wanting to improve their speaking, listening, reading, writing and grammar, and preparation for the Lehigh University TOPSS exam (required for teaching and graduate assistants).

**English Testing for Teaching & Graduate Assistants**
International graduate students whose first language is a language other than English who apply to become Teaching Assistants or Graduate Assistants must take and pass Lehigh University’s Test of Presentation and Speaking Skills (TOPSS) prior to beginning their instructional responsibilities. Students should contact their academic department directly for more specifics regarding the format and timing of the exam.

**The Freshman Composition Requirement**
ENGL 003 and ENGL 005 are the approved first-year English composition courses for international writers whose first language is a language other than English and for those international students who have not previously lived and studied in the US for four years or more. International undergraduates who wish to improve their advanced spoken English skills may also register for ENGL 015, Speech Communication for International Speakers.

**ESL Teacher Training**
Upper level undergraduates or graduate students with native or near-native English fluency who wish to learn about teaching English as a Second Language should register for ENGL 310. Introduction to the Principles & Practices of Teaching English to Speakers of Other Languages (TESOL). The ESL Department also offers ENGL 314, ESL Teaching Practicum, for those students who desire guided, real-life experience teaching English in the US or abroad.

**International Students and Scholars Office**
32 Sayre Drive, Coxe Hall, Bethlehem, PA 18015-3123. Tel: (610) 758-4859, Fax: (610) 758-5156. E-mail: intnl@lehigh.edu; Website: http://global.lehigh.edu/oiss; iHome (online system for international students and scholars): https://iss.lehigh.edu

The Office of International Students and Scholars (OISS) is a university-wide resource for students and scholars from abroad, and for U.S. students and faculty who are interested in the global focus. Its mission is to provide support services for international students and scholars to ensure maximum opportunities for them to achieve their goals; be a resource to the faculty, staff and administration on issues related to international students and scholars, cross-cultural communication and diversity; support the University’s efforts to internationalize the campus; and create an environment where the Lehigh community is exposed to a multitude of cultures, traditions and viewpoints by presenting internationally-focused academic, cultural and social programming.

**SERVICES**
A variety of cross-cultural programs are initiated by the OISS, including undergraduate and graduate orientations, spouse conversation groups, seminars on immigration matters, the International Bazaar, monthly social programs, and the weekly newsletter.

The year for international students and scholars at Lehigh begins with the International Orientation. Orientation takes place in conjunction with other programs offered by the undergraduate admissions office and/ or graduate departments, starting immediately before the university-wide orientation at the beginning of each semester. Orientation is strongly recommended for all new international students and scholars. Issues discussed include maintaining immigration status, filing for a social security number, opening a banking account, health insurance, and adjustment to university life at Lehigh and to the United States. International Orientation is a time to become accustomed to life in America, and to meet other international students.

**ADDITIONAL SPECIAL SERVICES FOR INTERNATIONAL STUDENTS**

**Career Services**
Advising and special workshops for careers for international students are provided.

**Food Service**
For undergraduate students on the meal plan, menus meet the international dietary needs of the students. There is a stir-fry bar and balanced meals for vegetarian diets.

**Health Center**
Fully staffed medical personnel meet both the physical and personal needs of all students. The Counseling Center has special services for international students.

**Immigration/Visa Advising**
Complete service is provided by OISS.

**Learning Center**
Free tutors are provided in writing, math and science.

**National Clubs**
Home country clubs from all regions of the world are established on campus. They form an important part of the cross-cultural dimension of the campus, providing social events, films, and international dialogue.

**Religious Services**
Services for all the major religions are on campus or nearby, including Muslim, Christian, Jewish, Hindu and Buddhist.

**Special Academic Programs**

**DISTANCE EDUCATION**
As a proven leader in distance education and innovation, Lehigh University’s Office of Distance Education has been committed to providing graduate programs and certificates to working professionals for over 20 years. Our programs emphasize academic excellence with a distinguished faculty, a shared community of learners, and superior curriculum. We are accredited by the Middle States Commission on Higher Education. Our distance program provides the student with the same level of educational excellence for which Lehigh University is renowned and strives to maintain the same level of quality of instruction and student service that is available to our on-campus students.

Through a unique approach to learning, we utilize two learning platforms for our programs, Classroom LIVE, an integrated, web-based virtual environment that delivers graduate programs in real time from classrooms on Lehigh’s campus to students, in their homes, at their workplaces, or while traveling, and Online, an asynchronous online format that offers flexible scheduling and participation. To provide the best educational experience for our students, supplemental tools may be used, including podcasts, live web-based conferencing, shared applications, and use of Course Site, Lehigh’s course management system.

We offer 10 graduate degrees in a variety of disciplines which include Biological Chemical Engineering, Chemical Engineering, Chemical Energy Engineering, Healthcare Systems Engineering, Management Science & Engineering, Manufacturing Systems Engineering, MBA, Mechanical Engineering, Molecular Biology, and Polymer Science & Engineering. We also offer 8 graduate certificates for Credit. They include Analytical Principles of Pharmaceutical Science, BioOrganic Principles of Pharmaceutical Science, Healthcare Systems Engineering, Management Science & Engineering, Manufacturing Systems Engineering, Polymer Science & Engineering, Quality Engineering, and Regulatory Affairs.

For more information on programs and course offerings, admission, registration and technical requirements, visit the distance education website at www.distance.lehigh.edu or call (610) 758-4372.
SUMMER SESSIONS
The Lehigh summer sessions program has been in existence for more than a century and is still a vibrant piece of the Lehigh experience. Opportunities abound at Lehigh in the summer with more than 200 diverse courses offered on campus, study abroad programs in exciting international locales such as Prague, Belgium, Shanghai, Ghana, London, Paris, and Ireland. We also offer an ever-increasing array of web-based courses, ranging from basic subjects such as Principles of Economics and Financial Accounting to eclectic topics including Technical Writing for Engineers, Society of Hip Hop Culture and How to Watch Shows like a Hollywood Screenwriter, just to name a few. In addition, there are many courses available, appropriate for rising high school seniors, allowing them to get a jump-start on their college career. For more information, visit the summer sessions website at summer.lehigh.edu see us on Facebook at www.facebook.com/LehighSummer (http://www.facebook.com/LehighSummer) call (610) 758-3966.

CONTINUING EDUCATION
Lehigh University departments and research centers offer a varied selection of non-credit continuing education programs for adults. Reflecting Lehigh’s traditional educational strengths, these offerings focus on professional development, organizational problem solving, and technical skills. They carry no regular academic credit, but participants can often earn some form of continuing education credentials.

Lehigh continuing education programs are designed to meet specific needs. Contents, schedules, and timing are adapted to effectively serve the audiences for which they have been developed. Apart from programs presented on the Lehigh campus, a number of seminars are available for “in-house” presentation to organizations on a contract basis. For more information about these programs, contact the appropriate department or research center.
Undergraduate Studies

A listing of undergraduate and graduate courses offered by Lehigh University can be found in the Courses, Programs, and Curricula section (p. 53), under each departmental heading. For purposes of record, all approved courses are listed. It must be understood, however, that the offerings in any given semester are contingent upon a number of factors, including student needs as determined at the time of registration.

CREDIT HOURS
Each course is designated a credit value of the course in terms of semester hours ("credit hours").

COURSE NUMBERING
The course numbering system specifies which courses can be applied to the program of study as the student progresses toward the undergraduate or graduate degree. In general, the numbering series is as follows:

- 0-99. Courses primarily for freshmen or sophomores. Not available for graduate credit.
- 100-199. Intermediate-level undergraduate courses. Not open to freshmen except on petition. Not available for graduate credit.
- 200-299. Advanced undergraduate courses. Courses in the College of Business and Economics and specific departments as noted in the listings are open to freshmen and sophomores only on petition. Not available for graduate credit in the major field.
- 300-399. Advanced undergraduate courses. Same as 200-299, but available for graduate credit in major field.
- 400-499. Graduate-level courses, open to undergraduates only by petition.

PROVISIONAL COURSES
Each instructional department is authorized to offer provisional courses, or those offered on a trial basis, as well as special opportunities courses. Such courses can become a permanent part of the university curriculum. These courses are numbered, as is appropriate, 95-98 . . . 195-198, . . . 295-298, . . . 395-398, for a maximum of two years.

PREREQUISITES
Academic preparation required for admission to courses is indicated under "prerequisites" included at the end of each course description. Prerequisites are stated in most cases for purposes of convenience in terms of Lehigh course. Academic status required for admission, where numbering does not fully describe this status, is also indicated under "prerequisites."

A student who does not have the status (e.g., sophomore standing) or the academic preparation set forth as prerequisites may request special consideration. A student may either obtain online permission from the designated college or department officer. Academic work completed elsewhere must be attested in this manner as being substantially equivalent to prerequisites listed. Each student is responsible to make sure they meet and maintain all conditions of prerequisite for their coursework prior to the start of classes. If a student fails to meet a prerequisite after registration for a given course, the college deans office, registrars office, and/or the instructor may take action to drop the student from a course with unmet prerequisites.

In a few cases, co-requisites are indicated. In such instances the co- requisite course is taken in the same semester.

INFORMATION LIMITS
The course descriptions are intended to guide the student in selecting appropriate courses. For reasons of space, descriptions are brief. In most cases, courses will have a significantly broader scope than the topics listed in the description. In some courses, material may change from what is described. If there is doubt concerning the appropriateness of any course for the individual's educational objectives, it is suggested that the student confer with the adviser.

ABBREVIATIONS
Whenever possible, course listings contain information indicating what requirements the course satisfies, the semester or semesters in which it is offered, and the name of the scheduled instructor or instructors.

While all information herein is subject to change, the information is included to serve as a guide in the selection of appropriate courses that best fulfill the student's academic requirements and personal goals.

The symbols following course descriptions for some College of Arts and Sciences courses include:

- GC. Courses that meet the Global Citizenship program requirements.
- HU. Courses that meet the Humanities distribution requirements.
- NS. Courses that meet the Science distribution requirements.
- SS. Courses that meet the Social Science distribution requirements.
- MA. Courses that meet the Mathematical distribution requirements.
- ND. Not designated to meet distribution requirements.

The symbols following course descriptions for some College of Engineering and Applied Science courses include:

- ES. This code plus the following number indicates that the course satisfies a number of hours of engineering science requirements for ABET accreditation.

Graduation Requirements

Students are expected to maintain regular progress toward the baccalaureate degree by carrying the "normal" course load—between 12 and 18 credit hours each semester. Each student is expected to complete the baccalaureate degree by attending four consecutive years and eight semesters. They may, however, wish to accelerate the pace toward graduation by using advanced placement credits, summer session study, and receiving credit for courses through examination. Students will have a limit of 8 calendar years to complete the requirements for the bachelor's degree. Students may petition the Committee on Standing of Students (COS) for up to a one-year leave of absence for special circumstances beyond their control.

Students in good academic standing earn their degrees by meeting the requirements of their specific degree curriculum as well as general university requirements. Students are expected to satisfy the credit-hour requirements of their chosen curricula. Students should confer with their advisors on matters related to curriculum.

Basic military science credit hours are in addition to the credit hours specified in the curriculum. A maximum of six credit hours of advanced military science courses may be applied toward the baccalaureate degree.

Undergraduate Residency Requirement

To be eligible to receive a Lehigh baccalaureate degree, the candidate must have completed either a minimum of 90 credit hours, or 60 of the last 75 credit hours at the University or in residency programs.

Five-Year, Two-Bachelor-Degree Programs

The university's five-year, two-degree programs enable a student to receive two bachelor degrees upon completion of five years of study. The civil engineering and earth and environmental sciences program that affords two bachelor degrees, and the electrical engineering and engineering physics two-degree program are examples of programs in the College of Arts and Sciences and the P.C. Rossin College of Engineering and Applied Science.

Some five-year, two-degree programs appear in the description of courses under Arts-Engineering and Five-Year Programs. It is possible to arrange for a dual bachelor degree program even after studying at Lehigh for some time. Engineering students, for example, who decide at any stage of study that they wish to meet the requirements for both the bachelor of arts and bachelor of science degree may sometimes complete the combined requirements in five years if the decision is made before the third year. A student entering Lehigh to obtain a second bachelor's degree, those Lehigh students who wish to declare a second degree in another college, or students wishing to pursue both a B.A. and a B.S. degree within the College of Arts and Sciences must have a minimum of 30 additional credit hours beyond the first degree credit-hour requirements in order to qualify for the second degree. All of the 30 additional credit
hours must be taken at Lehigh or in Lehigh residency programs. All special second degree programs must be approved by the dean of the college in which the degree is to be offered and the Standing of Students Committee.

Several ways exist for students to obtain two degrees in five years of study. See listings under ARTS-Engineering; Civil Engineering and Earth and Environmental Sciences; Electrical Engineering and Engineering Physics; and College of Education.

**Advisement**

The academic advisor is one of the most valuable resources in the educational process, not only to assist in making academic selections to match the student’s particular background, interests, and future objectives, but also to identify program options, to work out an academic pace, and to develop career planning strategies. The advisor will help to identify other resources and support systems available at the university, such as the Center for Academic Success, Counseling and Psychological Services, and the Center for Career and Professional Development.

Every undergraduate in the College of Arts and Sciences and the P.C. Rossin College of Engineering and Applied Science is assigned a faculty advisor upon matriculation. This advisor will usually change when the student selects a major or program.

Every undergraduate in the College of Business and Economics (CBE) is assigned to a professional advisor in the CBE Undergraduate Programs Office. Once a major is declared, a faculty mentor from the major department will be assigned for more in-depth conversations about major courses and career paths.

**Guide to Academic Rules and Regulations**

Over the years, the University has adopted numerous rules and regulations. Some of the principal rules and regulations are given here so that currently enrolled and potential undergraduates and graduate students will be apprised of what is expected of them, and what they can expect of the University.

This section concerns academic regulations. Additional regulations can be found in the Lehigh Handbook, and there is a comprehensive statement of all policy in the publication Rules and Procedures of the Faculty. The most up-to-date version of the Student Handbook can be found online at http://studentaffairs.lehigh.edu/handbook; the Rules and Procedures of the Faculty can be found online on the Provost’s website.

**Eligibility for Degree**

In order to be graduated, a candidate for a baccalaureate degree must achieve a minimum cumulative average of 2.00.

To be eligible for a degree, a student must not only have completed all of the scholastic requirements for the degree, but also must have paid all university fees, and in addition all bills for the rental of rooms in the residence halls or in other university housing facilities. Payment also must have been made for damage to university property or equipment, or for any other indebtedness for scholarship loans or for loans from trust funds administered by the university.

**Responsibility for meeting academic requirements.**

Each student is solely responsible for his or her progress toward meeting specific requirements for graduation. Academic advisers, department chairs and the associate deans staff are available to assist the student. It is strongly recommended that the student specifically consult with his or her adviser prior to the senior year to ascertain eligibility for the degree for which he or she desires to qualify and to determine that all program and hours requirements are met.

A student degree audit is available 24/7 via the online student information system for all undergraduate students. All students are recommended to go through this process before registering for each semester, including each in their senior year. The student degree audit will note all program deficiencies based on real-time academic history and current registration information.

**Final date for completion of requirements.**

For graduation, all requirements, scholastic and financial, must have been satisfied prior to the date stated in the university calendar.

**Application for Degree**

Candidates for graduation on University Day in May must file with the registrar on or before February 1 a written notice of candidacy for the degree; candidates for graduation in September file a notice of candidacy on or before July 1; candidates for graduation in January file a notice of candidacy on or before October 1.

Failure to file such notice by such dates mentioned debars the candidate from receiving the degree as of the next consecutive graduation date. If a petition for late filing is granted prior to the deadline to complete all requirements, a fee is assessed.

**Graduating Thesis**

The original of the undergraduate thesis, when required, is accompanied by drawings and diagrams whenever the subject needs such illustration. The original is kept by the university, as a part of the student’s record, for future reference; but copies may be retained by students and may be published, provided permission has first been obtained from the faculty.

**Undergraduate Credit and Grades**

A “semester hour,” used interchangeably with “credit hour,” is a course unit normally involving three to four hours of student effort per week during one semester. This includes both in-class contact hours and out-of-class activities. The major parameters influencing the in-class/out-of-class division include the mode of instruction and the level of the course.

**Definitions of Grades**

Course grades are A, A–, B+, B, B–, C+, C, C–, D+, D, D–, P, F, N, X, Z. The meaning of each grade is as follows: A–, excellent; B+, B, B–, good; C+ and C, competent; C–, continuation competency (the student has achieved the level of proficiency needed for the course to satisfy prerequisite requirements); D+, D, and D–, passing, but performance is not adequate to take any subsequent course which has this course as a prerequisite. P, pass-fail grading with a grade equivalent to D– or higher; F, failing; N, incomplete; X, absent from the final examination; Z, absent from the final examination and incomplete.

Grades are weighted as follows: A, 4.0; A–, 3.7; B+, 3.3; B, 3.0; B–, 2.7; C+, 2.3; C, 2.0; C–, 1.7; D+, 1.3; D, 1.0; D–, 0.7; F, 0. WF is counted as an F. 0. Quality points for each course are assigned according to the number of credit hours in the course.

Other symbols used for courses on student records are: W, withdrawn; WP, withdrawn with passing performance at the time of withdrawal; WF, withdrawn beyond the deadline and/or with failing performance; CR, credit allowed; NCR – no credit. NR is used when no final grade was received from the instructor of record by the final grade submission deadline.

Grades in the range of A through D–, P, and CR may be credited toward baccalaureate degrees within the limits of program requirements. Grades of F, N, X, Z, W, WP, WF, and NR cannot be credited toward the degree. Grades of W and WP do not count as hours attempted.

Courses in which grades of D+, D, D–, F, NCR, W, WF, NR, N, X, or Z are recorded do not meet prerequisite requirements. The student may petition to waive a prerequisite. Upon presentation of evidence of substantially equivalent preparation, and with the approval of the instructor of the course, the teaching department chair and the chair of the major department, the prerequisite will be waived.

The grade N (grade), may be used to indicate that one or more course requirements (e.g., course report) have not been completed. It is the obligation of the student to explain, to the satisfaction of the instructor, that there are extenuating circumstances (e.g., illness or emergency) that justify the use of the N grade. If the instructor feels the N grade is justified, he or she assigns a grade of N supplemented by a parenthetical letter grade, (e.g., NF). In such cases, the instructor calculates the parenthetical grade by assigning an F (or zero score) for any incomplete work unless he or she has informed the class in writing.
at the beginning of the course of a substitute method for determining the default grade.

In each case in which an N grade is given, the course instructor will provide written notification to the department chairperson stating the name of the student receiving the grade, the reason for the incomplete work, the work to be done for the removal of the N grade and the grade for the work already completed.

A student who incurs an N grade in any course is required to complete the work for the course by the fifth day of instruction in the next regular semester. The N grade will be converted into the parenthetical grade after the tenth day of instruction in the next regular semester, following receipt of the N grade, unless a petition to request an extension has been approved, or the instructor has previously changed the grade using the removal-of-incomplete procedure. The parenthetical grade will be dropped from the transcript after the assignment of the course grade.

The grade N may not be used to report absence from a final examination when all other course requirements have been met.

N grades do not count as hours attempted and are not used in computations of cumulative averages.

The grade X (grade) is used to indicate absence from the final examination when all other course requirements have been met.

In such cases, the instructor calculates the parenthetical grade by assigning an F (or zero score) for the missing final exam. The X grade may be removed by a make-up examination if the absence was for good cause (e.g., illness or other emergency). To be eligible for a make-up exam, the student must file a petition, and the petition must be approved by the Dean of Students. If the student fails to petition, or if the petition is not granted, or if the student fails to appear for the scheduled make-up examination, then the X grade will be converted into the parenthetical grade after the first scheduled make-up examination following the receipt of the X grade. If the petition is granted and the final examination is taken, the X grade will be changed by the instructor using the make-up examination procedures and the parenthetical grade will be dropped from the transcript.

Where valid reasons exist for not taking the make-up examination at the scheduled time, the student may petition for a later examination with a fee.

The grade Z (grade) is used to indicate both absence from the final examination and incomplete course requirements. The instructor calculates the parenthetical grade using an F (or zero score) for the final examination and either an F (or zero score) for incomplete coursework.

A student who incurs a Z grade in any course is required to complete the work for the course by the fifth day of instruction in the next regular semester. The Z grade will be converted into the parenthetical grade after the tenth day of instruction in the next regular semester following receipt of the Z grade. In no case shall the deadline for completion of the work be later than the last day of classes in the first full semester in residence (except summer) following receipt of the Z grade.

X and Z grades do not count as hours attempted and are not used in computations of cumulative averages.

Where failure to complete coursework prevents the student from taking the make-up examination at the scheduled time, the student may petition the Committee on the Standing of Students for a later examination.

Grades that were originally assigned an N, X, or Z grade, when converted or computed, will be noted with an ‘*’ asterisk prefix.

If no grade is received by the University Registrar before student grades are officially posted, a grade of NR will be assigned. It is the responsibility of the faculty member who failed to submit a grade to resolve the situation. If a correct grade is not submitted or the situation is not otherwise resolved then the NR grade will be converted to a grade of F on the tenth day of instruction of the next academic year semester.

Scholastic Averages and Probation

Scholastic requirements for undergraduate students are expressed in terms of the cumulative grade point average (GPA)—the weighted average of all grades received in residence or at institutions specifically approved for grade transfer. The cumulative GPA is computed at the end of each semester and the second summer session. The University transcript reports a student's cumulative GPA to two decimal places. When considering cumulative GPA for graduation honors and academic standing, the University truncates the GPA to two decimal places, with no rounding.

Following are the cumulative GPA requirements for good standing:

- freshmen to 22 earned credits
- sophomores 23 to 51 earned credits
- juniors and seniors with 52 or more earned credits

For computational purposes students who have completed 22 or fewer earned hours shall be required to achieve a 1.70 cumulative grade point average. Students who have completed 23 but fewer than 52 earned hours at the end of the most recent graded term shall be required to achieve a 1.80 cumulative grade point average. Students who have completed more than 53 earned hours at the end of the most recent graded term shall be required to achieve a 2.00 cumulative grade point average.

Other undergraduates including all General College Division, Lehigh Valley Association of Independent College cross registered students, high school scholars and R.O.T.C. students will be required to achieve a 2.0 cumulative grade point average—minimum average required for graduation—remain in good academic standing. Non-degree students with less than 12 credit hours attempted, however, will not have their progress evaluated until they earn at least 7 credit hours total. A non-degree student with two or more F grades is eligible to be reviewed by and may be placed on probation or dropped for poor scholarship at the discretion of the SOS committee.

Any undergraduate student who achieves a 1.69 or lower cumulative grade point average in a given term is eligible to be reviewed by and may be placed on probation at the discretion of the Committee on the Standing of Students.

Students who do not meet the above requirements will be placed on scholastic probation.

Students who, regardless of their cumulative averages, have failed more than eight hours of course work in any semester are also placed on scholastic probation.

**SCHOLASTIC PROBATION**

Students on scholastic probation are ineligible for (a) intercollegiate competition and other extracurricular activities in which they publicly represent the university; (b) major office (elective or appointive) in any university organization; and (c) other activities which require more time than should be diverted from primary purposes by students whose academic survival is at risk. The Dean of Students shall monitor and enforce this ruling.

**REMOVAL FROM PROBATION**

Students are removed from probation at such time as they meet the standard listed above, effective at the end of any semester or the second summer session.

**DROPPED FOR POOR SCHOLARSHIP**

A student who makes a 2.2 GPA or better in the probationary semester but fails to meet the standards stipulated is continued on probation for another semester. A student who makes less than a 2.2 GPA in the probationary semester and fails to meet the standards stipulated above is dropped for poor scholarship.

If a student goes on scholastic probation for a second (although not necessarily consecutive) term, a review by the Committee on the Standing of Students will determine whether the student will continue on scholastic probation or be dropped for poor scholarship.

**Course Withdrawal**

A student dropping a course within the first ten days of the semester (five days for summer sessions) will have no record of the course on the transcript. A student dropping all courses for which he or she is registered is considered to be withdrawn from the university (p. 26).

A student who withdraws from a course with the approval of his/her advisor and section instructor after the tenth day of instruction and
before the end of the eleventh week of instruction will have a grade of “W” assigned to the course.

A student who withdraws from a course with the approval of his/her advisor and section instructor after the eleventh week of instruction and before the end of classes receives a “WP” or “WF” at the discretion of the instructor. A “WF” is considered to be a failing grade.

An Add/Drop form signed by the student’s advisor must be submitted to the Registrar’s Office before the deadlines noted above to be official. No course may be dropped after the last day of classes during a term as noted on the University Calendar.

University Withdrawal

A student withdrawing from the university (dropping all courses during a given term) must submit the withdrawal form to the dean of students office. Withdrawal after registration day and during the first 11 weeks of instruction will be noted on the academic transcript by assigning a grade of “W” to all courses. A withdrawal after the eleventh week of instruction and before the end of classes will have the grade of “WP” or “WF” assigned for each course at the discretion of the instructor. The date of the withdrawal will be noted on the academic transcript for a withdrawal at any time during the term.

A student who reduces his or her course load below the minimum required for full time status, but does not withdraw from the university, becomes a part-time student for the rest of that semester. Some areas affected by part-time status are financial aid, athletic eligibility, veterans affairs, immigration status, insurance and loan deferment.

Undergraduate Leave of Absence

Each student is expected to complete the baccalaureate degree by attending Lehigh for four consecutive academic years. Once a student who has matriculated at Lehigh chooses to deviate from this attendance pattern, a revised degree plan, coordinated with his or her advisor and associate dean, must be submitted with a request for a leave by completing a petition to the academic leave of Absence. Petitions are available from the Registrar’s Office or the Dean of Students. The form must be signed by the student’s advisor and the associate dean of the college, and the completed form must be submitted prior to the start of any subsequent enrollment at another college or university.

Current Lehigh University students are prohibited from concurrent enrollment at any other college or university. Courses taken concurrently will not be eligible to apply towards a Lehigh degree. An exception is made for cross registration at another LVAC institution.

Special opportunity programs like the American University Internship, Hope College Urban Semester and the Institute for Shipboard Education (affiliated with another university), University of Virginia Semester at Sea, and Georgetown Washington Semester have limited access to Lehigh University students. For procedures concerning application for these programs, please see the Associate Dean of Students for Academic Support.

Students cannot assume that a leave will be granted to study at another college or university (this policy does not apply for study abroad through the auspices of Lehigh Abroad or LVAC programs). The program of study and reason for the leave must be approved by the SOS committee.

If unapproved leaves are taken, students are declared as non-returning and must apply for readmission to the University through the SOS committee if they wish to re-enroll. Courses taken at another college or university while on an unapproved leave will not be permitted to transfer toward a Lehigh University baccalaureate degree.

In addition, students taking an unauthorized leave of absence must be aware that their eligibility for student aid is jeopardized.

Any student who is uncertain about attending a future fall or spring term at Lehigh University is urged to discuss the matter with the Dean of Students Office or the Registrar’s Office prior to taking any action to withdraw or attend another college or university.

Students may take courses at another institution during a summer term without requesting an academic leave of absence. They should check with the Registrar’s Office for limitations and processes for transfer course approval prior to taking the courses.

Release of Final Grades

Grades for undergraduate students are available online as soon as possible following the deadline for reporting of grades online using the Banner Student Information System. Undergraduates students who require a printed grade report must submit the request in writing to the Registrar’s Office each term. Instructors may develop their own policies for release of unofficial reports of academic progress to individual students, or to their advisers, deans, or financial aid officers, on a need-to-know basis, including early release of unofficial final course grades. Any such policies must respect the rights of students to privacy.

Repeating of Courses

If a course is repeated the final grade received upon repetition of the course is counted in the cumulative average. Only the most recent grade and the credit associated with that course and grade counts towards degree requirements. The original grade and associated credit hours received will be excluded from the cumulative average and degree requirements.

A grade that was originally received in a course may not be changed by repeating the course under the pass-fail option.

Students repeating a course that has been graded C or better may not overload (greater than eighteen credits) during that term.

For deletion of a grade from the cumulative average after repeating a course, a student must:
1. file the deletion form with the registrar’s office; and
2. repeat the identical course with a final grade at Lehigh

All instances of repeated courses are displayed on the student’s academic transcript regardless of repeated status. Students are responsible for determining any academic or financial implications for repeating courses and for notifying the Office of the Registrar when a course is repeated.

Pass-Fail Systems for Undergraduates

STUDENT OPTION SYSTEM

The pass-fail grading option is intended to encourage sophomore level (and above) undergraduate students to take challenging courses outside the major field. Courses numbered below 100 are generally not available for optional pass/fail grading system. However, the College offering a course may establish a petition process to determine, on a case-by-case basis, whether a student is allowed to take a course numbered below 100 with pass-fail grading. Courses 400 and above are not available for the optional pass/fail grading system.

A student may register for no more than one course pass-fail numbered above 100 and below 400 in any one semester. Students should check the pass/fail restrictions for specific courses. He or she may take a maximum of six courses pass-fail per undergraduate career if the student is on a four-year program, or a maximum of eight courses per undergraduate career with a five-year, two-degree program. If a student changes a course from pass-fail grading to regular grading, that course will still count toward the maximum number of courses taken pass-fail during the student’s undergraduate career. The optional pass/fail option may not be used for major or minor subject credit toward graduation or for distribution requirements.

Each college faculty shall decide under what conditions and which courses or categories of courses throughout the university may be taken for pass-fail credit by students registered in that college, except for courses designated specifically for pass-fail grading. Each college shall keep the educational policy committee advised of changes in its rules.

A student designates the course(s) to be taken pass-fail normally at preregistration but not later than the fifteenth day of instruction in a regular semester or the fifth day of instruction in any summer session. Prior to this deadline, the student may transfer from pass-fail to regular grading, or vice-versa, without penalty. The courses designated for pass-fail grading by the student require the written acknowledgment of
the academic adviser. **Retroactive changes to/from pass-fail grading are strictly prohibited.**

Since the instructor giving the course is not officially notified which students are taking the course pass-fail, a regular letter grade is reported to the Registrar for the pass-fail students. The Registrar then records “P” for reported letter grades from A through D–, and “F” for a reported letter grade of F.

Under this system, the student surrenders his or her equity to letter grades of A through D–, except as specified below. A grade of P applies to the student’s graduation requirements but is not used in the computation of the cumulative average; whereas an F grade is included in the cumulative grade point average.

Acceptance into a program that does not allow pass-fail grading in a course is the only valid reason for converting the grade for a completed course from pass-fail to a letter grade. If a student changes his or her program such that a course previously taken for pass-fail grading is not allowed for pass-fail grading in the new program, the student must submit a petition to the Committee on the Standing of Students requesting acceptance by the new program, or substitution of the original letter grade submitted, or the substitution of another course. The recommendation of the advisor must accompany the petition.

**Transfer Credit**

Transfer of credit from other institutions is the responsibility of the Registrar. Any students planning to take work at other institutions in the United States or elsewhere should initially check with the registrar’s office on policies and procedures. Full time students may not be concurrently enrolled at any other institution, except for the LVAIC Consortium cross registered courses, without the advanced approval of the Committee on Standing of Students. Transfer of grades from institutions other than the LVAIC System is not possible.

- Pass/Fail credit/non-credit courses are not acceptable for transfer.
- Courses taken at a two year or four year institution where a grade lower than a “C” has been earned will not transfer. (“C-” or below will not transfer)
- Transfer courses may not be used to delete a prior grade from one’s cumulative grade point average at Lehigh University. Transfer grades are NOT calculated in the Lehigh GPA.
- No student may receive more credit at Lehigh than was granted at the original institution. Courses taken on the quarter system will have credit granted on a 3-2 ratio, no partial credit will be awarded. The student will receive credit equivalent to the number of credits indicated on the transcript, up to the number of credits for the equivalent course at Lehigh. The registrar has the final authority for the amount of credit awarded toward a Lehigh degree.
- No credit will be granted for a course in which the student has already received credit for its equivalent at Lehigh.
- No credit will be granted for continuing education units courses, correspondence, independent study or any course less than 3 weeks and/or 15 contact hours per credit without the advanced approval of a petition to the Standing of Students Committee.
- Students requesting transfer credit for online courses must submit the online course syllabus to the Registrar’s Office for review.
- Courses taken through dual enrollment programs while in high school must have been taught by a faculty member of the credit-awarding college or university in order to be considered for transfer credit. Additional verification paperwork is required to begin the transfer credit process.
- Courses must be taken at an institution that is accredited by one of the six regional associations.

**Course Auditing**

A student who is in good academic standing and has not failed any courses in the previous term may be approved to audit not more than one course per semester, which must be outside the curriculum requirements. Application to audit a course is by petition approved by the departmental chair and the Standing of Students Committee. In no case shall a student who has attended a course as an auditor be given an anticipatory examination for credit or register for the same course in the future. A student completing a course in this manner will have the course and the notation AU indicated on the permanent record. A student rostered on an audit basis may be withdrawn from the course with a grade of W for poor attendance. Audit courses do not count toward full-time status.

**Review-Consultation-Study Period**

The Review-Consultation-Study (RCS) period is intended to provide a period of time for informal academic work between the end of the formal instruction period and the beginning of the final examinations. It is expected that students will use this period to consolidate their command of the material in their courses. Faculty members make themselves available to their students at announced times during this period.

No quiz or exam may be given during the last five class days before final examination period begins and the RCS period.

**Graduation Honors**

Beginning with all new degree seeking students in the Fall of 2004 or any students graduating in the Spring of 2008, degrees with honors are awarded by vote of the university faculty to those students who have attained an average of not less than 3.40 in a minimum of 90 credit hours in residence at Lehigh University or in programs approved by the faculty to have grades and credit accepted toward the undergraduate degree.

Degrees with high honors are awarded by vote of the university faculty to those students who have attained an average of not less than 3.60 in a minimum of 90 credit hours in residence at Lehigh University or in programs approved by the faculty to have grades and credit accepted toward the undergraduate degree.

Degrees with highest honors are awarded by vote of the university faculty to those students who have attained an average of not less than 3.80 in a minimum of 90 credit hours in residence at Lehigh University or in programs approved by the faculty to have grades and credit accepted toward the undergraduate degree.

For the purposes of graduation honors calculations, courses taken more than once at Lehigh will only have the most recent grade used in the calculation. Courses taken under the cross-registration policy of the LVAIC and the Washington Semester program will be used.

Students who spend part of their career at another institution, or are transfer admits to degree programs, must have at least sixty earned credit hours of regularly graded (not pass/fail) courses that meet the residency requirement in order to be eligible for graduation honors.

**Department Honors**

Many departments offer honors work adapted to its curriculum for students who wish to demonstrate unusual academic ability and interest in exploring a chosen field through independent study and research. The precise nature of the program for each student is determined by the academic major department, but may include: unscheduled work or independent study, participation in graduate (400-level) courses, and an honors thesis or project.

Qualified candidates should inform their academic advisers by the end of the junior year of their intention to work for departmental honors. The adviser will give the college and the registrar names of graduating seniors working for departmental honors in particular majors. Student names will be published on the Commencement home page.

**Honor Societies**

There are at least 18 honor and course societies. The three best-known are:

- **Phi Beta Kappa.** The oldest honor society in the United States is represented at Lehigh by the Beta chapter of the Commonwealth of Pennsylvania, the 27th oldest chapter in the nation. The chapter’s council considers for invitation into its membership those students in each of Lehigh’s three undergraduate colleges who satisfy the following profile:
Special Undergraduate Academic Opportunities

The academic programs in the colleges are supplemented by five-year, two-degree programs as well as opportunities for advanced, foreign, and experiential study.

ARTS-ENGINEERING OPTION

The curriculum in arts-engineering is designed for students wanting a professional education in a field of engineering and also the opportunity to study a second field.

Arts-engineers fulfill all requirements for the professional engineering degree for which they are working. However, the first three years of science and engineering courses are scheduled over four years for the arts-engineer. During this period the arts-engineer is a student in the College of Arts and Science pursuing a bachelor of arts major program.

In many instances it may be advisable to take the two degrees at the end of the fifth year. Arts-engineers working towards the bachelor of science in biology, computer science, environmental science, geological sciences, geophysics, molecular biology, and statistics are advised to pay special attention to the engineering humanities and social science requirements, which must be met in time for the student to qualify for the B.S. in engineering.

Arts-engineers have the same opportunities for multiple majors and special interdisciplinary majors as are available to students working for the baccalaureate (B.S. or B.A. degree only) in the College of Arts and Sciences. Additional information may be obtained by contacting Prof. Bruce Thomas, Art and Architecture, Chandler-Ullmann.

BACHELOR/MASTER DEGREE PROGRAMS

Of increasing interest to undergraduates are the two-degree programs that may lead to both a bachelor and a master’s degree in five years. The five-year program in the School of Education enables those receiving a B.A. or B.S. degree to accomplish professional teacher training and serve as salaried interns in public schools. After the completion of one year of full-time teaching, secondary teachers can receive the master of arts and elementary teachers can receive master of education degrees.

Many other five-year, graduate-level combination programs exist, and students are advised to consult with their adviser in planning such programs. All students receiving masters degrees must be registered as full time degree graduate students for at least one full term.

Apprentice Teaching

The apprentice teaching program is designed to benefit juniors and seniors who wish to learn about teaching under the guidance of an experienced teacher. Apprentices often do a limited amount of supervised lecturing or leading of discussions, assist in making up and evaluating written assignments, and are available for individual consultation with students.

To participate in the apprentice teaching program a student must:

1. Have an over-all cumulative grade point average of 2.80 or better;
2. Have a cumulative major grade point average of at least 3.3 and have completed at least two courses in the major field in which apprentice teaching is done;
3. Have previously taken for credit the course or its equivalent in which the apprentice teaching will be done;
4. Meet the guidelines on file in each college dean’s office.

A student may register for apprentice teaching only once each semester, only once in a given course, and only twice during a college career.

To register for apprentice teaching each student-teacher partnership will submit an apprentice teaching agreement, indicating the duties and obligations for approval to the department chair and the dean of the student’s college in which the course is taken. This form must be submitted to the registrar before the first day of classes in the semester. To complete the course, the apprentice teachers must submit a written report of their experience to the supervising teacher, who will forward it to the Office of the Provost.

English as a Second Language

Timothy Cauller, Ed.D.
Director
Coxe Hall
32 Sayre Drive
Bethlehem, PA 18015
(610) 758-6099
www.lehigh.edu/esl

English as a Second Language (ESL) at Lehigh offers a variety of year-round courses and private tutoring for undergraduate and graduate students who would like to improve their academic English skills and their understanding of American pragmatics and culture.

ENGLISH DEPARTMENT CREDIT COURSES

Undergraduate students who are non-native speakers of English and have lived and studied in the US for less than four years will register for ENGL 003 and ENGL 005 (Composition and Literature for International Writers I and II) as their required first-year English composition courses. These two courses, taken consecutively in the Fall and Spring semesters, are designed specifically with international writers in mind and substitute for ENGL 001 and ENGL 002 general composition courses. Those first-year international undergraduate students who need additional focused practice with their American English speaking, listening, and pragmatic skills may be required to register for ENGL 015 (Speech Communication for International Speakers).

ESL PROGRAM (ESLP) COURSES

Graduate students can register for credit courses (one credit each) in academic writing, speaking & listening, and advanced academic presentations offered in both Fall and Spring semesters. Please refer
to the English as a Second Language course offerings for registration information.

**STEPUP INTENSIVE ENGLISH PROGRAM**

The StepUp Program is a rigorous, non-credit English program for admitted Lehigh students who are required to further improve their English skills prior to taking credit courses at Lehigh University. StepUp enhances students' English skills in advanced academic reading and writing, spoken academic language, and American pragmatics. StepUp also serves as an excellent orientation to the Lehigh University culture. For program information, dates, fees, and registration forms, visit the ESL website: www. (http://www.lehigh.edu/~inesl/StepUp)global.lehigh.edu/esl.

**INTERNATIONAL ENGLISH LANGUAGE CENTER (IELC)**

Graduate students can register for private tutoring appointments in ESL's International English Language Center (IELC). In each semester-long program, students will study individually with a professional ESL teacher utilizing a curriculum specifically customized to each student's interests and needs. For program information, dates, fees, and registration forms, visit the ESL website: www.lehigh.edu/~inesl.

**Credit by Examination**

Upon petition and presentation of evidence that he or she has qualified for it, a student already enrolled at Lehigh may be permitted by the Standing of Students Committee to take a special examination for credit towards graduation. Special examinations are granted only for extraordinary reasons and upon petition. There must be adequate supporting evidence of sufficient cause accompanying each petition. There is a fee for all special examinations.

Students taking a special exam after matriculation at Lehigh will have the grade and credits assigned to their permanent Lehigh record. Special exam credit will be counted as in residence credit and the grade will be used in all grade point average calculations. No special exam will be granted in a course that the student has already taken (except senior reexaminations) for credit or on an audit basis, or in a course in which the student has already completed more advanced work at Lehigh.

**Preparation for Graduate Work**

Students planning to continue in graduate programs should take advantage of the flexibility in many undergraduate programs to design an upper-division curriculum that meets requirements in the anticipated graduate program.

The policies of the colleges provides as much flexibility as possible for students who wish to change to new but related fields of study after the baccalaureate degree. Students should consult with their previous program adviser and the department representative of the new field to establish an academic program that will remedy any deficiencies in background.

**Guidelines for Undergraduates to Take Graduate Level Courses**

1. No undergraduate student may take 400-level courses during a term where the student's total credits are greater than 18 (including audits).
2. All students receiving a graduate degree must be enrolled one full semester or summer as a regular student prior to the awarding of a graduate degree.
3. An undergraduate student may use no more than 12 credits taken as an undergraduate toward a graduate degree. These courses must be at the 300 and 400 level and beyond all undergraduate degree requirements.
4. Students should have achieved junior standing and a grade point average of 3.0 to take 400 level courses.
5. Students must petition the Standing of Graduate Students and the Standing of Students for permission.
6. Students requesting a second graduate level course in a given term must petition the Standing of Graduate students committee. (Students should not expect to take a second graduate level course if enrolled for more than 15 credits.)

**Curricular Flexibility**

Choice is a regular part of university life, and encompasses the determination of a college and major, the selection of courses each term, and the development of life goals and career options.

Many of these choices are academic in nature. The undergraduate curricula are flexible, designed to accommodate the changing interests and needs of students. Boundaries between colleges are fluid, providing many options in an educational program. For instance, students may take a bachelor of science (B.S.) degree in the College of Business and Economics or the College of Engineering and Applied Science with a minor in journalism in the College of Arts and Sciences. There are five-year programs for which degrees are awarded in two colleges.

Students who wish to transfer from one undergraduate college to another may do so provided that they have achieved sophomore status and have completed at least 12 credits while in their college of matriculation. Students on academic probation may transfer between colleges with the permission of the committee on standing of students.

In addition, each receiving college may require the completion (with a minimum grade of C-) of no more than three introductory courses – courses without prerequisites – before transfer occurs. Students considering such a transfer must confer with their advisers to begin the process. Students who transfer to another college may require more than the traditional eight semesters to complete the course sequence in their degree program.

The College of Business and Economics requires a student to successfully complete either MATH 081 or MATH 021, and ECO 001 before transferring to that college. Courses considered equivalent to these courses will also satisfy the requirement such as approved transfer credit (including AP courses) for these courses taken at other institutions, or the successful completion of MATH 075 and MATH 076, or MATH 031, which are equivalent to MATH 021.

**Provisional Courses**

Instructional departments may introduce provisional courses temporarily within a semester, either experimentally or as a response to a contemporary social or scientific issue. If successful, such courses may become a permanent part of the university curriculum. These courses, identified with a 95, 96, 97 or 98 number (preceded by a 0, 1, 2, 3 or 4 indicating level) may be offered for a maximum of two years.

**LVAIC Cross-Registration**

Currently enrolled full-time degree seeking undergraduate students in good academic standing who have achieved sophomore status may register for up to two courses per term at any one of the member institutions (DeSales University, Cedar Crest College, Lafayette College, Moravian College, and Muhlenberg College). The student must obtain the appropriate approvals of his or her own adviser and the host institution registrar. The courses must not be available at the home institution and must be in the normal academic load and not produce an overload. Graduate students and courses (courses numbered 400 and above) are not eligible for cross registration.

All grades of courses taken through the LVAIC cross registration process will be accepted by the home institution and entered on the permanent record, and such grades will be used in computing the grade point average. Credits taken through the cross-registration process will be calculated as in-residence. The number of credit hours assigned to a course is the responsibility of the home institution registrar.

Students may not repeat a course at another LVAIC institution in which they expect to have a Lehigh cumulative grade point average adjustment.

Lehigh University students are not permitted to cross-register for courses in all January intersession programs, the evening program at Muhlenberg College, all weekend courses at Cedar Crest College, or the Access program at DeSales University. All independent study, tutorial, music lessons or groups, correspondence, and on line courses are prohibited from cross-registration without prior approval of the Lehigh University Standing of Students Committee.
SUMMER CROSS-REGISTRATION
Lehigh students must have been registered full time in the prior spring semester to be eligible to cross-register for a summer term. A maximum of two courses per session may be rostered. Students may not cross-register for a course being offered at Lehigh during the summer term.

Additional information on cross-registration can be found on the LVAIC website at the following link: http://www.lvaic.org/default.aspx?pageid=464

General College Division

The General College Division provides an opportunity for qualified persons not planning to seek a degree to pursue work of a general or specialized nature that their preparation and interests make desirable; provides a trial period for those who wish to become candidates for baccalaureate or graduate degrees, but whose preparation does not satisfy the entrance requirements for the established curricula; and provides an opportunity for qualified students to continue their education without being committed to a restricted or specialized program of studies. Courses taken in the General College Division may not be submitted to meet the requirements for a graduate degree.

For admission to the General College Division, the student must submit a special, simplified application to the undergraduate admissions office; the application must be submitted at least one month prior to the start of the semester in which the student hopes to enroll. The applicant must show maturity, seriousness of purpose and evidence of ability to pursue with profit the program of studies he or she desires. The student must have the established prerequisites for courses in which he or she wishes to enroll, and may register for courses up to and including those at the 300-level. 400-level courses are prohibited.

There is no established curriculum for the General College Division. Each student works on a program outlined to meet his or her special needs. Each program must be approved by the University Registrar and/or their designee, who serves as the director of the division. Students must obtain permission of the instructor for each course in which they seek to enroll each semester. Students in this division are granted final approval for enrollment on a case by case and space available basis.

Students in the division are not permitted to take courses using the optional pass/fail grading system, course audit, or cross register for courses in LVAIC.

Students in the division, as non-degree candidates, do not meet the eligibility criteria for federal student aid, under Title IV, including Federal Pell Grants and Federal Stafford Student Loans. Similarly, institutional financial aid also is limited to degree candidates.

Students in the division are not candidates for degrees and must maintain a minimum 2.00 grade point average. A student may transfer to regular matriculated undergraduate status in any of the colleges only upon petition to, and with the approval of, the Committee on the Standing of Students. Transfer to the graduate school is possible only through the normal graduate admission process.

With the exception above, students in the General College Division are subject to the same rules and regulations as students of the university. They pay the tuition and fees established for regularly matriculated students.
Graduate Study and Research

Lehigh began awarding graduate degrees in 1882. The first recipient, T.H. Hardcastle, of the Class of 1880, wrote his thesis on Alexander Pope, entitled it The Rights of Man, and read it aloud at commencement in June 1882.

The first Ph.D. was granted in 1893 to Joseph W. Richards, Class of 1886. Richards, who had a background in metallurgy and electrochemistry, taught at Lehigh until his death in 1921.

Women were admitted to the graduate program in 1918 when the faculty and the board of trustees agreed to grant the degrees of M.A. and M.S. to women, provided they attended classes in the late afternoon and on Saturdays “so that the general character of campus life shall not be affected.” Three women received graduate degrees in 1921, the first women to complete graduate work at Lehigh. In 1929, the rule was changed, and women were admitted on much the same basis as men.

In 1936, the Graduate School was established to administer the graduate program. The Ph.D., which was temporarily discontinued in 1894, was reinstated in nine departments: chemistry, chemical engineering, civil engineering, geology, history, mathematics, mechanical engineering, metallurgical engineering, and physics.

Tomlinson Fort, professor of mathematics, was selected in 1938 as the first dean of the Graduate School.

In 1995, graduate programs were decentralized and are now administered by the four colleges of the university, as described below.

COLLEGE OF ARTS AND SCIENCES
Donald Hall, dean
Dominic Packer, associate dean for research and graduate programs

The College of Arts and Sciences offers graduate degrees in the humanities, social sciences, mathematics, and natural sciences. The master of arts, master of science, and the doctor of philosophy degrees are given in most of the traditional academic departments and in some interdisciplinary programs. Advanced degrees may be obtained in the departments of biological sciences, chemistry, earth and environmental sciences, English, history, mathematics, physics, political science, psychology, and sociology. In addition, interdisciplinary degrees are available in American studies, environmental policy design, photonics, and polymer science and engineering.

Although degree requirements vary from department to department, most require a combination of formal coursework and independent research. Students work closely with a faculty adviser in formulating and carrying out their research programs. Students admitted to a traditional department who are interested in an interdisciplinary approach may design a program of study and research which draws on faculty and facilities in other areas of the college or university.

For the most up to date information, interested students should check the CAS graduate website (http://cas.lehigh.edu/grad) or contact the Office of Research and Graduate Programs, College of Arts and Sciences, 9 West Packer Ave., Bethlehem, PA. 18015, 610-758-4281 or email to incasgrd@lehigh.edu.

COLLEGE OF BUSINESS AND ECONOMICS
Georgette Chapman Phillips, Dean
Andrew J. Ward, Associate Dean

The College of Business and Economics offers the master of science degree in accounting and information analysis; master of science degree in economics; master of science degree in management; master of business administration with concentrations in business administration, corporate entrepreneurship, finance, marketing, international business, project management and supply chain management; and the doctor of philosophy degree in business and economics. In addition, the College of Business and Economics and the P.C. Rossin College of Engineering and Applied Science offer the MBA and Engineering. Students in this program will have the opportunity to concentrate in both a business area and an engineering area during their studies. The College of Education and the College of Business and Economics offer a joint masters degree in MBA and Educational Leadership, which will develop skills in business disciplines and prepare educators for roles in school administration.

The College of Business and Economics, the P.C. Rossin College of Engineering and Applied Science, and the College of Arts and Sciences offer a master of science degree in analytical finance, which provides a strong education in advanced finance and quantitative financial analysis tools. Students will be prepared to create innovative solutions for real financial problems using state of the art analytical techniques and computing technology.

There are five departments in the college: Accounting, Economics, Perella Department of Finance, Management, and Marketing. More information about the various degree programs appears below.

Information on the college’s graduate programs may be obtained at www.lehigh.edu/business or by contacting the College of Business and Economics, Graduate Programs Office, Rauch Business Center, 621 Taylor Street, Bethlehem, Pa. 18015, 610-758-4450.

COLLEGE OF EDUCATION
Gary M. Sasso, Ph.D., Dean
Thomas C. Hammond, Ph.D., Associate Dean

The College of Education is a nationally recognized graduate college. Our distinction resides in our ability to function as a community of scholars and teachers. The diversity of our partnerships, the quality of our research and teaching, and the invigorating and supportive learning environment distinguish us as leaders among graduate colleges of education.

The College of Education offers a master of arts in education, a master of education, a master of science in education, the educational specialist, a joint master in business administration/master of education, post-baccalaureate certificates in various concentrations, the doctor of education, and the doctor of philosophy. There are six academic programs within the college including: Comparative and International Education, Counseling Psychology, Educational Leadership, School Psychology, Special Education, and Teaching Learning and Technology. The focus of these programs is to prepare students for leadership roles in groundbreaking, cross-disciplinary inquiry that shapes educational practices nationally and internationally. While the College of Education does prepare individuals for leadership roles in school systems, we also prepare individuals for a variety of positions in business and industry, healthcare, private practice, and community-based organizations. We embrace the philosophy that a top quality education should provide the instruction, resources, and experience necessary to create a new type of educator; one who understands the nature of learning, social equity and cultural diversity; values collaboration and teamwork; and embraces societal challenges.

In addition to these six core academic programs, there are four other units within the College of Education:

Centennial School

The College of Education operates the Centennial School, a laboratory facility for children with emotional/behavior disorders that has both an elementary and a secondary component. Centennial School provides research opportunities, as well as practical experience, for advanced students in our counseling psychology, educational leadership, school psychology, and teacher-preparation programs.

The Center for Promoting Research to Practice

The center's mission is to generate new knowledge that will truly impact the lives of individuals with disabilities. The primary objective of the center is to create a living laboratory that establishes partnerships with schools, parents and families, and community service providers.
to enhance the use of best practices for individuals with disabilities. 

Global Online Graduate Degrees and Training Office

The Office of Global Online Graduate Degrees and Training provides online graduate education and training to students within Lehigh University’s College of Education. The Global Online Office’s international initiatives are designed specifically for international educators in the U.S. and worldwide. Offering graduate degree programs, principal certification, professional education certificates, and summer institutes via online courses and in-person throughout the academic year, the Global Online Office works with College of Education faculty to provide customized professional development programs at international schools worldwide. For more information, visit: coe.lehigh.edu/international

Information on the various degree programs can be obtained by contacting the College of Education, 111 Research Dr., Bethlehem, PA 18015, 610-758-3231 or visiting our website: coe.lehigh.edu/.

P.C. ROSSIN COLLEGE OF ENGINEERING AND APPLIED SCIENCE

Stephen P. DeWeerth, dean

John P. Coulter, associate dean for graduate studies and research

There are seven academic departments within the P.C. Rossin College of Engineering and Applied Science: chemical and biomolecular engineering, civil and environmental engineering, computer science and engineering, electrical and computer engineering, industrial and systems engineering, materials science and engineering, and mechanical engineering and mechanics. Master of science and doctor of philosophy degrees are available in each of these departments, as well as in bioengineering, computational and engineering mechanics, environmental engineering, computer engineering, structural engineering, and polymer science and engineering. In addition, master of science programs are provided in analytical finance, management science and engineering, manufacturing systems engineering, photonics, and wireless and networking engineering. Master of engineering degrees are offered in biological chemical engineering, chemical engineering, chemical energy engineering, civil engineering, computer engineering, computer science, electrical engineering, energy systems engineering, environmental engineering, healthcare systems engineering, industrial and systems engineering, management science and engineering, materials science and engineering, mechanical engineering, polymer science and engineering, structural engineering and technical entrepreneurship. In cooperation with the College of Business and Economics, students can also pursue a Master of Business Administration and Engineering (MB&E) degree. Certificate programs are available in the areas of healthcare systems engineering, management science and engineering, manufacturing systems engineering, nanotechnology, polymer science and engineering and quality engineering.

Graduate study in the P.C. Rossin College of Engineering and Applied Science is most often related to the college’s extensive research activity, and graduate students are expected to engage in analytical or experimental research as part of their programs of study. This activity involves students in the process of creating new knowledge under the direction of the college’s distinguished faculty and brings them into contact with some of the most modern and advanced experimental techniques. Many college research programs are supported by contracts, fellowships, and grants from industry and from federal, state, and local governments. This funding not only provides financial support for outstanding students but also allows them to deal with some of the more complex and pressing problems facing our society in the 21st century.

Many faculty members and graduate students in the P.C. Rossin College of Engineering and Applied Science are associated with interdisciplinary research centers and institutes as well as with their own departments. The opportunity for interdisciplinary study allows them to cross departmental lines in specific technological areas and to work with faculty and graduate students from other departments. Centers and institutes perform research that fall under five broad categories: materials and nanotechnology, infrastructural systems, applied life science and bioengineering, energy and the environment, and complex engineering systems. Information on individual centers and specific research activities can be found at URL www.lehigh.edu/engineering/research/centers/. Extensive research in many of these areas is also conducted within academic departments.

Further information on the graduate programs may be obtained through the Office of Graduate Studies and Research, P.C. Rossin College of Engineering and Applied Science, 19 Memorial Drive West, Bethlehem, PA 18015.

Admission to Graduate Study

A graduate of an accredited college or university may be considered for admission to graduate study. The decision to admit a student rests with the applicant’s major department and stands for one year following the first semester for which admission was offered. If more than one year elapses, the prospective student’s department reserves the right to reconsider the original offer. Students wishing to pursue an interdisciplinary degree may, in some cases, apply to the program directly.

Applications for admission may be completed online at https://www.applyweb.com/lehighg/index.ftl

An applicant may enter the graduate program as a student in the following categories: regular, associate, or non-degree. Except for qualified Lehigh undergraduates, only those who have been admitted officially by the graduate program office of an appropriate college or by a department in one of the categories above may register for graduate courses or take them for credit.

REGULAR GRADUATE STUDENTS

Only regular graduate students are candidates for graduate degrees. Application for admission as a regular graduate student must be filed by July 15 for the following fall semester or by Dec. 1 for the spring semester. Regular graduate students wishing to begin in the summer must apply before April 30. Certain departments or programs have earlier deadlines. Applicants should consult their respective departments or their dean’s office. In order to be considered for admission as a regular graduate student, the applicant must satisfy at least one of the following conditions: have an undergraduate GPA of at least 2.75 out of 4.00 (note: College of Education GPA minimum is 3.0); have an average of at least 3.00 for the last two semesters of undergraduate study; have a graduate grade point average of at least 3.00 for a minimum of twelve credit hours of graduate work completed at other institutions; or have successfully satisfied the probationary conditions as an associate graduate student (discussed below). Satisfying one of these conditions is necessary for admission as a regular graduate student but may not be the only condition required.

Graduate students who are non-native speakers of English are required to take the Test of English as a Foreign Language Internet-Based Test (TOEFL iBT). Please contact your department or program of choice for the required acceptance scores. Please also note that the TOEFL Paper-Based Test (PBT) and the TOEFL Computer-Based Test (CBT) have been discontinued and are no longer valid for admissions purposes.

The TOEFL iBT may be waived if a student has obtained a degree from an English language university in an English speaking country and demonstrates effective English language skills. Applicants should consult with their respective departments or program of choice to confirm whether they are eligible for a TOEFL iBT waiver.

Individual departments may evaluate their candidates for admission according to higher standards and additional criteria. Students seeking admission to Professional Certification Programs may have to meet additional requirements to comply with Pennsylvania Department of Education Regulations. Departments should be consulted for information regarding required examinations for admission. For example, candidates for the MBA program are required to take the Graduate Management Admissions Test (GMAT) or the Graduate Record Exam. In some cases, GRE subject tests are required.

Admission of a student to graduate standing is executed through the Office of Graduate Studies in each college or the respective dean’s office. Credentials for admission to counseling psychology and school psychology programs and to all College of Education doctoral programs are acted upon only once a year.
Certification, with the number of credits being dictated by the external institution. For external certification, students are admitted to pursue coursework for credits of graduate coursework without seeking a degree. Non-degree students can receive any transcript or grade report from the university or enroll for additional courses. When the probationary period of nine credit hours is completed, associate graduate students must petition for regular student status in order to enroll for additional coursework. Such a petition requires the submission of any regular admission documents not already on file. Courses completed during a successful probationary period may count toward a graduate degree if they are part of an approved program.

Non-degrees

Students who do not wish to enter a degree program may seek admission with non-degree status. In this case, the prospective student completes an abbreviated application form which can be completed online at https://www.applyweb.com/lehighg/index.ftl. The admissions criteria for non-degree graduate students are: 1) a bachelor's degree from an approved institution with an overall grade point average of at least 3.0; (applicants with undergraduate GPAs below 3.0 may be admitted with the approval of the department in which they wish to take courses); or 2) evidence that the applicant is presently a student in good standing in an appropriate graduate program at an approved institution; or 3) evidence that the applicant has received an appropriate graduate or other advanced degree from an approved institution. In addition, non-native English speakers are required to demonstrate English language skills equal to those required of degree-seeking students and are held to the same TOEFL standards. Admission decisions for non-degree students are made by the dean of the appropriate college or other responsible official designated by him/her for this purpose. The signature of the designated official on the application and registration forms confers admission to the non-degree graduate student status. Informal transcripts will be accepted for initial admission, but formal transcripts must be on record before the student can receive any transcript or grade report from the university or enroll for additional courses.

Non-degree options

In addition to degree programs, there are two non-degree options: 1) Regular non-degree and 2) Non-degree for external certification. Regular non-degree admission is for students who wish to take up to 12 credits of graduate coursework without seeking a degree. Non-degree for external certification students are admitted to pursue coursework for the purpose of obtaining certification through an external accrediting agency. These students complete coursework for the appropriate certification, with the number of credits being dictated by the external accrediting agency. Given this external control of credit requirements, the number of credits will vary and will typically exceed the 12-credit limit for regular non-degree students. A student admitted as non-degree may subsequently be admitted to a degree program, but would need to submit all components required for admissions consideration by that degree program. Students should consult their respective college dean's office for proper procedure.

Graduate course auditing

With the permission of the departmental chair, graduate students can be admitted to a course as auditors. This course will not count for credit towards any graduate degree, and may not subsequently be taken for credit. In no case shall a student who has attended a course as an auditor be given an anticipatory examination for credit or register for the same course in the future. A student completing a course in this manner will have the course added to his or her transcript with the notation “AU” indicated on the permanent record. A student rostered on an audit basis may be withdrawn from the course with a grade of “W” for poor attendance.

Lehigh university undergraduates

A Lehigh undergraduate with a 3.0 cumulative grade point average who has achieved Junior standing may take any 400-level course for which he or she is qualified. The qualifications are defined by the department and are certified by the course instructor and department chairperson through petition to the Graduate and Research Committee. Additional information on constraints on undergraduates taking graduate level can be found in Guidelines for Undergraduates to Take Graduate Level Courses (p. 29). Undergraduates at Lehigh who are within a few hours of meeting the requirements for a baccalaureate degree may, with the special approval of the Graduate and Research Committee, enroll for up to 12 credit hours of study for graduate credit (6 in the P.C. Rossin College of Engineering and Applied Science). Lehigh undergraduates may apply course credits taken in the undergraduate program toward a graduate degree under the following conditions: 1) the course credits are not submitted as part of the requirement for an undergraduate degree; and 2) courses for possible graduate credit are approved in advance by the course instructor, department chairperson, and the dean of the college. The student must receive a final course mark of B- or better.

Readmission

A student who has not been registered in a Lehigh graduate program for one year must petition for readmission. Petitions approved by the student’s major department must be forwarded to the registrar’s office.

International students and scholars

International applicants must hold an American bachelor’s degree or an equivalent foreign degree requiring at least 16 years of primary, secondary, and university education. International applicants applying for regular graduate student status must submit all documents required for that status (see above).

Registration

Requirements

All graduate students using Lehigh University resources must be registered. No graduate student may register for more than 16 credits per semester. University employees may register for, at most, two courses per semester with appropriate approval. The maximum registration in a summer session is two concurrent courses and no more than 14 summer credits across all summer sessions.

Registration procedure

Registration is scheduled for a two-week period at a time designated on the university calendar. Graduate registration for new students is held during the week preceding the start of classes. Students should check with their departments for registration and semester class schedules. Graduate students may register using the online system after consultation with their adviser, or complete paper registration forms available in their departments. A course adviser will discuss course selections with students and provide the registration PIN or sign registration forms upon approval.

Late registration penalties

Registration after the designated period during the prior term for continuing full-time graduate students or between the second and tenth day of class during the fall and spring semesters, and the second and fifth day of class during the summer sessions will require a late
registration fee. Students who have not completed the registration process by the tenth day of the regular academic semester or by the fifth day of the summer session will not be permitted to attend class.

**FULL-TIME STATUS**

In order to maintain full-time enrollment status, a graduate student must ordinarily register for a minimum of nine credits each semester. Full-time students may not be employed full-time. Identification as a full-time student is important for three purposes:

1. eligibility for financial aid,
2. compliance with visa requirements for international students, and
3. for university and national graduate enrollment data.

Full-time status may be maintained with fewer than nine credits of registration after fulfillment of degree credit-hour requirements and under some other selected circumstances, provided that the student is, in fact, continuing a program of full-time study and research. In such cases, the status must be certified each semester on the Graduate Full Time Certification request form, first by the department and then by the appropriate college.

**Graduate Credit and Grades**

Course grades are defined as for undergraduates (p. 24) except that, at a minimum, no final course mark lower than C- may be counted toward a graduate degree and pass-fail registration is not allowed for graduate students. No regularly admitted student who receives more than four final course marks below a B- in courses numbered 200 or higher is allowed to continue registration as a graduate student. Individual degree programs may have higher standards.

The N grade is defined as for undergraduates (p. 24) except that, parenthetical grades are not required for thesis or research courses and graduate students have a calendar year to remove course incomplete grades unless an earlier deadline is specified by the instructor. Graduate student incomplete course grades that are not removed remain as N or N (grade) on the student record for one year. After one year, the N grade will be converted to an F and the N (grade) will be converted to the parenthetical letter grade. Incomplete grades may be extended an additional year with approval of the course instructor and the graduate coordinator. After two years, outstanding incomplete grades will be converted to an F or the parenthetical mark. After two years, students may appeal to the Committee on Standing of Graduate Students (SOGS) with a timeline and plan for completion. Thesis or research project N grades may remain beyond one year until the work is completed.

The X grade is defined as for undergraduates (p. 24) except that to be eligible for a make-up examination a graduate student must file a petition and the petition must be approved by the Graduate and Research Committee. The instructor schedules and administers the make-up exam.

The Z grade is defined as for undergraduates (p. 24) except that graduate students have a calendar year to complete coursework following a Z grade unless an earlier completion deadline is specified by the instructor. The X portion of the grade is removed as described for undergraduates. Z grades which are not removed remain on the record of graduate students. All petitions for exceptions are sent to the Committee on Standing of Graduate Students (SOGS).

A student’s grade that was originally assigned an N, X or Z grade when converted or computed will be noted with an asterisk prefix.

**REPEATED COURSE POLICY**

If a graduate student repeats a course, each time that course is taken it is included in the academic record, as is the final grade assigned, and both appear on the official student academic transcript. All final course grades assigned are included in the calculation of the student’s cumulative grade point average. Course credits from a repeated course, however, count only once toward satisfying graduation credit requirements.

**WITHDRAWAL FROM A COURSE**

When a student drops a course within the first ten days of the semester (five days for summer sessions) no indication of this action is recorded on the academic transcript. A student that drops all courses for which he or she is registered is considered to be withdrawing from the university.

A student who withdraws from a course after the tenth day of instruction and before the end of the eleventh week of instruction will have a final course mark of “W” assigned to the course. This is a non-punitive grade.

A student who withdraws from a course after the eleventh week of instruction and before the end of classes receives a “WP” or “WF” at the discretion of the instructor. A “WF” is considered to be a failing grade and is calculated as such in the term and cumulative grade point average. An Add/Drop form signed by the student’s adviser must be submitted to the registrar’s office before the deadlines noted to be official.

**UNIVERSITY WITHDRAWAL**

A student withdrawing from the university (dropping all courses during a given term) must submit the Drop/Add form signed by the adviser to the registrar’s office. Withdrawal after registration day and during the first eleven weeks of instruction will be noted on the academic transcript by assigning a final course mark of “W” to all courses. A withdrawal after the eleventh week of instruction and before the end of classes will have the grade of “WP” or “WF” assigned for each course at the discretion of the instructor. The date of the withdrawal will be noted on the academic transcript for a withdrawal at any time during the term.

**GRADUATE STUDENT SCHOLASTIC REQUIREMENTS**

The following guidelines state the minimum requirements for all graduate students. Individual degree programs may have higher standards.

**Associate and Non-Degree Students**

Associate and Non-Degree Students will be placed on probation when they receive their first final course mark below a “B-” and will be dropped for poor scholarship at the end of a term when the student has accumulated either two “C”, “C-” or “C+” final course marks or one final course mark below “C-”.

If an associate student is assigned two grades below a “B-” in the same term the student is eligible to be dropped without any term on probation.

Once on probation, students remain on probation until they are granted regular status or receive degree. Students who are eligible to be granted regular status but fail to apply by the regular student deadline will be evaluated according to the regular student criteria.

**Regular Students**

Regular Students will be placed on probation at the end of the term in which they are assigned their fourth final course mark below a “B-” in courses numbered 200 or above and will be dropped for poor scholarship at the end of any term in which they are assigned their fifth final course mark below a “B-”.

Once regular students are placed on probation they will remain on probation until they receive their degrees.

**Readmission**

Graduate students who have been dropped for poor scholarship are ineligible to enroll for the next regular term. After one term away they may petition for readmission. The department and the dean’s office must review the petition. If approved, the student will be readmitted on probation and may be dropped again with any additional final course marks below a “B-”.

**Graduate Leave of Absence**

**Graduate Student Leave of Absence Policy**

During the course of graduate study, students may find themselves in circumstances that require them to interrupt their graduate work. When these occasions arise, the University allows students to request a leave of absence for either personal or medical reasons. The information provided below is designed to assist students in making a smooth transition away from graduate study and then back again.

Students are required to submit the Leave of Absence Request form to the Office of Graduate Student Life. If the student is eligible, the Office of Graduate Student Life will then notify the academic adviser, program director, department chair, graduate associate dean of the appropriate college and the registrar. In order to enhance their
successful return to graduate school, students are strongly encouraged to meet with their advisers to discuss their plans and to keep the lines of communication open.

Please note that a “withdrawal” indicates the student intends to discontinue graduate study, whereas a “Leave of Absence” indicates that the student intends to return at a specified later date. This policy addresses leaves after which the student intends to return and resume his or her studies.

Important Information about Requested Leaves of Absence:

• Only students who have successfully completed at least one semester of graduate work and are in good academic standing are eligible for a leave of absence. Students in their first semester who request a leave will need to petition for readmission.

• Funded students who are requesting a leave due to the birth or adoption of a child should apply for a Graduate Student Parental Leave. Students can access information and the form here: http://www.lehigh.edu/~inprv/pdfs/GraduateStudentParentalLeavePolicy11-17-09withForm.pdf

• The University will grant a leave of absence for up to one year. If more time away is required, students may request a second year of leave. Should students require more than two years away from the University, they will be required to apply for readmission to the program at the end of their time away. A leave that commences during the semester will count as an entire semester away in terms of total leave time allowed.

• If students take a leave during the semester, they may be required to submit a drop/add form to the Registrar’s Office (http://www.lehigh.edu/~inengrit/gradforms/pdfs/add_drop.pdf). Students may be eligible for a prorated refund. Please consult the Bursar’s Office for details: (http://www.lehigh.edu/~inburs/refund.html).

• An approved leave of absence extends the time-to-degree deadline for the length of the approved leave, but only up to the university-mandated maximum of two years.

• While on leave, students are not registered with the University. This has important implications:

  • The student may not submit work, take exams, propose or defend theses or dissertations, or use faculty time.

  • The student will not have access to University services, including the Health and Counseling Centers, the Fitness Center, and Library and Technology Services. This means the student’s Lehigh email account will be suspended and he or she will be unable to use library services. However, the College Dean’s Office may request that the email account and library privileges remain active during the term of the approved leave, up to a maximum of two years.

• Funded students cease to receive stipend payments from the start of the approved date of the leave. Students receiving funding provided to the university by external grants or contracts should consult with their funding-related adviser/supervisor about applicable rules, procedures and possible limitations. While those who have provided financial support for students who go on leave will do their best to support those students when they return and resume their studies, it is not possible to guarantee such support will be available when the student returns.

• Student loans may come out of deferment and the student may be required to begin repaying his/her loans. Please consult Financial Aid: http://www.lehigh.edu/~infao/graduate/index.html.

• Immigration status may be affected for international students. Please consult the Office of International Students and Scholars: http://www.lehigh.edu/oiss/

• Students living in campus housing will need to make other living arrangements, since only registered students in good standing are eligible for such housing. Unfortunately, Residential Services also cannot guarantee space upon the student’s return.

• Students enrolled in the University health insurance plan may be able to keep their health insurance during the term of the health insurance contract. In this case, students can contact the University Health Center to obtain a list of primary care doctors in the community to use during their leave of absence. Please consult the student health insurance brochure for eligibility restrictions: https://financeadmin.lehigh.edu/sites/financeadmin.lehigh.edu/files/offices/bursar/docs/HealthInsuranceBrochure.pdf

• Students requesting a leave for medical or psychological reasons must include documentation from their health provider which indicates a recommendation for the leave and expected time away. The documentation is submitted to --and is only available to-- the Director of Graduate Life. Such documentation remains kept confidential.

• Students who need to be absent within the semester (no more than a few weeks in duration) must consult with their professors about the possibility of making up missed classwork and, if applicable, work related to their funding support. In these circumstances, students do not need to submit an official Leave of Absence request. Students may consult the Director of Graduate Student Life with questions and concerns.

• To formally request a leave of absence, students must complete the form at the following link: http://lehigh.edu/go/gradloa

Important Information about Involuntary Leaves of Absence:

• The University may require an involuntary leave of any student who appears to have a serious physical, psychological or emotional disorder which offers reasonable cause to believe he or she may be a danger to self or others, or may disrupt proper activities of the University community and its members, or may be unable to look after his or her affairs adequately. An involuntary leave of absence is included in the maximum leave of two years.

• Time-to-degree deadlines are not extended for students who are suspended due to Code of Conduct violations.

Returning from Leave and Resuming Graduate Studies

• When ready to resume graduate study, students are required to complete the Graduate Readmission Form, available at the following link: http://lehigh.edu/go/gradreadmit

• Returning students are encouraged to contact their program adviser as early as possible to discuss registration.

• Returning students may only re-enroll for a full semester or summer session. In order to meet this requirement, such students need to be aware of registration deadlines.

• Students who take a leave from graduate study without requesting an official leave of absence will be required to petition the Standing of Graduate Students (SOGS) committee for readmission if they’ve been away from the University for more than one year. Unapproved leaves count toward the two-year leave maximum.

If you have any questions about this policy or its application, please contact the Director of Graduate Student Life, Kathleen Hutnik, either by email kaha@lehigh.edu or telephone 610-758-3648 (http://catalog.lehigh.edu/graduatestudyandresearch/graduateleaveofabsence/tel:610-758-3648).

Graduation

DEGREE REGISTRATION

A student must be registered in the semester in which the degree is conferred. If a student is not registered for a course, he/she must register for maintenance of candidacy. Candidates for September degrees do not need to be enrolled the summer preceding the degree if they were enrolled both fall and spring of the previous academic year.

APPLICATION FOR DEGREE

Candidates for graduation on University Day in May must file with the registrar on or before February 1 a written notice of candidacy for the degree; candidates for graduation in September file a notice of candidacy on or before July 1; candidates for graduation in January file a notice of candidacy on or before October 1.

Failure to file such notice by such dates mentioned debar the candidate from receiving the degree at the ensuing graduation exercises. If a petition for late filing is granted, but before deadline to complete all requirements, a fee is assessed.

CLEARANCE

Graduate students must receive clearance from the university prior to the awarding of the degree. The following obligations must be satisfied:
• Students must complete all coursework, including any incomplete grades they may have received.
• Theses must be cleared by the registrar’s office.
• Dissertations must be cleared by the appropriate dean’s office.
• All financial obligations must be cleared with the bursar. Tuition fees, bookstore charges, library fines, and motor or vehicle fines must be paid before graduation.
• All library books on loan must be returned.
• Students must turn in their student identification cards at the I.D. card office.

The interdepartmental clearance sheet must be completed. This form requires the signature of the student’s department chairperson (except for the College of Education), before it is submitted to the registrar at least three days prior to graduation.

### Tuition and Fees

#### TUITION PAYMENT
Graduate students who register at least six weeks prior to the start of classes will receive an email notification to their Lehigh email account that their tuition bill is ready to view online at the e-Bill Suite. Students that register less than six weeks prior to the start of classes will most likely not have a tuition bill generated prior to the start of classes. To remain in good standing, tuition charges must be paid prior to the start of classes even if the student has not received a tuition bill because of his/her late registration for classes. Students can review their current account balance online 24/7 by logging into the e-Bill Suite or the Campus Portal. Information about the various payment options is available at the Bursar’s Office website at www.lehigh.edu/inburs/ or by calling the Bursar’s Office.

#### TUITION REFUNDS
A student in good standing who formally withdraws or drops a course(s) before 60% of the semester has been completed is eligible for a tuition refund. Academic fees are non-refundable after the first day of classes. The “first day of classes” is considered the first day of the semester, not the first day a particular class meets. Courses not following standard semester dates will have percent-of-semester-completed refunds based on dates for that specific course. Online courses percent-of-semester-completed are based on access availability, not if/when student first accessed course material. No tuition refunds will be made for courses of one week or less after the first day of class.

### Tuition and Fees for 2016-2017 Per Credit Hour

| College of Arts & Sciences       | $1,420 |
| College of Business & Economics | $1,075 |
| College of Education, and for fulltime elementary and secondary teachers and administrators enrolled in the other three colleges | $565 |
| College of Engineering & Applied Science | $1,420 |
| Special Programs MBA & Engineering | $1,420 |
| MBA/Educational Leadership       | $825  |
| MS/Analytical Finance            | $1,420 |
| MS Accounting and Information Analysis | $1,235 |
| M² - Masters of Science in Management - 9 month program (30 credits) | $46,350 |
| Accelerated MBA (1-year)         | $63,000 |
| Audit charge per course – same as credit charge in the appropriate college | |
| Maintenance of candidacy – same as a one-credit charge in the appropriate college | |
| Master's candidate registration fee – same as a one credit charge in the appropriate college | |

### Living Accommodations
The university maintains a graduate student housing complex in the Saucon Valley that has 135 living units. This complex, Saucon Village Apartments, provides units generally on a yearly lease basis. For the 2016-2017 period beginning in September, the following are the monthly rents exclusive of utilities:

<table>
<thead>
<tr>
<th>Type of Accommodation</th>
<th>Rent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency apartment</td>
<td>$595</td>
</tr>
<tr>
<td>One-bedroom apartment</td>
<td>$680</td>
</tr>
<tr>
<td>Two-bedroom apartment w/o AC</td>
<td>$755</td>
</tr>
<tr>
<td>Two-bedroom apartment w/AC</td>
<td>$770</td>
</tr>
<tr>
<td>Three-bedroom apartment</td>
<td>$785</td>
</tr>
</tbody>
</table>

### 230 W Packer/Packer House Rent
The university also maintains graduate housing on the Asa Packer campus. 230 W. Packer and Packer House provide single bedrooms within small houses where residents share bathrooms and a common kitchen. These rooms are provided on a 9 month (230 W. Packer) or yearly (Packer) basis. For the 2016-2017 period beginning in September, the following are the monthly rents:

<table>
<thead>
<tr>
<th>Type of Accommodation</th>
<th>Rent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Bedroom</td>
<td>$535</td>
</tr>
<tr>
<td>Large Bedroom</td>
<td>$565</td>
</tr>
</tbody>
</table>

### Other Fees

<table>
<thead>
<tr>
<th>Fee Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application fee</td>
<td>Consult with individual college (for graduate admission consideration)</td>
</tr>
<tr>
<td>Late pre-registration</td>
<td>$100</td>
</tr>
<tr>
<td>Late application for degree</td>
<td>$50</td>
</tr>
<tr>
<td>Late payment (after announced date)</td>
<td>$200</td>
</tr>
<tr>
<td>Returned check fine</td>
<td>$35</td>
</tr>
<tr>
<td>Identification card (replacement)</td>
<td>$30</td>
</tr>
<tr>
<td>Thesis distribution</td>
<td>$55</td>
</tr>
<tr>
<td>Dissertation distribution</td>
<td>$90</td>
</tr>
<tr>
<td>MBA Orientation Fee</td>
<td>$375</td>
</tr>
<tr>
<td>Supervision fee 1</td>
<td>$100 to $250</td>
</tr>
</tbody>
</table>

1 Assigned to full-time graduate students who do not select their full class load during the designated period each term.
2 College of Education (per 3 credits) Intern courses require a special supervision fee which varies from $100 to $250. Inquire in your department.

### Financial Aid

Financial aid is available only for regular, full-time graduate students. Teaching assistantships, research assistantships, graduate assistantships, fellowships, and scholarships are academic awards made by individual academic departments. Several graduate assistantships unrelated to a particular area of study can be obtained by applying to administrative offices. International students are also encouraged to apply for funding to outside sponsoring agencies and/or home governments. Finally, please note that all student loan programs are administered by the Office of Financial Aid located at 27 Memorial Drive West. (Please read the section below regarding loans and work-study.)

### Academic Awards

Requests for fellowships, scholarships, research assistantships, teaching assistantships, and graduate assistantships to begin in the fall semester must be filed with academic departments no later than January 15. (Some departments have earlier deadlines.) Generally, a special committee formed by department faculty selects the recipients of these awards based upon merit; students are not required to submit a financial statement.

In addition to their stipends, graduate students holding half-time teaching appointments generally receive tuition remission. Fellowship holders also receive a stipend and tuition award. Scholarship recipients are awarded tuition. Research assistants receive a stipend for research services, but their tuition is commonly paid directly by research projects.

### Teaching Assistants and Graduate Assistants

Teaching assistant and graduate assistant (TA/GA) are technical terms used to describe specific types of Lehigh University graduate students. The duties of TAs and GAs are generally set by the departments or offices that appoint them, but certain conditions must be satisfied.
A summer TA/GA registers for a maximum of three credit hours in each
quarter-time and eighth-time TA/GA appointments are possible for full-time resident
graduate students, with stipends and tuition remission appropriately reduced.
Each TA/GA must be paid a specific stipend, which is set for
the academic year by the dean of the appropriate college after
consultation with the Director of Budget.
Qualified TAs/GAs receive tuition remission for at most ten credit
hours in a regular semester. No TA/GA may register for more than
credit hours. A student who is a TA/GA during the preceding
academic year is entitled to at most three hours of thesis, research,
or dissertation registration (not course credit) in the following
summer without payment of tuition (except in the College of
Education).
Each TA/GA is a half-time position and each TA/GA provides services to
Lehigh University of up to twenty hours per week. Quarter-time and
eighth-time TA/GA appointments are possible for full-time resident
graduate students, with stipends and tuition remission appropriately reduced.
Each TA/GA must be paid a specific stipend, which is set for
the academic year by the dean of the appropriate college after
consultation with the Director of Budget.
Qualified TAs/GAs receive tuition remission for at most ten credit
hours in a regular semester. No TA/GA may register for more than
ten credit hours. A student who is a TA/GA during the preceding
academic year is entitled to at most three hours of thesis, research,
or dissertation registration (not course credit) in the following
summer without payment of tuition (except in the College of
Education).
Each TA/GA is appointed by a process which begins with a
formal letter of appointment issued by the appropriate department
chairperson. The appointment letter specifies standard university conditions including stipend level, time of arrival, length of service,
and the requirement of satisfactory academic progress and
performance of duties. Each department chairperson submits written
notification of TA/GA appointments to the appropriate college dean or
vice president.

The Graduate and Research Committee endorsed academic guidelines for new teaching assistants which exceed minimum admission requirements. Each TA should satisfy one of the following: have a GPA of 3.0 or better in the undergraduate major field of study; have a GPA of 3.5 in the senior year major field; rank in the 85th percentile or higher on the Graduate Record Exam or other standardized test; or have a GPA of 3.5 in at least twelve hours of graduate work in the major field. Exceptions to these guidelines shall be made only with the approval of the appropriate dean.

In addition, each teaching assistant must make normal progress toward a graduate degree. The definition of normal progress may vary among departments, but the criteria for satisfactory progress are established by the department faculty and the Graduate and Research Committee. Teaching assistants who fail to satisfy these criteria are ineligible for reappointment.

In addition to achieving the minimum TOEFL IBT scores necessary for admission, potential Teaching Assistants and Graduate Assistants whose first language is not English who will be working with Lehigh undergraduates in academic settings (classrooms, recitations, labs, office hours, etc.) must pass Lehigh University’s Test of Presentation and Speaking Skills (TOPSS) prior to beginning their instructional responsibilities. At the Department’s discretion, students who score in the conditional range on the TOPSS may be appointed as a TA or GA but will be required to attend English as a Second Language courses, re-take the TOPSS, and achieve a passing score within one semester.

Tuition remission for qualified TAs/GAs is authorized by the appropriate dean or vice president as part of the registration process. Each college dean or appropriate vice president will be provided tuition remission accounts against which TA/GA remissions will be charged. The accounts will be budgeted at an amount equal to the nine-hour TA/GA tuition rate times the approved number of TA/GA positions and will be included in the annual operating budget. The budgets shall not be exceeded. If additional TA/GA positions are desired on a temporary basis, the account executive must provide for the transfer of budget support to the remission account. These budgets are to be used exclusively for tuition remission for authorized TA/GA positions.

There are a limited number of summer TA/GA appointments. These TA/ GAs must receive the same monthly stipend as academic year TAs/GAs and devote up to twenty hours per week to the GA/TA responsibilities. A summer TA/GA registers for a maximum of three credit hours in each summer session of appointment and receives tuition remission for that registration.

**OTHER GRADUATE ASSISTANTSHIPS**

Graduate students may apply directly to administrative offices for graduate assistantships unrelated to their areas of study. The availability of these assistantships is based upon the needs of the individual departments. GAs are appointed regularly by the office of the vice provost for student affairs, the dean of students office, the university counseling service, and by career services.

**LOANS AND WORK-STUDY AWARDS**

Graduate students may apply for Federally funded loans (Direct Unsubsidized Loan or Graduate PLUS Loan) through the Office of Financial Aid. Federal funds are awarded using the Free Application for Federal Student Aid (FAFSA) which can be completed on the web at www.fafsa.ed.gov. In addition to the FAFSA, Lehigh University requires a university application (Graduate Student Financial Aid Application). Applications for Federal loans cannot be processed and funds cannot be disbursed, until the FAFSA is received and reviewed.

Eligibility for student loans is based on the number of credits to be taken and the total amount of assistance received. Any change to the number of credits to be taken or the amount of aid received may affect loan eligibility. To avoid problems with your loan application, it is important that you notify the Office of Financial Aid of any changes in your enrollment or in the amount of aid received. It is the student's responsibility to notify the Office of Financial Aid of any changes.

Visit the Office of Financial Aid website for additional information: www.lehigh.edu/financialaid

**Degree Information**

The following degrees are offered by the university: the master of arts, the master of business administration, the master of business administration and educational leadership, the master of business administration and engineering, the master of education, the master of engineering, the master of science, the doctor of philosophy, the doctor of education, and the doctor of arts.

Students pursuing multiple graduate level degrees must meet minimum unique degree credit-hour requirement for courses taken at Lehigh. A single master’s degree requires a minimum of 30 credits (see transfer credit policy for any exceptions); a single doctoral degree requires a minimum of 72 credits, or 48 for a student with a prior master’s degree. A student seeking two master’s degrees will be required to take at least 60 credits at Lehigh, but may petition to transfer in credits towards the first master’s degree. No credit used for a master’s degree may be counted towards reducing the minimum requirement of 48 Lehigh credit hours for a doctoral degree. No graduate credit may be counted towards two graduate level degrees.

Candidates for the master’s degree have six years in which to complete their programs. Students should confer with their advisers to be certain that specific department and program course requirements are met. The following requirements must be satisfied by master’s candidates in all departments.

**PROGRAM FOR THE MASTER’S DEGREE**

A student’s program must include: not less than 30 credit hours of graduate work; not less than 18 credits of 400-level coursework (research or thesis registration counts as part of the 400-level coursework requirement); and not less than 18 credits of coursework in the major, of which 15 credits must be at the 400 level. Coursework for the master’s degree must be taken under at least two instructors and must be approved by Lehigh University. With the approval of the department chair, between 9 and 15 credits of graduate coursework taken elsewhere may be transferred to a Lehigh master’s program. The number of credits that may be transferred depends on the number of credits in the master’s program: Up to 9 credits for programs of 36 credits or less; up to 12 credits for programs of 37 to 48 credits; and up to 15 credits for programs of 49 to 60 credits. Programs, departments and colleges may have more restrictive transfer rules, however, and students should consult their program offices to learn of any such restrictions.

Course transfers require submission of completed course-transfer petitions, with course descriptions and transcripts, as well as departmental recommendation. Final course marks of B or better are required, such courses may not have been applied toward any
prior degree, the courses must have been completed at an institution accredited by one of the six regional accrediting associations, and those courses must have been completed within four years of the first enrollment in the Lehigh master’s program.

A student must complete the form, “Program for Master’s Degree,” setting forth the courses proposed to satisfy the degree requirements. This form should be approved by the department and then submitted to the registrar as soon as possible after 15 credit hours toward the degree have been completed. Approval of the program by the registrar signifies that the student has formally been admitted to candidacy for the master’s degree.

**THESIS AND COMPREHENSIVE EXAM**

Candidates in some programs may be required to submit a thesis or a report based on a research course of at least three credit hours, or to pass a comprehensive examination given by the major department. The department will specify which of these requirements apply and may require both. If required, the thesis or report shall not count for more than six credit hours, and thesis registration is limited to a maximum of six credit hours. If the thesis or research project involves human subjects, the student must complete the university human subjects review packet and receive written approval from the Institutional Review Board. All approved thesis/dissertations copies must be submitted by the appropriate deadlines in electronic form by following the procedures and guidelines found on the LTS Web site URL: http://libraryguides.lehigh.edu/etd. Please contact your college dean’s office for further clarification.

A non-thesis option exists for certain programs in the Colleges. Students should check with their departments regarding that option.

**TIME AND REGISTRATION REQUIREMENTS**

A candidate for the doctor of philosophy degree ordinarily is expected to devote at least three academic years to graduate work. In no case is the degree awarded to someone who has completed fewer than two full academic years of graduate work. All post-baccalaureate work toward the doctorate must be completed within ten years. A student beginning doctoral coursework after an elapsed period of at least one semester after the master’s degree has been conferred is granted seven years in which to complete the doctoral program.

Doctoral students whose graduate study is carried out entirely at Lehigh University must register for a minimum of 72 credits beyond the bachelor’s degree. Students who have earned a master’s degree at another university must register for a minimum of 48 credits. These requirements include registration for research or dissertation credits. Students participating in approved dual-degree doctoral programs involving external institutions may transfer up to 25% of their total required doctoral program research credits to Lehigh for work that was performed at the external partner institution. Approval of such programs is required by the dean of the relevant Lehigh college.

Full-time students working toward the doctorate normally register for a minimum of nine credits each semester. If the minimum degree registration requirement of 72 or 48 credits is attained prior to formal admission to doctoral candidacy, continued registration of at least three credits per semester is necessary. Such registration does not automatically grant full-time student status, however. Full-time student status must be confirmed on the graduate full-time certification form.

Students seeking to receive both a master’s degree and a doctoral degree must complete a minimum of 72 graduate credits at Lehigh and must meet all requirements of both degrees.

After admission to doctoral candidacy, a student must maintain candidacy by registering at least two times each calendar year (in each academic semester or in one academic semester and one summer session). After completion of the minimum registration requirement, plus any additional requirements of the student’s department or program, students are permitted to register for ‘Maintenance of Candidacy’ and will be charged a single credit hour of graduate tuition at the appropriate rate for the degree program in which they are enrolled. Full-time status must be certified on the full-time certification form each semester.

**CONCENTRATED LEARNING REQUIREMENT**

Each doctoral degree candidate must satisfy Lehigh’s concentrated learning requirement. This requirement is intended to ensure that doctoral students spend a period of concentrated study and intellectual association with other scholars. Two semesters of full-time Lehigh graduate study, or 18 credit hours of Lehigh graduate study, either on or off campus, within a fifteen-month period must be completed.

Individual departments may impose additional stipulations. Candidates should check with their advisers to be certain that they have satisfied their concentrated learning requirements.

**LANGUAGE REQUIREMENTS**

Language requirements for the Ph.D. are the option of, and in the jurisdiction of, the candidate’s department. Since proficiency in a language is not a university requirement, each department decides which languages, if any, constitute part of the doctoral program.

**QUALIFIERS**

Many departments require students who wish to enroll in doctoral programs to pass qualifying examinations. Since these examinations vary among departments, students should ask their advisers or department chairpersons for more detailed information. If a qualifying examination is not used, students should find out how and when eligibility to pursue doctoral studies is determined.

**ADMISSION TO CANDIDACY**

With the help of an academic adviser, the student names the faculty members of the doctoral committee, a special committee formed to guide the student through the doctoral program. The committee is responsible for assisting the student in formulating a course of study, satisfying specific departmental requirements, submitting a suitable dissertation proposal and for overseeing progress in research, and evaluating the completed dissertation. At least four faculty are appointed to the committee; one must be a member of an outside department. Committee membership must be approved by the university’s Graduate and Research Committee or its designee.

A doctoral student should apply for candidacy no later than two years after completion of the master’s degree or its equivalent and after passing qualifying examinations, if they are required by the major department. The prospective doctoral candidate must submit to the doctoral committee a written program proposal that includes a discussion of proposed dissertation research. Upon receiving committee approval of the proposal, the candidate submits the proposal, signed by the committee members, to the appropriate dean for action by the Graduate and Research Committee or its designee. The dean will advise the student of the committee’s decision.

If the dissertation research involves human subjects, all research procedures and instruments must be approved by Lehigh University’s Institutional Review Board (IRB) prior to the involvement of the subjects.

**GENERAL EXAMINATIONS**

Examinations composed and administered by the members of the student’s doctoral committee are designed to test the candidate’s proficiency in a particular field of study. These examinations, which may be either written or oral, should be passed at least seven months before the degree is to be conferred. If a student fails the general examination, a second examination may be scheduled no earlier than five months after the first. If the results of the second examination are unsatisfactory, no additional examination is scheduled.

**DISSERTATION AND DEFENSE**

The doctoral candidate is required to write a dissertation prepared under the direction of a Lehigh University professor. The dissertation must address a topic related to the candidate’s specialty in the major subject, show the results of original research, provide evidence of high scholarship, and make a significant contribution to knowledge in the field.

Upon approval of the advising professor and, if required by the department, secondary readers, the final draft of the dissertation is submitted to the appropriate dean (or designee) for inspection by the date posted in the academic calendar. Upon its return, the student should distribute copies of the draft to the members of the doctoral committee for review and for suggestions for revision. The candidate then schedules a dissertation defense before the doctoral committee, additional faculty members the department may add to the examining committee, and the general public. After the dissertation has been defended and revised accordingly, the student must submit the finished...
dissertation to the appropriate dean for review by the university's Graduate and Research Committee (or its designee) no later than the date specified in the academic calendar for completion of all degree requirements. All approved dissertations must be submitted by the appropriate deadlines in electronic form by following the procedures and guidelines found on the LTS Web site URL: http://libraryguides.lehigh.edu/etd. Please contact your college dean’s office for further clarification. Guidelines stipulating the standard form of the dissertation are available in the dean’s office.

**Graduate Studies Organizations**

**THE GRADUATE AND RESEARCH COMMITTEE**
The Graduate and Research Committee consists of twelve members representing the faculties of Lehigh’s colleges: four from the College of Arts and Sciences; two from the College of Business and Economics; four from the P.C. Rossin College of Engineering and Applied Science; and two from the College of Education; plus the college deans, the registrar, the vice provost for research, the director of the office of research, two non-voting graduate student members, and a member of the student senate. The committee formulates policies and regulations on graduate education and it recommends policies and procedures for research-related activities. The committee interprets and applies faculty rules governing graduate students and degrees, including questions concerning student petitions and appeals.

**GRADUATE STUDENT SENATE**
The Graduate Student Senate is comprised of graduate student representatives from each academic unit. The general assembly meets bi-monthly during the academic year. This body represents the graduate student community regarding graduate programs and graduate student life at Lehigh. Graduate students selected by the Graduate Student Senate are non-voting members of the Graduate and Research Committee and other university committees. The Senate provides a forum for discussion with university officials and committees, advocates for policy change, disseminates information, and plans social events in order to facilitate communication and community building among graduate students.

**Research Centers and Institutes**

Lehigh has developed a number of centers and institutes to provide greater research and academic opportunities for students and faculty. Centers and institutes are generally interdisciplinary and complement the scholarly activities of academic departments and represent scholarship and research based on the expertise and capabilities of a group of faculty members. Frequently, centers relate to the broad-based research needs of government, industry, and the social community.

**RESEARCH ORGANIZATIONS/ DIRECTORS AND STAFF**

Directors and staff members of the university’s research centers and institutes are listed. Complete degree information may be found in the faculty and staff alphabetical listings. In some cases, areas of research interest are given.

All addresses are Bethlehem, Pa. 18015, and the area code is (610).

**Advanced Materials and Nanotechnology (CAMN) (Center for)**

5 E. Packer Ave; 610-758-3850
Richard Vinci, Director (Mat Sci); Chris Kiely, Nanocharacterization Laboratory Director (Mat Sci/Chem Eng); Filbert Bartoli (ECE); Rick S. Blum (ECE); Alec Bodzin (Ed); Hugo Caram (Chem Eng); Helen Chan (Mat Sci); Xuanhong Cheng (Mat Sci); Lesley Chow; John Coulter (Mech Eng); Stephen Cutcliffe (STS); Hannah Dailey; Volkmar Dierolf (Phys); Yujie Ding (ECE); John DuPont (Mat Sci); Sharon Friedman (Journ and Comm); James Gilchrist (Chem Eng); Joachim Grenestedt (Mech Eng); Martin Harmer (Mat Sci); Mittalidas Hatalis (ECE); James Hwang (ECE); Heather Jaeger; Anand Jagota (Chem Eng); Himanshu Jain (Mat Sci); Sabrina Jedlicka (Mat Sci); Sushil Kumar (ECE); Kai Landskron (Chem); Charles Lyman (Mat Sci); Anthony McHugh (Chem Eng); Steven McIntosh (Chem Eng); Wojciech Misiolek (Mat Sci/Mech Eng); Herman Nied (Mech Eng); Daniel Ou-Yang (Phys); Raymond Pearson (Mat Sci); Jeffrey Rickman (Mat Sci); James Roberts (Chem); Donald Rockwell (Mech Eng); Slava Rotkin (Phys); Richard Sause (Civil & Env Eng); Mark Snyder (Chem Eng); Michael Stavola (Phys); Nicholas Strandwitz (Mat Sci); Svetlana Tatic-Lucic (ECE); Jean Toulouse (Phys); Natasha Vermaak (Mech Eng); Dmitri Vezenov (Chem); Masashi Watanabe (Mat Sci); Edmund Webb (Mech Eng); Zhuyuan Yan (ECE); Xiahui (Frank) Zhang (Mech Eng); Chou Zhou (ECE)

**Staff:** Katrina Kraft, Administrative Manager; Animesh Kundu, Research Scientist; Gene Lucadamo, Industrial Liaison Officer; Susan Stetler, Coordinator; Suxing Wu, Research Scientist

The Center for Advanced Materials and Nanotechnology (CAMN) was formed in 2003 to demonstrate Lehigh University's commitment to the emerging field of nanotechnology and to expand and apply established strengths in advanced materials research. The center evolved from the Materials Research Center, first established in 1964. CAMN's mission is to promote and engage in strategic areas of research and education in advanced materials and nanotechnology that meet the needs of students and industry. Current research areas include nanoparticle synthesis, catalysis, biomaterials and biotechnology, interfacial kinetic engineering, polymer, ceramic, and metal nanocomposites, micro-electromechanical systems (MEMS), metals and alloys, microfabricated devices for clinical diagnostics, bio-sensors, materials for energy and electronics, and materials modeling.

**INNOVATIVE INTERDISCIPLINARY RESEARCH PROGRAMS WITH STATE AND FEDERAL GOVERNMENT**
The CAMN engages in a variety of government supported research activities. These enable innovative student projects, laboratory equipment upgrades, interactions with technology businesses, and translation of university research commercial applications. Since 2011, CAMN also leads five universities in a five-year Multidisciplinary University Research Initiative (MURI) under the Office of Naval Research on engineering better materials through the understanding of interphase behavior at the atomic scale. CAMN also seeks and participates in research projects and initiatives funded by a number of other state and federal agencies, utilizing Lehigh faculty and industry partnerships to create effective teams and increase the impact and return on funding obtained.

**PROJECTS AND RELATIONSHIPS WITH INDUSTRY**
The CAMN Industrial Liaison Program (ILP) facilitates interactions with industry to support R&D needs and create opportunities for innovation. The ILP connects with a wide range of technology based companies, and manages industry collaborations with faculty and students. It also helps companies access lab facilities, conduct research and development, solve problems, obtain funding and other business support, and learn about new developments. These connections expose Lehigh students to industry challenges and practices, and can lead to internship and employment opportunities.

The Lehigh Emerging Technologies Network (formerly the Lehigh Nanotech Network or LNN) was organized in 2004. The LETN is an organization of business, education, and government members that facilitates the understanding, advancement, and commercialization of materials and nanotechnology for a broad range of applications. The LETN conducts events for members to learn about novel technology research and applications, funding opportunities, and educational initiatives. It provides a way for companies to connect to government technology initiatives and to members that are active in teaching, developing, applying, and commercializing technology. The LETN currently includes over 125 organizations including regional partners like the PA Department of Community and Economic Development, Ben Franklin Technology Partners of Northeast PA, the Lehigh Valley Economic Development Corporation, and the Manufacturers Resource Center.

**STATE-OF-THE-ART FACILITIES**

Laboratory facilities are available for use by students and faculty, and through the ILP to industry and government researchers. The CAMN Nanocharacterization Laboratory is a leading center for electron microscopy, with a diverse array of high level equipment. The laboratory houses one of the largest collections of electron microscopes of any university in the United States, and is managed and utilized by highly skilled scientists and engineers for cutting edge research. The
Advanced Technology For Large Structural Systems (ATLSS) Research Center

Established in May 1986 with a grant from the National Science Foundation (NSF), the Center now addresses the research goals of the NSF, the U.S. Department of Transportation, the Commonwealth of Pennsylvania, the U. S. Department of Defense, and numerous national, state, and local industry and government organizations and agencies. Approximately 80 people, including graduate and undergraduate students, research associates, faculty and staff members representing the disciplines important to large structural systems are active at the Center.

ATLSS research areas include: Advanced Structural Systems and Materials; Measurement, Simulation, and Evaluation of Structural Systems; Infrastructure Reliability, Maintenance, and Life-Cycle Performance; Intelligent Structural Systems; and Infrastructure Hazard Mitigation with particular emphasis on Earthquake-Resistant Structures. The research is conducted in close association with engineers and scientists from several Lehigh departments, industry, government, design and professional groups and other universities.

ATLSS has excellent research facilities and equipment, including two world-class structural testing facilities; the Fritz Engineering Laboratory and the ATLSS Multi-Directional Testing Laboratory, in which researchers study large-scale structural subassemblies under static, dynamic, and/or cyclic multidirectional loading with complete computer-controlled experimentation. A recent grant from the NSF created the real-time multi-directional (RTMD) experimental facility to evaluate the performance of engineering designs and materials during earthquakes, hurricanes and other storms, tsunamis, landslides, and other disasters as part of NSF’s Natural Hazards Engineering Research Infrastructure (NHERI) program. ATLSS also has outstanding resources for computing, mechanical testing, welding, metallography, and non-destructive evaluation.

RESEARCH ACTIVITIES
Advanced Structural Systems and Materials
Research is conducted on new structural forms and structural systems to promote efficiency through innovation and to promote the competitive use of high-performance steel, concrete, fiber-composites, and mixed systems for bridge, building, and ship-hull applications.

Measurement, Simulation, and Evaluation of Structural Systems
Techniques for measuring and simulating the behavior of structural systems under realistic loading conditions are being developed and implemented in the laboratory and in the field. Lab and field assessments are made on bridge, highway, railway and ship structures for evaluating their behavior under load, and evaluating the effects of corrosion, fatigue, and other damage.

Infrastructure Reliability, Maintenance, and Life-Cycle Performance
Research is conducted on optimal design, maintenance, monitoring and management of infrastructure systems, and on structural health monitoring, structural damage models and assessment, and predicting the remaining life of structures considering uncertainty.

Infrastructure Hazard Mitigation
Research is conducted on engineering processes and structural systems and materials technology to predict and reduce economic losses and injuries from hazard events, such as earthquake, blast, fire, and vehicular impact.

Intelligent Infrastructure Systems
Research is conducted on materials, components, and systems for sensing, processing and utilizing sensor information, and adaptively controlling the behavior of the large-scale structures of the infrastructure.

Educational Opportunities
The ATLSS Center facilitates broad programs of study and research in the fields of structures and materials. Graduate students in the Center’s programs receive master of science, master of engineering, or doctor of philosophy degrees, usually in structural engineering, materials science and engineering, or mechanical engineering. Financial support for graduate students is available through the ATLSS Center by means of fellowships and research assistantships related to sponsored research programs.

Undergraduates participate in the Center’s research through summer internships and academic-year special projects.

Advanced Technology For Large Structural Systems (ATLSS) Research Center

117 ATLSS Drive, Imbt Laboratories, Mountain Campus 610-758-3525; Fax 758-5902; www.atlss.lehigh.edu

Administration: Richard Sause, Ph.D., ATLSS Director, Manager Infrastructure Monitoring Program; James M. Ricles, Ph.D., ATLSS Deputy Director; Chad Kusko, Ph.D., Administrative Director; Ian Hodgson, P.E., Manager Industry Testing Program; Peter Y. Bryan, B.S., Manager Computer Systems; Doris Oravec, B.S., Financial Services; Leila Mazarul, Coordinator; Geraldine Kery, Research Coordinator; Richard Sause, Ph.D., Co-Director Pennsylvania Infrastructure Technology Alliance (PITA) and Research for Advanced Manufacturing in Pennsylvania (RAMP); James M. Ricles, Ph.D., Director Real-Time Multi-Directional Testing Facility (RTMD)

Faculty Associates: Helen M. Chan, Ph.D., Materials Science & Engineering; John N. DuPont, Ph.D., Materials Science & Engineering; Dan Franpogol, Ph.D., Structural Engineering; Joachim L. Grenestedt, Ph.D., Mechanical Engineering & Mechanics; Wojciech Z. Misiolok, Ph.D., Materials Science & Engineering; Clay J. Naito, Ph.D., Structural Engineering; Herman F. Nied, Ph.D., Mechanical Engineering & Mechanics; Sibel Pamukcu, Ph.D., Civil & Environmental Engineering; Raymond A. Pearson, Ph.D., Materials Science & Engineering; Stephen P. Pessiki, Ph.D., Structural Engineering; James M. Ricles, Ph.D., Structural Engineering; Richard Sause, Ph.D., Structural Engineering; John L. Wilson, Ph.D., Structural Engineering; Shamim Pakzad, Ph.D., Structural Engineering; Muhammad T. Suleiman, Ph.D., Geotechnical Engineering; Paolo Bocchini, Ph.D., Structural Engineering; Spencer Quiel, Ph.D., Structural Engineering

Faculty Emeritus Associates: John W. Fisher, Ph.D.,emeritus, Structural Engineering; Alan W. Pense, Ph.D.,emeritus, Materials Science & Engineering; Ben T. Yen, Ph.D.,emeritus, Structural Engineering


The ATLSS Engineering Research Center is a national center for research and education on structures and materials of the infrastructure.

INNOVATIVE EDUCATIONAL COURSES AND PROGRAMS
The CAMN facilitates programs of study and research that cross the departmental lines of science and engineering curricula to help provide a fundamental, broad background in materials science and nanotechnology. Graduate students participating in research supported by CAMN usually receive a Master of Science or PhD in the science or engineering discipline of their choice, or in an interdisciplinary program such as polymer science. A Graduate Certificate Program in Nanomaterials enables students to gain a working knowledge of a broad range of materials, instrumentation, and techniques. Credits earned towards this certificate may be accepted as part of a Masters or PhD in Materials Science and Engineering, or a Masters in Nanomaterials.


For more information, contact Professor Richard Vinci, Director, CAMN, Lehigh University, 5 E. Packer Avenue, Bethlehem, PA 18015-3194; rpv2@lehigh.edu (mph2@lehigh.edu); website www.lehigh.edu/nano.
The Baker Institute also supports the entrepreneurship-related activities. Institute operations include:
- The Institute champions, highlights and promotes entrepreneurship resources for that network, and serving as a visible central portal,
- A network of entrepreneurship-related programs on campus. By expanding help coordinate, deepen and improve synergies among the substantial curricular opportunities for students, faculty and the broader community.
- To expand the creative pipeline of innovation-related curricular and extra-curricular opportunities for diversity of thinking and innovative research. All of the
- The Baker Institute for Entrepreneurship, Creativity and Innovation actively fosters and champions the entrepreneurial culture at Lehigh to advance creativity and innovation for economic, cultural and social development. The Baker Institute is designed to create a culture of entrepreneurship across the university, promote innovative thinking and the realization of entrepreneurial ideas in any field. To that end, the principal goals of the Institute are to:
  - Nurture the creative entrepreneurial mindset and skills—in any discipline—among students, faculty, staff and the community to develop a culture committed and able to bring about transformative change;
  - Provide opportunities for Lehigh students of all disciplines and levels to graduate with the skills, experience and attitudes necessary to move creative ideas and new solutions for social problems successfully into sustainable practice;
  - Provide supporting infrastructure that enables and significantly increases the likelihood of practical scaling up of innovative ideas and technologies to implementation and launch of new organizations.
- Based squarely on a cross-university approach, the Baker Institute aims to expand the creative pipeline of innovation-related curricular and extra-curricular opportunities for students, faculty and the broader community. The Baker Institute serves as an umbrella organization to support and help coordinate, deepen and improve synergies among the substantial network of entrepreneurship-related programs on campus. By expanding resources for that network, and serving as a visible central portal, the Institute champions, highlights and promotes entrepreneurship opportunities on campus and throughout the community.
- The mission of the Chemical Process Modeling and Control Research Center at Lehigh University is to advance the theory and application of feedback control techniques, dynamic modeling, optimization and automation, and to apply these tools to a range of chemical and biological systems. A key execution strategy involves close collaboration with industrial partners to identify and solve technological relevant automation problems.
- The mission of the Chemical Process Modeling and Control Research Center at Lehigh University is to advance the theory and application of feedback control techniques, dynamic modeling, optimization and automation, and to apply these tools to a range of chemical and biological systems. A key execution strategy involves close collaboration with industrial partners to identify and solve technological relevant automation problems.
- The Center was established in January 1985 through the efforts of faculty members of the chemical engineering department at Lehigh University, leading industrial processing companies, the Ben Franklin Partnership Program of the Commonwealth of Pennsylvania, coupled with the organizational and financial support of the National Science Foundation (NSF).
- The center provides a unique atmosphere for fundamental research, development of specific techniques, application to real industrial processes, and opportunities for advanced education (M.S. and Ph.D.) in chemical process modeling and control for academics and industrial practitioners. Facilities are available for real time testing of new algorithms in experimental process units, development of dynamic simulations of real processes, and the close collaboration with researchers in several other fields of chemical processing.
- Interdisciplinary collaboration is encouraged with other research groups, centers, or institutes engaged in biotechnology, polymer processing, environmental science, applied statistics, signal processing, chemical reaction engineering, and process design.

**EDUCATION**
An integral part of the center is the commitment to conduct an outstanding program dedicated to the education of undergraduate and graduate students. The center has and continues to attract top quality students from a large group of well recognized international universities. In addition, each year several industrial companies send employees to receive advanced training and engage in research efforts for particular company technical requirements.

**FACULTY**
The center brings together several faculty members from different engineering disciplines in the university engaged in the research and educational efforts of the center. Visiting faculty from other well recognized universities supplement these researchers and provide opportunities for diversity of thinking and innovative research. All of the associated faculty members are recognized around the world as leaders in their respective fields of specialization. They also serve as consultants to a variety of industries.
theoretical developments to practical problems. The center has the use of several dedicated computer facilities with numerous workstation computers continuously available to the students, faculty, and staff. In addition to the local computing network, the center’s researchers have access to the Lehigh University central computing facilities and its outside links to other worldwide computing systems and data networks. The center has several laboratories with sophisticated equipment dedicated to process control research work.

**AREAS OF RESEARCH**

The research activities of the Center span a wide spectrum of problems in large complex chemical process design, dynamical analysis and control, as well micro and nanoscale complex process development, evaluation, dynamical analysis and control. A recently added area of research studies the role of feedback control in biological systems with particular emphasis on neuronal systems encountered in neuroscience and neurology. The research themes emphasize a combination of new theoretical developments, new applications and translation of new theoretical developments to practical problems.

1. **Synthesis and PlantWide Control**

   During the last decade Center faculty have done pioneering work in the area of plantwide control, which has resulted in the only textbook that covers this important area. There continue to be a number of projects in this area.

   a. **On Demand Control of Processes with Multiple Products:** This project studies the design and control of processes in which consecutive reversible reactions produce multiple products. The demand for these products can vary, so the process and its control system must be able to produce exactly the desired amount of each individual product. An ideal system has been studied first in which the effect of equilibrium constants and volatilities can be explored. A real chemical system is also being studied (the production of methyl amines).

   b. **Design and Control of Tubular Reactors Systems:** Adiabatic gasphase exothermic reactions are often carried out in tubular reactors. There are several types of systems: a single adiabatic reactor, multiple adiabatic reactors in series with either intermediate cooling or "cold shot" cooling (mixing some cold feed with the hot reactor effluent) and a cooled tubular reactor. These alternatives are being studied in terms of both steadystate design (which has the lowest total annual cost) and dynamic controllability (which provides the tightest temperature control in the face of disturbances).

2. **Dynamics and Control of Distillation**

   Reactive distillation is an emerging area in chemical engineering because it offers potential savings in capital and energy costs in some systems, particularly for reversible reactions. A recent project explored several reactive distillation systems: ETBE, methyl acetate, TAME, ethylene glycol and metathesis of pentene. The steadystate economic designs of these systems were studied. Then their dynamical and control were explored. Different types of chemical systems require types of control structures. These columns are sometimes operated using an excess of one of the reactants and sometimes using exact stoichiometric amounts of the two fresh reactant feeds. Both the process design and the control scheme are different with these two scenarios.

3. **Convex Optimization Techniques in Linear and Nonlinear Process Control**

   The last few years have seen the emergence of a new class of optimization problems that have been variously referred to as Linear Matrix Inequalities (LMIs), semidefinite programming (SDP) problems and convex problems. We were one of the first groups to explicitly show the applicability of LMIs in process control by reformulating the modelbased predictive control (MPC) algorithms as LMI problems. There are several classes of problems involving control of systems subject to constraints that are amenable to LMI formulation. These include efficient offline MPC for fast sampling time processes, observerbased nonlinear, MPC, multimodel transition control using MPC, antiwindup, moving horizon estimation and evaluation of robustness, i.e., the impact of model uncertainty on controller performance. These new control algorithms are being tested on numerous application platforms.

4. **Multi-Model and Hybrid Systems Analysis and Control**

   Hybrid and multimodel systems are a class of systems in which there is interaction between continuous dynamical behavior of systems with discrete switching behavior. For example, systems described by piecewise linear multiple models are continuous and linear within a prescribed region and switch to a different linear model description in a different prescribed region of the statespace. Other examples include switches and overrides that switch one of a family of controllers into the closedloop, based on the operating space and control objective.

   Our research in this area has focused on two broad problems: (1) control of systems described by multiple piecewise linear models; (2) formulation of saturated systems as switched/piecewise linear models and subsequent antwindup controller design using piecewise quadratic functions. We demonstrated, through a case study, the control of a highly nonlinear solution copolymerization reactor using multimodel switching MPC. We have also shown how an appropriate antwindup controller synthesis problem can be formulated using piecewise quadratic Lyapunov functions.

5. **Dynamics and Control of Micro and Nanochemical Systems**

   Microchemical systems are a new generation of miniature chemical systems that carry out chemical reactions and separations in precisely fabricated three dimensional microreactor configurations in the size range of a few microns to a few hundred microns. Typical microchemical systems combine fluid handling and reaction capabilities with electronic sensing and actuation, are fabricated using integrated circuit (IC) manufacturing techniques and use silicon and related IC industry materials, polymers, ceramics, glass or quartz as their material of construction. The goal of this integrated research and education program is to study the unique dynamical properties of such integrated microchemical systems and to develop a framework for designing implementable feedback control techniques for this class of microsystems. Concepts for distributed and boundary control theory will be employed to study the modelbased feedback control formulation of microchemical systems and to develop a technical framework for microsystem controller design. The Integrated Microchemical Systems Laboratory (under the direction of Professor M.V. Kothare) conducts this research as part of the Center.

6. **Control of Biomedical Systems**

   We are currently working on applying control techniques to emerging problems in biomedical engineering, in particular, in neuroengineering. This involves developing models of ensembles of neurons in the human brain and use of such models in optimizing closed loop neuroprosthetic rehabilitation strategies.

For more information, contact Mayuresh V. Kothare (coDirector) or William L. Luyben (coDirector), Center for Chemical Process Modeling and Control, Iacocca Hall, Lehigh University, 111 Research Drive, Bethlehem, PA 18015-5791, (610) 758-6654, fax (610) 758-5297, email: mayuresh.kothare@lehigh.edu, wll0@lehigh.edu.

**Developing Urban Educational Leaders (CDUEL) (The Center for)**

111 Research Drive; 610-758-6093
www.lehigh.edu/education/cduel/

George White, Ed.D., Director; Floyd Beachum, Ph.D., Bennett Professor of Urban School Leadership; Jon Drescher, Professor of Practice; Craig Hochbein, Ph.D., Assistant Professor Educational Leadership; Andrea Goff, Projects Director

The mission of CDUEL is to cultivate transformational educational leadership in urban communities by conducting research, developing leadership competencies, and improving leadership practices that enhances student learning and development. The center is committed to developing leaders who support education at all levels of a community, including teachers, principals, parents and human service workers. Special emphasis is placed on work involving small to midsized urban communities.
Research support for institute activities is obtained from industrial organizations through their membership in the Emulsion Polymers Industrial Liaison Program as well as government agencies. Hence some considerable effort is made to relate the research results to industrial needs. Consequently, graduates can find excellent opportunities for employment.

EDUCATIONAL OPPORTUNITIES
Graduate students in the Institute undertake dissertation research leading to the master of science or doctor of philosophy degree in existing science and engineering curricula or in the Center for Polymer Science and Engineering. Programs of study are tailored to meet the individual needs of each student and considerable flexibility is permitted in the selection of courses and a research topic. Educational and research opportunities exist for postdoctoral scholars and visiting scientists as well as resident graduate students. In addition, the institute holds a short course each June, “Advances in Emulsion Polymerization and Latex Technology” that typically attracts a number of industrial participants as well as EPI students and is an excellent opportunity to interact with industrial scientists and engineers.

For more information, write to H. Daniel Ou-Yang, Emulsion Polymers Institute, Iacocca Hall, Lehigh University, 111 Research Drive, Bethlehem, PA 18015. Please visit our web site at http://www.lehigh.edu/~inemuls/epi/ for further details.

Energy Research Center

117 ATLLSS Drive; 610-758-4090

The mission of the Energy Research Center is to find solutions to national and global energy and energy-related problems by collaborating with federal, state and local agencies, energy businesses, technology developers and suppliers, the research community and academic institutions. The Energy Research Center accomplishes this mission through its continued commitment to innovative research and development, while recognizing the important link between energy and the environment. The Center brings together faculty and professional staff within Lehigh University to conduct research, foster partnerships between government and industry, provide funding, research and educational opportunities to university graduate and undergraduate students, and promote international research collaboration. Originally founded in 1972 as the Task Force for Energy Research, the Center was organized into its present form in 1978.

ENERGY RESEARCH
Research within the Center falls into five major categories. Projects of interest include:

Energy Conversion/Power Generation
This research program area has several components. The largest focuses on the equipment and processes used in large fossil-fired electric power plants, with research on methods of improving power plant conversion efficiency, of reducing emissions of carbon dioxide and of other gaseous pollutants, and of reducing the cost of generating electricity. A second group of projects deals with fusion energy, with an emphasis on the physics of magnetic plasma containment in fusion reactors. Other projects deal with topics such as fuel cell conversion systems; hydrogen production, capture of carbon dioxide, and reduction of fresh water requirements for power plant cooling.

Energy-Related Environmental Research
The Center’s environmental research program deals with air pollution, solid waste, and ground water contamination issues resulting from power generation and energy conversion activities; and reduction of amounts of fresh water required for power plant cooling.

Originality: 111 Research Drive originated in 1975, the Emulsion Polymers Institute (EPI), provides a focus for graduate education and research in polymer colloids. Formation of the institute constituted formal recognition of an activity that had grown steadily since the late 1960s. Recently, the research thrust of the Institute has been broadened to include engineered particles. The new focus is rooted in fundamental scientific-based particle design, but guided by identified applications, while still maintaining a core competency in emulsion polymerization. The rapidly broadening applications for particle technologies in fields such as biotechnology (e.g., drug delivery, imaging, assembly of biocompatible scaffolds), nanotechnology (e.g., directed assembly of hierarchically ordered, functional structures), and others demand a concomitant diversification of the institute to include a broader class of particles: polymeric, inorganic, hybrid, macroionic, metallic, as well as novel particulate composites designed at the nanoscale that will span all industrially-relevant scales.

The institute has close ties with polymer and surface scientists in the Center for Polymer Science and Engineering (CPSE), Center for Advanced Materials and Nanotechnology (CAMN), and the departments of chemical engineering, chemistry, physics, and materials science and engineering. These ties reflect the interdisciplinary nature of research that is carried out in the Institute.

RESEARCH ACTIVITIES
Fundamental particle research in the institute spans particle synthesis, particle functionalization, and directed assembly of particles into higher order, functional structures. Continuing emulsion polymers research is a blend of theoretical and experimental problems related to the preparation, characterization, and applications of polymer latexes and are aimed at understanding the kinetics, mechanisms, morphology, and the colloidal, surface and bulk of the latexes. Applications of this fundamental technology, resulting from interdisciplinary research among the faculty associated with the institute, stand to align well with the strategic university and college-level nanotechnology, biotechnology, and energy/environment initiatives. Many projects within EPI achieve what has been the largest obstacle to commercialization of nanotechnology: scalable process design of nanoscale functioning materials. Materials fabricated by EPI researchers are designed to function either as nano- or microscale sensors, material modifiers, or to self-assemble into advanced materials that depend on the nanoscale features of its constituents. In addition, engineered particle technologies developed at EPI and other institutions have allowed for the validation of soft condensed matter theories at scales available to experimentalists. In the biotechnology area, research focuses on diagnostic and therapeutic technology to prepare particles that are biocompatible, biologically specific, easily detectable, and responsive to external controls. In the area of energy, work focuses on a variety of different unique particle technologies that may be used in applications such as catalysis and photocatalysts for the hydrogen economy, photovoltaics and solar cells, and membrane separations. In the environmental area, in addition to seeking novel particle technology for contaminant remediation in water, tailor-made colloidal particles with desirable surface properties, should provide model systems for fundamental insight into surface phenomena, relationships between bacterial adhesion to a surface and cellular bioenergetics, and bacterial transport through unsaturated porous media. Similarly, model porous media constructed by engineered particles could benefit research on the sources, fate and transport of bacteria in the environment, new water treatment technologies for developing countries, and alternative water disinfection technologies.
Energy-Related Materials Research
This focus area considers materials issues in the energy field. Examples include high temperature coatings for boiler tubes, welding processes for new alloys, containment vessels for nuclear waste materials, component life prediction, and development of catalysts for pollution control. Energy Conservation and Renewable Energy. The Center’s research program in energy conservation deals with reducing energy use in manufacturing and with the development of high efficiency electric motors. Renewable energy research focuses on utilization of biomass materials as fuels.

Basic Energy Sciences
Faculty and students in engineering and science also carry out research to improve our understanding of the basic phenomena that underlie the knowledge base required for developing new and improved energy technologies.

Educational Opportunities
The Center’s research programs provide opportunities for graduate students interested in working in the energy area. Most of the departments in the College of Engineering and Applied Science, as well as several departments within the College of Arts and Sciences, are active in energy research and offer both masters and doctoral degree programs suitable for studies of energy-related topics.

All degrees are granted by the academic departments and graduate students interested in energy enroll in traditional graduate degree programs in departments of their choice. These students specialize in energy by complementing their programs with a selection of energy-related courses. They pursue their graduate research in energy areas under the supervision of faculty from the Energy Research Center or from other research centers or academic departments.

Financial support for graduate students is available through fellowships and research assistantships.

OUTREACH AND INDUSTRIAL LIAISON ACTIVITIES
The Center’s Energy Liaison Program is a mechanism for providing consulting and problem-solving to member companies. The Liaison Program also provides opportunities for involving industry in sponsored research projects.

ADDITIONAL INFORMATION
For more information, write to Dr. Carlos E. Romo, Director, Energy Research Center, Lehigh University, 117 ATLLSS Drive, Bethlehem, PA 18015, or e-mail at cer@lehigh.edu (ek0@lehigh.edu). Please visit our website at www.lehigh.edu/energy

Enterprise Systems Center (ESC)
The Enterprise Systems Center (ESC) was established in 1995. This multidisciplinary center is committed to providing student experiential learning and leadership development through industry value creation. ESC maintains a wide network of regional industry partner relationships to serve as a platform for course projects, summer and co-op projects and leadership immersion activities. Partnership and teaming on projects and programs is important and occurs frequently with the Department of Industrial and Systems Engineering as well as other departments and centers. The center seeks to advance interdisciplinary research and scholarship relating to analytics, information technology, new process development, sustainable manufacturing and enabling businesses to maintain global competitiveness. Additional research initiatives focus on discovering new methods for collaboration among academic, industry and government partners through the use of advanced technology. Emphasis is given to innovative systems approaches to problem-solving. Operating as one of the centers in the P.C. Rossin College of Engineering and Applied Science, the ESC is housed in Mohler Laboratory. The Enterprise Systems Center provides undergraduate and graduate students from all four colleges with the opportunity to work on teams with faculty and industry professionals to solve a variety of real world problems. Participation in these work teams, with ESC’s unique layered mentoring, provides students with a level of work experience representative of what they will encounter following graduation. This is often a critical factor in winning highly competitive employment positions. Since its inception, ESC has completed more than 1000 projects with industry and government partners. Over 3000 undergraduate and graduate student have benefited from experiential learning and leadership development through involvement with the Enterprise systems Center.

RESEARCH ACTIVITIES
The ESC conducts research into the development and implementation of enterprise strategies to improve the effectiveness of organizations. This research involves the utilization of systems thinking, information technology, and leadership approaches that add value to engineering education. In its applied research efforts, the Center focuses on analytics techniques, operational improvements, enterprise resource optimization, sustainable manufacturing and product development or enhancement. Operational improvement research with partner companies has included the development of decision support systems, predictive analytics or workflow analysis. ESC is also engaged in sustainability initiatives, including life prediction, and development of catalysts for pollution control. Energy management research covers the identification of constraints and throughput improvement, evaluating sustainable manufacturing opportunities, agile business practices, utilization of analytics tools and creating new solutions for supply chain management. Work in enterprise resource optimization has included methodologies for business process reengineering and for the analysis and selection of Enterprise Resource Planning (ERP) systems. Applied research in product development and enhancement has included the use of computer modeling and simulation along with analysis and evaluation of existing products, and design for manufacturability and assembly support.

Involvement in these applied research activities with industry partners provides Lehigh students with hands on learning experiences built on progressive responsibility and contribution to high impact company projects. From these activities, students gain leadership skills and valuable industry experience.

The creation of technology-enabled educational resources augments traditional learning models. Coupled with knowledge management technology, these resources create integrated learning experiences and materials to support engineering courses. The ultimate objective is to identify key components of innovative behavior and develop the educational methods necessary to transfer to students the skills and experiences that will prepare them for leadership roles in society.

The Enterprise Systems Center houses laboratories and initiatives that enhance the overall center mission stated as follows: “The ESC is committed to helping students learn, while simultaneously providing value for our clients. We believe that our research should be driven by industry needs and enabled by close partnerships and collaboration.”

The newly established ESC Advanced Analytics Laboratory provides increased workspace and resources for industry projects and research programs. The laboratory supports a program structure designed to increase awareness, understanding and implementation skill development of a broad spectrum of analytics tools and techniques.

Within the ESC is the Learning Collaboratory, an innovative educational environment designed to promote inquiry-based and competency-driven experiential learning. It enriches the classroom lectures with practical experience through industry partner interactions. The Collaboratory supports team learning, action learning, and the application of technology to augment traditional educational resources.

EDUCATIONAL OPPORTUNITIES
The ESC provides support for courses in the analysis and design of manufacturing systems, decision support systems (DSS), computer graphics (CAD), computer integrated manufacturing (CIM), industrial engineering techniques, analytics, experimental projects in industrial engineering, and leadership development. These courses are offered through the Industrial and Systems Engineering department. The ISE senior project class utilizes ESC facilities and a video teleconferencing system to step beyond the traditional classroom experience in the preparation and presentation of its culminating presentation.

The ESC is continuously developing new programs as part of its Leadership Initiative. ESC has founded and is home to the engineering leadership minor, the leadership development course (IE382) was recently named as one of the top curriculum innovations by the Institute of Industrial Engineers. The Lehigh Chapter of the National Society of Leadership and Success and the Innovation and Leadership Residency Club are also managed as part of the Enterprise Systems Center operation.
Participation in industry partner projects is open to all Lehigh students, both undergraduate and graduate, regardless of academic major, based on an interview process.

For more information, contact Dr. Emory W. Zimmers, Jr., Director, Enterprise Systems Center, Lehigh University, Mohler Lab, Second Floor, 200 West Packer Avenue, Bethlehem, PA 18015 (ewz0@lehigh.edu) or visit our website http://www.lehigh.edu/~inesc/

Global Islamic Studies, Center for

Program Director: Robert Rozehnal, Ph. D. (Duke)
Email: ror2@lehigh.edu # Phone: 610-758-5695
Website: http://cgis.cas2.lehigh.edu/
Supported by the Office of Interdisciplinary Programs, 610-758-3996; incasip@lehigh.edu
Williams Hall, 31 Williams Drive

Core Faculty
Saladin Ambar, Ph.D. (Department of Political Science); Taieb Berrada, Ph.D. (Department of Modern Languages and Literatures); Nandini Deo, Ph.D. (Department of Political Science); Susan Kart, Ph.D. (Department of Art, Architecture and Design); Khurram Hussain, Ph.D. (Department of Religion Studies); Michael Raposa, Ph.D. (Department of Religion Studies); Robert Rozehnal, Ph.D. (Department of Religion Studies); Bruce Whitehouse, Ph.D. (Department of Sociology and Anthropology)

The Center for Global Islamic Studies (CGIS) is an intellectual community committed to the interdisciplinary study of Islamic civilization. The Center was established at Lehigh in 2009 with the generous support of the Andrew W. Mellon Foundation. Cutting across numerous academic disciplines and departments, CGIS supports the academic exploration of the diverse cultures and rich historical legacy of the Muslim world—from its roots in Abrahamic prophecy and Greek philosophy, to its long interaction with the West and profound impact on global culture, trade, art and architecture, literature, politics, philosophy, science and religious life, from Morocco to Malaysia to Bethlehem, Pennsylvania.

CGIS promotes teaching and research designed to take Islamic Studies into and beyond the classroom by offering students, faculty and the broader community a variety of forums for dialogue, debate and experiential learning. The Center’s intellectual core is distinguished by three distinct signatures:

- an integrated undergraduate academic program that provides Lehigh students with multiple outlets to encounter the diversity and dynamism of global Islam
- a comparative, interdisciplinary approach to Islamic studies that goes beyond narrow geographic areas and political issues to explore the broader landscape of Islamic civilization, both past and present
- the translation of theory into practice, linking rigorous scholarship on the Muslim world to direct, practical, hands-on learning beyond the boundaries of the Lehigh campus

RESEARCH ACTIVITIES
With seed funding from the Mellon Foundation and ongoing support from the Provost’s Office, CGIS promotes faculty and student research projects in interdisciplinary, comparative Islamic Studies.

EDUCATIONAL OPPORTUNITIES
The launch of the Center for Global Islamic Studies is a pivotal component in the continued expansion of the undergraduate educational experience at Lehigh University. Drawing on the university’s experience in building interdisciplinary programs, its institutional commitment to international education, and its substantive relationships with numerous Muslim partners both in the Lehigh Valley and internationally, the Center for Global Islamic Studies plays a central role in the university’s mission to provide Lehigh’s students with transformative learning experiences that cross academic disciplines and broaden horizons on today’s globalized world.

Humanities Center

Committee: Suzanne M. Edwards, English and Director Humanities Center; Jodi Eichler-Levine, Religion; Seth Moglen, English; Mary Foltz, English; Khurram Hussain, Religion; Monica Miller, Religion and Africana Studies; John Pettigrew, History; Nicholas Sawicki, Art, Architecture and Design; Amardeep Singh, English

The humanities consider how we understand and record human experiences. Encompassing a wide range of disciplines including philosophy, history, literature, religion, visual arts, music, and language, humanistic study teaches us how to think creatively and critically about our own identities and our connections to others—whether they live across the street or across the world, whether they lived long ago or will live in the futures we imagine. The Humanities Center at Lehigh University is thus vital for building community both on and beyond our campus. The Humanities Center creates interdisciplinary intellectual opportunities for students, faculty, and staff engaged in humanistic inquiry across departments and programs. Through speaker series, reading groups, conferences, an undergraduate research journal, research grants, and informal gatherings, the Humanities Center fosters a broad community rooted in vibrant, rigorous, and creative inquiry into what it means and has meant to be human. The Humanities Center hosts an annual speaker series on a theme, bringing scholars, writers, artists, and activists to speak on a single issue. Recent themes have included Home, Movement, Contagion, Speaking Bodies, and the Posthumanities.

RESEARCH ACTIVITIES
The Humanities Center fosters interdisciplinary research activity in several ways. Faculty, graduate students, and undergraduates may apply for funding to support reading groups, colloquia, conferences and visiting speakers. Graduate students may apply for modest financial support to enable them to travel to present research at academic conferences. The center sponsors a works-in-progress series, which fosters dialogue about ongoing research projects in the humanities. Summer, Individual and Collaborative Research Grants are available for faculty and graduate students. The objective of these grants is twofold:

1. to strengthen the intellectual community of Lehigh’s scholars in the Humanities and
2. to provide support for faculty to pursue a humanistic research project or creative activity and for graduate students to finish their dissertations.

EDUCATIONAL OPPORTUNITIES
The Humanities Center hosts and sponsors the production of the Lehigh Review, an undergraduate research journal founded in 1992 by the Lehigh humanities faculty. Original articles range in topic and subject across the spectrum of undergraduate study, from English to Economics and Physics. Published annually, the entire publication process—from reviewing submissions to editing to design and illustration—is handled almost exclusively by undergraduate students and supervised by a graduate student instructor. The Humanities Center also hosts a wide range of informal activities to create a lively, unstructured humanistic community.

For more information visit the Humanities Center website http://humanities.cas2.lehigh.edu/ or contact the Director, Suzanne Edwards at the Humanities Center, 224 West Packer Avenue, Bethlehem, PA 18015 or by email at sme6@lehigh.edu.

Institute for Interactivist Studies

Interactivism is a philosophical and theoretical approach to modeling multiple biological, mental, and social phenomena. It is attracting interest from scholars and researchers around the world. For a general description, see: http://www.lehigh.edu/~mhbo/InteractivismManifesto.pdf

The primary functions of the Institute for Interactivist Studies are:

1. to build on the growing interest in the model,
2. to promote interactivist research,
3. to give Lehigh greater visibility within this wider community of people involved in the interactivist research program.
INTERNATIONAL MATERIALS INSTITUTE FOR NEW FUNCTIONALITY IN GLASS

7 Asa Drive. 758-4217. www.lehigh.edu/imi

Himanshu Jain, Eng.Sc.D., Director

Lehigh's International Materials Institute for New Functionality in Glass (IMI-NFG) was founded in 2004 on a program by the same name and sponsored by the National Science Foundation under an initiative to advance materials research globally by enhancing coordinated international collaboration between U.S. researchers and educators and their counterparts worldwide. The Institute's long term goal is the creation of a worldwide network in glass research for new applications, and the development of a new generation of scientists and engineers with enhanced international leadership capabilities. Specifically on campus, it promotes new activities in glass research through international and national collaborations, and the development of new approaches to the education of glass. Faculty and students from various Departments of Rossin College of Engineering and Applied Science, and College of Arts and Sciences participate in its activities listed below.

Half of the 20 most significant inventions of the 20th century, as identified by the National Academy of Engineering, would not have materialized without glass. The solutions to 12 of the 14 grand engineering challenges of this century depend on the availability of glass either as a support material or as an active component for sensing, information storage, treatment delivery, etc. The discovery of new phenomena, along with continually improving properties and processing methods, will keep glass at the cutting-edge of technology. Unfortunately, in recent decades glass education has fragmented with the result that a larger number of students is exposed to glassy materials, but with relatively shallow, cursory knowledge that does not prepare them to become a professional glass scientist or engineer.

The Institute normally awards one fellowship annually to a Ph.D. candidate enrolled at Lehigh University for dissertation research and writing in the 18th century. The Lawrence Henry Gipson Institute for Eighteenth-Century Studies is established in 1971, to honor one of America's most distinguished scholars, who served as a long-time member of the faculty at Lehigh. Gipson's monumental life work, The British Empire Before the American Revolution (15 volumes) was written between 1936 and 1970. Gipson received the Pulitzer Prize in History in 1962 for Volume 10, subtitled, The Great War For Empire. When he died in 1971, Professor Gipson left his entire estate to Lehigh and provided the original endowment for the institute.

RESEARCH ACTIVITIES

The income from the endowment of the institute is used to encourage faculty and student research in the eighteenth century by providing grants to defray travel costs, copying, and other expenses to permit scholars to visit necessary libraries and depositories. The Gipson Institute normally awards one fellowship annually to a Ph.D. candidate enrolled at Lehigh University for dissertation research and writing in any field of eighteenth-century studies. The institute also helps provide additional resources to build the university library's research collections in eighteenth-century studies.

EDUCATIONAL OPPORTUNITIES

The institute invites leading scholars to give lectures and supports relevant programs such as interdisciplinary seminars and visiting scholars interested in the eighteenth century. Occasional symposia have been published and the institute maintains a continuing close relationship with Lehigh University Press for publishing original manuscripts on the eighteenth century.

For more information, write to either of the co-directors, Michelle LeMaster, Department of History, Maginnes Hall, 9 W. Packer Ave., or Scott Paul Gordon, Department of English, Drown Hall, Lehigh University, 35 Sayre Drive, Bethlehem, PA 18015.
Martindale Center for the Study of Private Enterprise

Main Office: Rauch Business Center, Suite 350 / 621 Taylor Street / 610.758.4771

Current Faculty: Todd A. Watkins, Ph.D., Executive Director, and Director of the Microfinance Program; Robert J. Thornton, Ph.D., Associate Director, and Editor of Martindale Publications; Judith McDonald, Ph.D., Associate Director, and Director of the Canadian Studies Institute; Jesus M. Salas, Ph.D., Director of the Family Business Institute.

Faculty Emeriti: J. Richard Aronson, Ph.D., founding Director.

Affiliated Faculty: Martindale Student Associates Honors Program Mentors: Stephen H. Cutiliffe, Ph.D.; Catherine M. Ridings, Ph.D.; Richard N. Weisman, Ph.D.

Staff: Janice Johnston Howie, Martindale Program Director; Stephanie A. Olexa, Ph.D., Program Manager, Family Business Institute; Melissa Gallagher, Administrative Coordinator.

The Martindale Center for the Study of Private Enterprise was established in the College of Business and Economics in 1980 with a gift from Elizabeth Fairchild Martindale and Harry Turner Martindale ’27. The Center develops a range of programs and activities to promote understanding of the structure and performance of the US economic system and its relationship with the world economy.

The Martindale Student Associates Honors Program is an international undergraduate research program launched at the same time as the establishment of the Center. Each year, a cohort of students competitively selected from across all disciplines engages in research on the economy of a foreign nation. Their resulting academic papers are published in volumes of the Center’s undergraduate research journal, Perspectives on Business and Economics.

Martindale’s Microfinance Program, launched in 2005, comprises a broad range of activities including faculty research, undergraduate and graduate student research, academic-industry initiatives, workshops and conferences, opportunities for field immersion in the US and abroad, and a community lending practicum and internships for students.

Martindale’s Canadian Studies Institute was established in 1984. Its role is to promote understanding of Canadian economic and political issues by supporting topics of mutual interest to US and Canadian faculty, and by bringing Canadian speakers to campus.

Established in 2016, the Family Business Institute is the Martindale Center’s most recent initiative. The Institute seeks to provide high-quality educational experiences, backed by world-class research, to assist families in managing, growing, and developing their businesses, and researchers exploring challenges unique to family business. The Institute pursues its mission through research programs, executive education initiatives, workshops, and activities that engage Lehigh students with family businesses, including internships and support for courses.

The Martindale Center produces a range of scholarly publications and provides sponsorship and support for faculty research, lectures, conferences, and visiting scholar and executive-in-residence programs.

Contact Us: Martindale Center for the Study of Private Enterprise Rauch Business Center, Lehigh University College of Business and Economics 621 Taylor Street, Bethlehem, PA 18015 ***** Executive Director: Todd A. Watkins 610-758-4954 / tw4@lehigh.edu ***** Martindale Program Director: Janice Johnston Howie 610-758-4492 / jaj205@lehigh.edu ***** Canadian Studies Institute Director: Judith A. MacDonald 610.758.5345 / djm0@lehigh.edu ***** Family Business Institute Director: Jesus Salas 610-758-4488 /.jms408@lehigh.edu ***** Family Business Institute Program Manager: Stephanie Olexa 610-758-4488 / sau289@lehigh.edu ***** Administrative Coordinator: Melissa Gallagher 610-758-4771 / mmg314@lehigh.edu ***** Website: https://cbe.lehigh.edu/martindale

Murray H. Goodman Center for Real Estate Studies

Rauch Business Center, 621 Taylor Street; 610-758-4786
Stephen F. Thode, DBA, Director

The Murray H. Goodman Center for Real Estate Studies was established in 1988 through a major gift from Murray H. Goodman, ’48. The center is a self-supporting, interdisciplinary unit of the College of Business and Economics. The center provides financial support and other assistance for courses in real estate and real estate finance, supports scholarly research in real estate, and sponsors joint activities with practitioners in the real estate field.

EDUCATIONAL OPPORTUNITIES
The center provides resources for the teaching of graduate and undergraduate courses in real estate, real estate finance, and ire@l (Integrated Real Estate at Lehigh). ire@l is a three- to four-year course of study open to all undergraduate students at Lehigh.

The ire@l curriculum consists of:

Core Courses
- IPRE 001 Introductory Seminar in Real Estate 3
- IPRE 002 Field Laboratory 2
- IPRE 301 Case Studies in Real Estate Value Creation 3
- IPRE 347 Practicum in Real Estate I 2
- IPRE 348 Practicum in Real Estate II 2
- IPRE 302 IPRE Internship (mandatory summer internship) 1

Optional Courses
- IPRE 101 Real Estate Practicum Clerkship I 1
- IPRE 102 Real Estate Practicum Clerkship II 1

Additional Courses
- FIN 336 Real Estate Finance 3
- GBUS 425 Real Estate Financing and Investing 3

In addition, the center sponsors a continuing series of seminars and presentations by real estate executives and practitioners through the ire@l program. As part of the ire@l program, the center also serves as a clearinghouse for students seeking internships, externships and job shadow opportunities with real estate firms and related companies.

RESEARCH ACTIVITIES
Consistent with the university’s encouragement of scholarly research, the center provides funding for faculty research in the real estate area. Funding possibilities include: summer faculty research grants; travel, telephone and administrative support; and grants for part-time graduate assistants. The center also maintains a file of sponsored research opportunities available through private foundations, government agencies and practitioner organizations and provides administrative support to faculty applying for such funding.

PRACTITIONER INTERACTION
The third aspect of the center’s activities is its interaction with practitioners in the real estate field. The increased emphasis on continuing education and research among real estate practitioner organizations, as well as Lehigh’s proximity to major real estate markets, enable the center to engage the practitioner community in a variety of joint projects. These joint projects include:
1. sponsored research projects;
2. continuing education programs and short courses;
3. special conferences and events of national and/or regional interest; and,
4. center-sponsored databases and continuing activities of interest to the practitioner community.

For more information, write to Dr. Stephen F. Thode, Director, Murray H. Goodman Center for Real Estate Studies, Rauch Business Center, Lehigh University, 621 Taylor Street, Bethlehem, PA 18015, or call (610) 758-4786 or email irealgc@lehigh.edu (stf0@lehigh.edu).
Philip and Muriel Berman Center for Jewish Studies

Director: Hartley Lachter, Ph.D. (New York University) (https://religion.cas2.lehigh.edu/content/hartley-lachter)
Email: inber@lehigh.edu # Phone: 610-758-3996
Website: http://cjs.cas2.lehigh.edu/
Supported by the Office of Interdisciplinary Programs, 610-758-3996; incasip@lehigh.edu
Williams Hall, 31 Williams Drive

Core Faculty
Jodi Eichler-Levine, Ph.D.(Department of Religion Studies); Hartley Lachter, Ph.D. (Department of Religion Studies); Nitzan Lebovic, Ph.D. (Department of History); Roslyn Weiss, Ph.D. (Department of Philosophy); Ben Wright, Ph.D. (Department of Religion Studies)

The Philip and Muriel Berman Center for Jewish Studies, established in 1984, develops, administers, and coordinates a comprehensive program in Jewish studies at Lehigh University. The center is directed by Hartley Lachter, Philip and Muriel Berman Chair of Jewish Studies.

Several faculty members, including two Philip and Muriel Berman professors, teach Jewish studies classes at Lehigh. In 2007, the Helene and Allen Apter Chair of Holocaust Studies and Ethical Values was created with the generous support of Helene and Allen Apter '61 and Lehigh's College of Arts & Sciences.

Other activities of the center include designing and implementing new courses and seminars, an annual lecture series, scholarly colloquia held overseas, and academic conferences. The Berman Center also co-sponsors events with other departments and programs at Lehigh and at institutions across the Lehigh Valley. The Center also provides funding to students to help them pursue study abroad experiences or other enhancements to their academic work in the field of Jewish Studies.

Center for Photonics and Nanoelectronics

Center for Photonics and Nanoelectronics (CPN)
Web: www.lehigh.edu/cpn
Locations: Sinclair Laboratory (7 Asa Drive, Bethlehem, PA 18015) and Sherman Fairchild Laboratory (16A Memorial Drive East, Bethlehem, PA 18015)

Center Director:
Nelson Tansu (ECE), CPN Director & Daniel E. ’39 and Patricia M. Smith Endowed Chair Professor
Office: Sinclair Laboratory Room 205; Phone: (610) 758-2678; Email: Tansu@Lehigh.Edu

Core Faculty:
Nelson Tansu (ECE), CPN Director & Daniel E. ’39 and Patricia M. Smith Endowed Chair Professor; Michael J. Stavola (Phys), Sherman Fairchild Chair Professor; Filbert J. Bartoli (ECE), Chandler Weaver Chair Professor; Volkmann Dieroff (Phys), AGT Distinguished Professor; Himanshu Jain (Mat Sci), Diamond Distinguished Chair Professor; Ivan Biaggio (Phys), Full Professor; Yujie Ding (ECE), Full Professor; Miltiadis Hatalis (ECE), Full Professor; James C. M. Hwang (ECE), Full Professor; H. Daniel Ou-Yang (Phys), Full Professor; Slava V. Rotkin (Phys), Full Professor; Svetlana Tatlic-Lucic (ECE), Full Professor; Jean Toulouse (Phys), Full Professor; Xuanhong Cheng (Mat Sci), Associate Professor; Jonathan J. Wierer (ECE), Associate Professor; Yevgeny Berdichevsky (ECE), Assistant Professor; Mark Chen (Chem), Assistant Professor; Heather M. Jaeger (Chem), Assistant Professor; Sushil Kumar (ECE), Associate Professor; Chao Zhou (ECE), Assistant Professor; Siddha Pimpuktar (MSE), Assistant Professor; Zakya H. Kafafi (ECE), Adjunct Professor

Affiliated Faculty:
Helen M. Chan (Mat Sci); James F. Gilchrist (Chem Eng); Brandon A. Krick (Mech Eng); Kai Landskron (Chem); Yaling Liu (Mech Eng); Wojtek Misiolek (Mat Sci); Sudhakar Neti (Mech Eng); Daniel Ou-Yang (Phys); Mark A. Snyder (Chem Eng); Nicholas Strandwitz (Mat Sci);

Dimitrios Vavylonis (Phys); Dmitri Vezenov (Chem); Richard P. Vinci (Mat Sci)

Scientific / Technical Facility Manager:
Dr. Renbo Song

Overview
The Center for Photonics and Nanoelectronics (CPN) at Lehigh is a center formed from the merger of two long standing centers (Center for Optical Technologies / COT, and Sherman Fairchild Center for Solid State Studies / SFC). Both SFC and COT has long history of innovation and scientific advances tracking back to the late 1970s and early 2000s, respectively. The merged center CPN inherits the faculty (diverse expertise and core technical backgrounds), students, facilities, resources, reputation, history, and legacy (faculty alumni and student alumni connections) of both Center for Optical Technologies (COT) and Sherman Fairchild Center (SFC). The success of the former Center leaderships in establishing both COT and SFC as the leading programs in photonics and solid state electronics, respectively, has provided a solid foundation for the CPN leadership to advance further in advancing and integrating the science and technologies of photonics and nanoelectronics. The CPN is entrusted with a substantial resource, which is used for initiating and integrating new initiatives, as well as enabling faculty operational and graduate students fellowship. Additional information is available: www.lehigh.edu/cpn

PhD Research and Graduate Program
The CPN's central mission is to produce first-rate and highly-competitive PhD graduates in the fields of photonics, optoelectronics, and nanoelectronics, and applications of these core technologies [energy, medical, communications, and environments]. The CPN has produced more than 70 PhDs in engineering and applied sciences during the past decade, and 8 of our (graduate student / faculty) alumni had been elected as members of the Academies. Significant research activities exist within the Center for Photonics and Nanoelectronics at Lehigh (www.lehigh.edu/cpn), and the current strengths span from III-Nitride and compound semiconductor technologies, organic based electronics and photonics, bio-related materials and devices, nonlinear optics, plasmonic and metamaterials, and flexible photonics technologies.

Integrated Nanofabrication and Cleanroom Facility
The CPN operates the integrated nanofabrication and cleanroom facility at Lehigh. The Integrated Shared Facility provides tremendous access for MOCVD epitaxy, cleanroom fabrication, nanofabrication, packaging capabilities, and device characterizations / measurements for photonics / optoelectronics / nanoelectronics devices. The Integrated Facility is run by a set of highly accomplished technical staff, and the access to this facility is available for faculty at Lehigh, faculty from other universities, and industrial users. The details of such facility is available at: http://www.lehigh.edu/~incpn/research/facilities/index.html

Collaboration – Universities, National Laboratories, and Industry
The CPN faculty actively seeks to collaborate on groundbreaking research work with external faculty members, partners in national laboratories, and partners in industry. The broad topics of pursued within CPN in photonics, optoelectronics, and nanoelectronics areas provide opportunities to develop complementary research from basic sciences, materials, devices, integrated systems, and applications. The attractive industrial membership program in supporting research at Lehigh is also available.
The Center for Polymer Science and Engineering (CPSE) was formally established at Lehigh University in July 1988. The center provides a unique opportunity for faculty and students from the traditional departments of chemistry, chemical engineering, materials science and engineering, mechanical engineering and mechanics, and physics to perform interdisciplinary research in polymer science and engineering. The center aims to prepare first-rate scientists and engineers with proficiency in polymers, fostering cross-disciplinary polymer research, organizing and teaching continuing education short courses in areas of interest to the polymer industry, and organizing campus wide seminars.

Research Activities
The center has a wide range of research activities covering the field of polymers. The following are the major research themes: emulsion polymerization and latex characterization, surface/interfacial aspects of polymer colloids, polymer adhesion, polymer blends, polymer matrix composites, melt processing of polymers, and polymers for microelectronic packaging.

Research Facilities
The following research instrumentation is available for the Center for Polymer Science and Engineering: X-Ray Photoelectric Spectroscopy (ESCA), Scanning Auger Electron Spectroscopy, Laser Raman Spectroscopy, Mossbauer Spectroscopy, Nuclear Magnetic Resonance Spectroscopy of both solids and solutions (NMR) (3 instruments; 90 MHz, 300 MHz and 500 MHz), Fourier Transform Infrared Spectroscopy (FTIR) (both conventional and photo-acoustic), a variety of advanced transmission and scanning electron microscopes, modulated differential scanning calorimetry, hi-res-thermogravimetric analysis, instruments for rheological studies (including a TA Instruments Dynamic Hybrid Rheometer), particle sizing instruments (Coultier N4M, Joyce-Loebi Disc Centrifuge, Capillary Hydrodynamic Fractionation, and Hydrodynamic Chromatography), Gel Permeation and Gas Chromatography units, Electrophoretic Mobility apparatus, mechanical testing machines, and Polymerization Reactors, including Bottle Polymerizer, Tubular Reactor, Stirred Tank Reactors with on-line sample analysis for residual monomer.

Educational Opportunities
Programs of study for individual students are designed to meet the student’s interests, the requirements of the academic department, and the student’s dissertation committee. Considerable flexibility is permitted in the selection of courses and a research topic. Lehigh University has been awarding interdisciplinary M.S. and Ph.D. degrees in Polymer Science and Engineering since 1975 and online masters degrees since 2002. Graduate students conducting polymer research may also earn the M.S. and Ph.D. degrees in the classical fields of chemistry, chemical engineering, materials science and engineering, physics, or mechanical engineering and mechanics. For further information please refer to the Polymer Science and Engineering Program in the section: Interdisciplinary Graduate Programs.

For more information about the center activities, admission to graduate school, or financial aid, contact: Dr. Raymond A. Pearson, Director, Center for Polymer Science and Engineering, 5 East Packer Avenue, Bethlehem, PA 18015; (610) 758-3857. Dr. James E. Roberts, Chairman, Polymer Education Committee, Lehigh University, 6 East Packer Avenue, Bethlehem, PA 18015; (610) 758-4841 or Lisa Areciga, Coordinator, Lehigh University, 5 East Packer Avenue, Bethlehem, PA 18015; (610) 758-4222. Please address applications to one of the participating departments. Please visit the web site: www.lehigh.edu/~ipolict/index.html or e-mail rp02@lehigh.edu, jer1@lehigh.edu, lia4@lehigh.edu

Promoting Research to Practice - Schools, Families, Communities (Center for)
L111 Iacocca Hall, 111 Research Drive 610-758-3221
Linda Bambara, Ph.D.; George J. DuPaul, Ph.D.; Lee Kern, Ph.D.; 
Patricia Manz, Ph.D.; Ageliki Nicolopoulou, Ph.D.; Brook Sawyer, Ph.D.; 
George White, Ph.D.

The Center for Promoting Research to Practice seeks to develop practical solutions to real problems for those individuals at risk or who have disabilities. All too often research that is created for these individuals remains at the development level and is not disseminated into best practices. Using an interdisciplinary approach and establishing a living laboratory through partnerships with schools, parent and families, and community service and support providers, the Center aspires to distinguish itself as a leader at state, regional, and national levels in addressing the need for the production of research to reach the users and consumers of research. The mission of the Center for Promoting Research to Practice (CPRP) is to generate new knowledge that will favorably impact the lives of individuals with or at risk for disabilities and promote the use of evidence based best practices by schools, families, and community service providers. The Center emphasizes the conducting of applied research, partnership, and dissemination.

APPLIED RESEARCH OPPORTUNITIES
The CPRP focuses on securing research projects that emphasize bringing research findings from the field and moving them into effective practice with evaluation of outcomes. The projects secured by the CPRP faculty focus on individuals who have identified areas of disability or are considered at risk for developing disabilities. Currently, the Center has research projects examining the most effective intervention strategies for improving behavioral and academic outcomes for students with behavior disorders. One project focuses on understanding effective, scientifically based interventions in educating students who present severe challenges to the schools. Included in the Center is a research project that aims to develop and integrate Little Talks, an intervention to bolster language and literacy among low-income infants and toddlers, in home-based early intervention. Additionally, two projects focus on supporting the language and literacy development of preschool children with language impairment, a population of children who are at risk for developing reading disorders in school-age years. A few completed projects include the implementation and evaluation of progress monitoring within a Response to Intervention model of school-wide change in six high need elementary schools in two diverse school districts, evaluation of the Philadelphia home-school visitor model for infants and toddlers, and a project focused on the evaluation of the Early Reading First initiative to improve early literacy in Head Start preschool children.

PARTNERSHIP
The Center forms and maintains partnerships at national, regional, and local levels. Several objectives are established to accomplish this goal. The CPRP assists with the development and implementation of research projects designed in local school districts and intermediate units, as well as early childhood education and intervention providers.
Many school districts, particularly small and rural districts, do not have the capacity to engage in widescale research efforts. Yet, these districts often have very significant needs for empirically based decision making. The CPRP provides a cost effective vehicle for these districts to engage in such research efforts. Another level of partnership for the CPRP is interdisciplinary research within the University community. This objective is met through facilitating cross- college and cross-program proposals. Continuous efforts are made to invite colleagues from across departments and colleges in the University to join with faculty in the College of Education in pursuing research interests that are within the mission of the Center. Efforts also continue to conduct research with colleagues across institutions. Projects have included partner institutions such as Children’s Hospital of Philadelphia, Ohio University, the Ohio State University, Oregon Research Institution, Temple University, Teachers College, University of Missouri, University of Nebraska-Lincoln, University of Pittsburgh, American Institutes for Research, Utah State University, and Inspired Learning, LC, in Allentown.

DISSEMINATION

The CPRP is a resource for distilling and bringing research findings to the field. Investigators conducting research have published the outcomes of findings in professional journals and outlets. In addition, the CPRP initiates dissemination to parents, teachers, and other practitioners in a format that more easily affects practice.

The Center’s mission, goals, current accomplishments, as well as its future initiatives are disseminated to groups on- and off-campus. Included in its objectives are the development of publicity about the Center itself and outcomes of Center projects through varied forms of communication across campus as well as institutions of higher education, local/state educational agencies, community agencies, and parent groups.

For more information, contact Dr. Gary Sasso, Dean, College of Education, Lehigh University, Iacocca Hall, 111 Research Drive, Bethlehem, PA 18015; 610-758-3221 or email gms208@lehigh.edu; Web site: http://coe.lehigh.edu/cprp.

Value Chain Research (Center for)

Rauch Business Center, 621 Taylor St.

CENTER MISSION

The Center for Value Chain Research (CVCR) is committed to supporting and sharing research and information through the integration of emerging theory and best practices. The center’s research focuses primarily on, but is not limited to, value chain planning and development activities, which connects corporate strategy with value chain execution.

WHAT THE CENTER DOES

• Provides a unique, multidisciplinary approach to research, offering exciting new opportunities for innovation by integrating analytical and quantitative engineering approaches with process-driven and field-based business research.

• Conducts professional development seminars and symposiums, APICS certification courses, and executive round tables.

• Disseminates research findings through professional conferences, scholarly publications, and curriculum development.

AFFILIATED FACULTY

Robert Trent, Ph.D., Director; Liuba Belkin, Ph.D.; William Forster, Ph.D.; Doug Mahony, Ph.D.; Corinne Post, Ph.D.; Catherine Ridings, Ph.D.; Nada Sanders, Ph.D.; Michael D. Santoro, Ph.D.; Susan Sherer, Ph.D.; Oliver Yao, Ph.D.; Zach Zacharia, Ph.D.

For more information, contact Prof. Robert Trent, Director, (rjt2@lehigh.edu), Center for Value Chain Research, Lehigh University, Rauch Business Center, 621 Taylor Street, Bethlehem, PA 18015; (610-758-5157). Web site: http://cvcr.lehigh.edu

Other-University Related Centers

BEN FRANKLIN TECHNOLOGY PARTNERS OF NORTHEASTERN PENNSYLVANIA

The Ben Franklin Technology Partners of Northeastern Pennsylvania (BFTP/NEP) is headquartered in Ben Franklin TechVentures® on the Mountaintop campus and is a wholly-owned subsidiary of Lehigh. Serving a 21-county region, the Center is part of a four-member, state-funded economic development program that is an initiative of the PA Department of Community and Economic Development and is funded by The Ben Franklin Technology Development Authority. Ben Franklin frequently utilizes the faculty, students, and resources of Lehigh to accomplish its tasks.

BFTP/NEP fosters innovation to stimulate economic growth. By providing knowledge and investment resources, Ben Franklin facilitates the creation of new products, sophisticated technologies, and novel processes among entrepreneurs and established companies to help them prosper. The result: the creation and retention of highly paid, sustainable regional jobs and a strong economic climate.

The goals of BFTP/NEP include helping early-stage technology-oriented firms to form and grow, helping established manufacturers to improve productivity through the application of new technologies and practices, and promoting an innovative community-wide infrastructure that fosters a favorable business environment for high-growth companies. Founded in 1983, the Ben Franklin Technology Partners of Northeastern Pennsylvania has:

• Created and retained 40,747 jobs.
• Established 482 new companies.
• Commercialized and developed 1,433 new products and processes.

The Ben Franklin program is structured to help companies achieve sustainable competitive advantage. Statewide, new tax revenue generated because of Ben Franklin represents a 3.6-to-1 payback to the Commonwealth.

Assistance includes expertise, largely contributed in the northeast by the center’s association with Lehigh and other leading research universities, and funding, with investments ranging from $30,000 to $150,000 per year for up to three years. Faculty and students involved with Ben Franklin gain experience in solving real issues for working companies. Technical and business assistance services are provided on a year-round basis.

BFTP/NEP owns and operates Ben Franklin TechVentures, an award-winning business incubator and post-incubator facility. Sixty-four successful companies have graduated from the BFTP/NEP incubator, grossing more than $1.2 billion in annual revenue last year and creating more than 6,400 jobs. Ben Franklin TechVentures is LEED Gold certified.

For more information, contact the Ben Franklin Technology Partners of Northeastern Pennsylvania, Lehigh University, Ben Franklin TechVentures, 116 Research Drive, Bethlehem, PA 18015-4731; 610-758-5200; www.nep.benfranklin.org (http://www.nep.benfranklin.org). E-mail: info@nep.benfranklin.org.

MANUFACTURERS RESOURCE CENTER (MRC)

Founded in 1988 as a wholly owned subsidiary of Lehigh University, MRC is one of seven statewide Industrial Resource Centers (IRCs) established to help small and mid-size manufacturers grow and remain competitive. In 1994, MRC joined the National Institute of Standards and Technology (NIST) Manufacturing Extension Partnership (MEP) which is comprised of 59 nationwide centers. MRC works with manufacturing companies by leveraging its own staff of experienced Business Development Managers with public and private sector resources. Through our assistance and work with manufacturers, we help raise the economic level of the region by creating high impact, cost-competitive manufacturers.

Due to space restrictions MRC moved off the Goodman Campus to the Hanover Plaza in Allentown, a central location for Lehigh Valley manufacturers. MRC serves all of Lehigh, Northampton, Berks, Carbon and Schuylkill counties and offers services in six broad areas:

• Technology Acceleration Services that include Technology Scouting and Technology Driven Market Intelligence (TDMI), Innovation Engineering, and Product Development.

• Strategic Business Growth Services and top line initiatives that include strategic planning, market opportunity research, focused lead generation, website and brand strategies, marketing/sales coaching, export services and supplier development.
• Operational Excellence services that include Lean, Six Sigma, Quality and Hoshin Deployment programs. We incorporated sustainability and coaching components into our Lean training and now apply a Green lens for greater profitability and cost savings;
• Business Performance Services to help mentor companies in financial analysis and strategies, capital sourcing and management, mergers and acquisitions, establishing visual business intelligence systems, technology and innovation strategies, “Green” and Sustainability transformations, tax credit opportunities, and other related services;
• Leadership Development & Training that includes the Manufacturing Leadership Institute (MLI), Individual Culture Assessments, CoreValue® Business Assessments, Customized Leadership Coaching, Human Resource Development and the Image of Manufacturing. Through one-on-one coaching, strategic “doing” management and milestone development, we can help you grow your effectiveness as a leader.
• A strategic mix of Training and Certification programs that are beneficial to any manufacturing organization. We connect manufacturers with experienced, proven resources that specialize in Lean manufacturing training, tools, coaching and certification. We also offer our own 13-part “Lean Master Certification” program, a “train and do” curriculum that includes everything you need to prepare for and pass the SME Bronze Exam. The course curriculum includes ex-Toyota keynote instructors and other national presenters, as well. The hands-on elements of the program are also adding to the excitement from the classes. Participants get to actually use the tools when they are taught — reinforcing the proper protocol and use in real time. MRC also offers SixSigma Training and Certifications, as well as coaching, mentoring and SPC-based assessments. We also offer Quality Certifications that connect manufacturers in need of quality management process solutions with best-in-breed resources. Whether its ISO, AS, API, HACCP or another quality-related certification, we have the experts and connections to help you gain certification.

For further information or assistance, please contact MRC at 961 Marcon Boulevard, Suite 200, Allentown, PA 18109. Jack E. Pfunder is President & CEO and can be reached at (610) 628-4575 or email him at jack.pfunder@mrcpa.org. Please visit our website at www.mrcpa.org (http://www.mrcpa.org).

MANUFACTURING SYSTEMS ENGINEERING (CENTER FOR)
200 W. Packer Avenue; (610) 758-5157
Keith M. Gardiner, Ph.D., director; John P. Coulter, Ph.D.; Steven L. Goldman, Ph.D.; Parveen P. Gupta, Ph.D.; David J. Hinrichs; Jacob Y. Kazakia, Ph.D.; John B. Ochs, Ph.D.; Lawrence V. Snyder, Ph.D.; Robert J. Trent, Ph.D.; George R. Wilson, Ph.D.

The Center for Manufacturing Systems Engineering was created in response to the expressed needs of industry for educational and research services which were distinctively cross-disciplinary. A primary responsibility of the center is the administration of a Master of Science degree in Manufacturing Systems Engineering. This world-renowned program started in January of 1984 as a result of a major initiative grant from the IBM Corporation. It now has 413 alumni who are working as managers and technical leaders in industry around the world. The center has four major thrusts:

1. A graduate program which offers a curriculum leading to the Master of Science degree in MSE.
2. Research directed at solving problems of manufacturing; this also serves to maintain faculty currency and provides a vehicle for student project and thesis studies.
3. Technology transfer to sustain the free flow of knowledge from the research laboratories to industrial applications, and from leading edge member industries back into the classrooms.
4. The provision of service by supporting conferences, clinics, workshops and other means for communicating and disseminating the advantages of sound manufacturing systems engineering practice.

Graduate Education
The 30-credit master's degree MSE program is cross-disciplinary, administered through the College of Engineering and Applied Science, with additional courses provided by the College of Business and Economics. Four core courses, 4-5 graduate level elective courses (at least one elective must be an MSE-numbered course), and a 3 or 6 credit research project or thesis are requirements of all candidates for the M.S. degree. Courses are offered on campus and scheduled so that part-time students can complete the degree in two years. It is possible for distance students to earn the MS in MSE degree remotely. Special activities in the program are team-intensive and include in-depth studies of companies, tours of industry, industry-related research and internships. Additionally, an MSE option is available in the MBA&E program.

Research Activities
Students in the MSE program undertake research of interest either to their employers, or to industry in general. Research activities range from additive manufacturing, microelectronics packaging, the use of lead free solders, welding specifications, pharmaceutical industry processes and equipment development qualification, design management, and process development for surgical products. There are investigations into activity-based costing, design management, application of financial information systems, and injection molding. There is collaboration with other centers, departments and laboratories in the preparation and planning of research proposals and programs which aim to improve the understanding of manufacturing.

For more information, contact: Keith M. Gardiner, kg03@lehigh.edu, Director, Center for Manufacturing Systems Engineering, H. S. Mohler Laboratory, Lehigh University, 200 W. Packer Avenue, Bethlehem, PA 18015, or call (610) 758-5157 or visit our website at https://mse.lehigh.edu

PHILIP RAUCH CENTER FOR BUSINESS COMMUNICATIONS (THE)
621 Taylor Street; 758-4863
Joseph M. Manzo, MBA, director
The Rauch Center for Business Communications supports the business curriculum for both undergraduate and graduate programs. Courses/programs administered through the center include BUS 005 and the Excel Competency program. BUS 005 is a one credit required course in the undergraduate program which addresses the foundations of business integrity. The Excel Competency program addresses the analysis and presentation of data in the context of business. This program is a prerequisite for 3 core courses in the undergraduate curriculum.

The center also partners with the faculty to develop methods for improving students’ writing and presentation skills. Programs are developed with the faculty and are integrated into the syllabus for the faculty member’s course where writing and/or presentations are required.

For more information, write to Anne Nierer, Coordinator, The Philip Rauch Center for Business Communications, Lehigh University, 621 Taylor Street, Bethlehem, PA 18015-3117, or email jmm6@lehigh.edu or phone 610-758-4863.

SMALL BUSINESS DEVELOPMENT CENTER
Sandra F. Holsonback, Ph.D., director; Robert Mineo B.S., MBA, program director, Financing Assistance Program; David Dunn, B.S., program director, Government Marketing Assistance Program; Cora Landis, program director, Lexnet; Christine Cleaver, B.S., program director, South Bethlehem Assistance Program; Brett Smith, BA, MBA, Consultant; Mary Beth Zingone, Consultant; (www.lehigh.edu/sbdc)

Established in 1978, the SBDC provides general management assistance to over 1,000 entrepreneurs and small businesses per year in the Lehigh Valley and surrounding areas. Primary funding for this program comes from major grants from the U.S. Small Business Administration and the Commonwealth of Pennsylvania.

Specialized Programs
The Management Assistance Program delivers general management consulting to existing small firms and startup ventures. Services are offered to retail, service, wholesale, construction and manufacturing
firms. Research is offered through electronic data base research. Seminars are offered on many topics of interest to start-up and growing firms.

**International Trade Development Program (ITDP)**
The International Trade Development Program (ITDP) is a specialized outreach effort of the Small Business Development Center. The ITDP helps companies with exportable products to develop export marketing plans and establish direct contacts with international markets. Seminars, trade missions and research projects support the efforts of this program.

**Government Marketing Assistance Program**
The Government Marketing Assistance Program assists potential suppliers to government sales in identifying and developing procedures. Clients are handled on a one to one basis. Trade fairs and seminars are also offered.

**Financing Assistance Program**
The Financing Assistance Program provides assistance in loan packaging and financial planning and helps clients identify appropriate financing sources. The program administers the Lehigh Valley Small Business Loan Pool and the Lehigh Valley Chapter of the Northeastern Pennsylvania Angel Network, a partnership program with the Ben Franklin Technology Partners of Northeastern PA. Contracts with the Lehigh/Northampton Revolving Loan Fund, the Lehigh Valley Economic Development Corporation and other funding agencies provide resources for this assistance.

**Lehigh Valley Export Network (LEXNET)**
The Lehigh Valley Export Network (LEXNET) is the regional office of the Team Pennsylvania Export Network. Throughout the year LEXNET brings PA foreign office representatives to the Lehigh Valley to meet with SBDC clients and discuss in country export assistance needs. LEXNET also assists with export finance programs such as Market Access Grants allowing small and midsized manufacturing or service companies to participate in international trade events. Specialized training events and seminars are also held throughout the year.

**South Bethlehem Assistance Program (SBAP)**
The South Bethlehem Assistance Program (SBAP) is a specialized outreach effort of the SBDC that provides technical assistance to businesses located in the South Bethlehem Area.

**Business Education and Training Program (BETP)**
The Business Education and Training Program of the Small Business Development Center provides specialized workshops, seminars and customized training for the small business community.

**Small Business Consulting (formerly LUMAC)**
The Lehigh University Small Business Consulting Program (a graded three-credit course) was established in 1972 on the initiative of undergraduate students. Through support from the SBDC, approximately 150 students per year gain practical experience by providing counseling to sixty businesses.

For more information, write to Sandra Holsonback, Director, Small Business Development Center, 416 E 5th Street, Bethlehem, PA 18015
Courses, Programs and Curricula

For more information about specific academic programs and opportunities, see the following pages.

College of Arts and Sciences (p. 53)
College of Business and Economics (p. 58)
College of Education (p. 60)
P.C. Rossin College of Engineering and Applied Science (p. 61)
Interdisciplinary Undergraduate Study (p. 64)
Interdisciplinary Graduate Study and Research (p. 64)

College of Arts and Sciences

Donald E. Hall, dean; Diane T. Hyland, senior associate dean; Cameron Wesson, associate dean; Jackie Krassas, associate dean; Dominic Packer, associate dean.

The College of Arts and Sciences is the heart of Lehigh University offering a wide variety of academic majors, minors and programs, while also providing essential liberal arts access to all Lehigh students. Arts and Science faculty are engaged as active scholars, are highly accessible, and are committed to the teaching mission of our undergraduate programs. A hallmark of our college is the faculty’s ability to engage students interactively and experientially in research and scholarship.

Students in the College develop new habits of mind that characterize the liberal arts education, such as testing assumptions, respecting evidence, and probing the unknown with curiosity and an open mind. Those habits prepare our graduates to thrive in an uncertain world. Through a combination of college-wide distribution requirements and major field requirements, Lehigh Arts and Sciences students investigate and acquire knowledge of human cultures and the physical and natural world by studying arts and humanities, mathematics, natural sciences, and social sciences.

Studying broadly in the areas above and concentrating deeply in a major field will help develop intellectual traits and skills needed to create the lifelong learning habits necessary to confront constantly changing social conditions, emerging technologies, careers and lives.

The College of Arts and Sciences offers several curricular options:

- A four-year arts and sciences curriculum leading to a bachelor of arts or bachelor of science degree in designated fields
- A five-year arts-engineering curriculum leading to a bachelor’s degree from the College of Arts and Sciences and a bachelor of science degree from the College of Engineering and Applied Science
- Dual degree programs within the college and in conjunction with the other two undergraduate colleges.

TEACHER PREPARATION

- A five-year program leading to a bachelor’s degree from the College of Arts and Sciences and a master’s degree in Education from the College of Education

MAJOR DEGREE PROGRAMS IN THE COLLEGE

Bachelor of Arts and Bachelor of Science Degree Programs

Two distinct bachelor-degree programs are offered by the College, each distinguished mainly by the proportion of courses taken in the major field. For the Bachelor of Arts degree the student takes a comparatively smaller number of courses to fulfill the major requirements plus a selection of courses in various fields outside the major. For the more professionally oriented Bachelor of Science degree, offered by the College in designated disciplines, the student takes a more extensive concentration in the major field, along with a proportionally smaller number of courses outside the major. Except for this distinction, the same basic requirements must be met for both degree programs (including the minimum number of 120 hours for graduation and the minimum average in the major of 2.0). No more than six hours of military science may be applied toward either degree.

Bachelor of Arts Degree

ARTS & Humanities

Architectural history, architecture, art, art history, Asian studies, classical civilization, classics, design arts, English, modern languages and literature (French, German, and Spanish), music, music composition, philosophy, religion studies, theatre

Social Sciences

African Studies, anthropology, cognitive science, economics, environmental studies, global studies, history, international relations, IR/MLL joint major, journalism, journalism/science writing, political science, psychology, STS (science, technology and society), sociology/social psychology, sociology and anthropology, urban studies, women, gender and sexuality studies

Mathematics and Natural Science

Astronomy, behavioral neuroscience, biology, chemistry, computer science, earth and environmental science, mathematics, molecular biology, physics

BA degrees in predental science, premedical science, or preoptometry science are available to students who are admitted to certain combined degree programs (see Health Professions Programs).

Bachelor of Science Degree

Astrophysics, behavioral neuroscience, biochemistry, biology, chemistry, computer science, earth and environmental science, mathematics, molecular biology, pharmaceutical chemistry, physics, psychology, statistics

GENERAL PLAN OF UNDERGRADUATE STUDY

Students in the College are required to choose - usually by the end of the sophomore year - a major field and to complete a program of courses, selected in consultation with the student’s advisor, to provide the breadth that is the mark of a liberal education. For most students, the credits earned for the major and those earned for the distribution requirements are not enough to meet the graduation requirement of 120, and students take free elective courses in areas of interest to earn the remaining credits. Three schemes of courses - one in the student’s area of concentration (the major-field requirements), a second set drawn from certain designated disciplines (the distribution requirements representing the minimum set), and a third set without constraints (the free electives) - make up the educational program in the College.

Major Field of Concentration

By majoring in a specific discipline a student establishes a foundation of knowledge in that field and starts to apply its traditional body of knowledge. By submitting to increasingly challenging and complex exercises in a distinct discipline over several semesters and under the guidance of mature practitioners, the student can start to feel the rewards of intellectual mastery of a subject. The student thus develops expertise and intellectual sophistication.

Along with introductory courses in the discipline, the minimum number of credits for the major is 30. The student must maintain a minimum grade-point average of 2.0 in the major field.

Standard major sequences

When a student chooses one of the standard majors, a faculty member from the department or program offering the major becomes a student’s major advisor and assists the student in constructing a program of study. In all cases, the final responsibility for meeting both major and non-major requirements rests with the student.

Special interdisciplinary majors

In addition to the standard major programs, specially structured interdisciplinary major sequences between majors are possible. For example, a student interested in a professional school of urban or regional planning might wish to structure a special major consisting primarily of courses in political science and economics or in economics and social relations.

Any student may, with the aid of faculty members chosen from the disciplines involved, devise an interdisciplinary major program to include no less than thirty credits of related course work, of which at least 15
credits must consist of advanced courses. The major advisors and the dean of the college must approve the program.

**Multiple majors and Dual degrees**
A student who wishes to fulfill the requirements for more than one major program has two options. A double major is a single BA degree with two majors (some students complete triple majors). A student pursues a double major by declaring both majors. Typically, double majors can be completed in four years, but sequencing of courses and time conflicts with required courses can introduce delays. No more than three courses may overlap two majors.

A dual degree program is a combined BA and BS program or two Bachelor of Science degrees in one or more of our undergraduate colleges. The BA is in the College of Arts and Sciences, and the BS may be in any one of the three undergraduate colleges. A student pursues a dual degree by declaring the first program and then petitioning the Standing of Students Committee for permission to pursue the second degree program. A semester-by-semester plan and a major declaration for the second degree must accompany the petition to pursue a dual degree. The dual-degree student must satisfy major and distribution requirements for both degrees and earn a minimum of 30 additional credits beyond those required for the first degree. All of the 30 additional credits must be taken at Lehigh or in Lehigh residency programs. The requirement of 30 additional credits typically makes the dual degree program a five-year program. There is no limit on the number of overlapping courses between two degrees, but there must be at least 30 credits of non-overlapping coursework in each degree program. For administrative purposes, students who take two degrees or two majors must designate one as the primary major or primary degree.

**Distribution Requirements**
Whatever expertise in a single discipline an undergraduate may achieve, curiosity lures most of us beyond the confines of a single chosen specialty. Furthermore, in a swiftly changing world, careers are being rapidly redefined and only a person of broad intellectual mindset can consider where their talents may be most useful to society. Many of the basic modes of thought and work in various fields are being reformulated, often producing surprising influences in the public and private spheres. To develop a satisfying professional life and be a responsible citizen of our increasingly global world, one needs exposure to the concepts and methods of a variety of disciplines.

The distribution requirements draw upon four primary domains of learning. The faculty believe exposure to these broad areas will help students develop a basic understanding of the various forms of knowledge generated in these fields. Specific credit hours are required in each of the following four domains: arts and humanities, mathematics, natural sciences, and social sciences.

**Distribution Requirements for the B.A. and the B.S.**

- **First-Year Seminar**
  - One course during the first year
  - 3-4

- **English Composition**
  - Two courses during the first year
  - 6

- **Mathematics**
  - Chosen from mathematics or designated courses from philosophy or computer science
  - 3

- **Natural Sciences**
  - Chosen from those designated in: astronomy, biological anthropology, biosciences, chemistry, earth and environmental sciences, physics, and neuroscience
  - At least one science course must also include the associated laboratory
  - 8

- **Social Sciences**
  - Chosen from those designated in: anthropology, classics, economics, political science, history, international relations, journalism, psychology, social psychology, social relations, sociology, SJS, and urban studies
  - 8

- **Arts and Humanities**
  - Chosen from those designated in: architecture, art, classics, history, modern languages and literature, English, music, philosophy, religion studies, and theatre
  - 8

**Total Credits**

1. Students and advisors should monitor closely the progress toward completion of requirements. Courses taken to satisfy a major program may be used to satisfy distribution requirements in only one distribution area.

Total required for graduation: 120 credits

**ECKARDT SCHOLARS PROGRAM**
The Eckardt Scholars Program is a highly selective and unique honors program in the College of Arts and Sciences. The program prioritizes intellectual curiosity, independent work, and close mentoring relationships between students and faculty. Each incoming class includes approximately twenty Eckardt Scholars. These students receive unique academic privileges that provide them with great opportunities at Lehigh and beyond. Students in the program are exempt from the Arts & Sciences distribution requirements and work with their major advisor and the Eckardt Scholars Program Director to create a flexible course of study that best suits their academic interests and ambitions. Although exempt from distribution requirements, students will complete the requisite number of credits for their degrees and all correlate requirements for their majors. The program includes participation in two Eckardt Scholar Seminars and completion of a large independent project (e.g., a thesis, artistic creation, or other capstone experience) during the senior year.

Participation in the Eckardt Scholars Program is restricted to only the most well-qualified students. Some students may be invited to enroll at the time of admission to the university while others are identified by faculty and encouraged to apply during their first few semesters. Those admitted to the program are selected on the basis of their academic records, written statements of educational goals, and at least two faculty recommendations.

In addition to the academic privileges of the program, Eckardt Scholars are offered an array of special opportunities, such as close mentoring, invitations to special events, funding for research projects, career advising, etc.

**JUNIOR-YEAR WRITING CERTIFICATION**
The faculty of the College of Arts and Sciences value writing as an essential tool for learning. Writing well is indispensable for performing responsibly in any profession and in most areas of life. Beyond the two English courses required in the first year, students are encouraged to take courses that provide continued practice in writing. In particular, each student must complete at least one "writing-intensive" course, normally during their junior year. Some major programs require the writing-intensive course be taken in the major field, while others allow it to be chosen freely from writing-intensive courses offered by any department or program. Courses that satisfy the writing-intensive requirement may also be used to fulfill major or distribution requirements. Please note: only courses designated as "WI" in the course catalog or select independent studies may be used to fulfill this requirement.

**FOREIGN LANGUAGE STUDY**
Students planning to pursue graduate study toward a doctorate are reminded that most graduate schools require doctoral candidates to demonstrate a reading knowledge of one or two foreign languages. Proficiency in foreign languages is advantageous for careers in law, government, journalism, commerce, industry and other fields.

**INTERNSHIPS**
Many departments and programs offer credit for internship experiences. Students should consult with their home department for information on arranging internships. The University faculty has established three important criteria that must be met by all internships: 80 hours of work are required for each credit awarded, no credit can be awarded for an internship ex post facto, and the student must register for the internship course during the same term that the internship work is actually conducted. Students should be sure to pre-arrange all internship experiences with the appropriate department. Internship credits
cannot be awarded for work experiences without a distinct educational component. A memorandum of understanding circulated among the employer, student, and departmental internship course director helps to promote a common understanding of the educational and work objectives of the internship. Students are advised that not all work experiences advertised as “internships” warrant academic credit, even though they may be otherwise worthwhile.

MINOR PROGRAMS IN THE COLLEGE

Certain departments, divisions, and programs in the College of Arts and Sciences afford an opportunity to minor in an additional field of concentration other than the major field.

A minor consists of at least 15 credits; the specific content is determined by the department, division, or program concerned. A minor is optional and, if successfully completed, will be shown on the university transcript in the same manner as the major field. A 2.0 minimum grade-point average is required for courses in the minor. Because of this requirement, no course in the minor program may be taken with Pass/Fail grading. No more than one course may be double-counted toward a major and a minor, and no more than one course may overlap between two minors.

Minors in the College of Arts and Sciences departments and programs are available for degree candidates in other colleges within the university, with approval of their college advisor.

The following are established minors in the College of Arts and Sciences. Some minor-program descriptions are collected within departmental descriptions, or located elsewhere, as indicated by parentheses. Students in the College of Arts and Sciences may also complete a minor in Business through the Business College or an Engineering minor through the College of Engineering.

- Actuarial Science (Mathematics)
- Africana Studies
- Anthropology (Sociology and Anthropology)
- Art (Art, Architecture and Design)
- Art/Architecture History (Art, Architecture and Design)
- Asian Studies
- Astronomy
- Biology (Biological Sciences)
- British Literature (English)
- Business
- Chemistry
- Chinese (Modern Languages and Literature)
- Classical Civilization (Classical Studies)
- Classics (Classical Studies)
- Cognitive Science
- Communication (Journalism and Communication)
- Computer Science
- Design
- Earth and Environmental Sciences
- Economics
- Education (Education Minor, this section)
- Engineering
- English
- Environmental Studies
- French (Modern Languages and Literature)
- German (Modern Languages and Literature)
- Global Studies
- Graphic Communication (Art and Architecture)
- Health, Medicine and Society
- History
- International Environmental Policy
- International Relations
- Japanese
- Jewish Studies
- Journalism (Journalism and Communication)
- Latin (Classical Studies) (minor offered through Classics program)
- Latin American Studies
- Mathematics, Applied (Mathematics)
- Mathematics, Pure (Mathematics)
- Military Science
- Molecular Biology (Biological Sciences)
- Museum Studies (Art and Architecture)
- Music
- Music Industry
- Philosophy
- Physics
- Political Science
- Probability and Statistics (Mathematics)
- Psychology
- Public Administration (Political Science)
- Public Relations (Journalism and Communication)
- Religion Studies
- Russian (Modern Languages and Literature)
- Science, Technology and Society
- Science Writing (Journalism and Communication)
- Social Relations (Sociology and Anthropology)
- Sociology (Sociology and Anthropology)
- Spanish (Modern Languages and Literature)
- Studio Art (Art and Architecture)
- Sustainable Development
- Theatre
- Women, Gender, and Sexuality Studies
- Writing (English)

FIRST-YEAR SEMINAR PROGRAM

During the first year, every student in the College of Arts and Sciences is required to enroll in a First-Year Seminar. College seminars provide an intimate and supportive environment that facilitates the transition to university life. Within the seminar students develop skills that serve as a framework for their future scholarly work – how to read closely, think critically, write clearly, learn cooperatively, speak persuasively, and solve problems creatively.

Courses in this program are an excellent way to explore a subject that may be new, or to enter more deeply into an area of previous interest. Whatever the topic, FYSs emphasize reading assignments, papers, and oral presentations, while others include tests, laboratory work, or fieldwork.

PRE-LAW PROGRAMS

Lehigh has a strong pre-law tradition. In keeping with the policy of the Association of American Law Schools, the university does not have a prescribed pre-law curriculum. Successful candidates for law school demonstrate skills in critical analysis, logical reasoning, and communication and have pursued rigorous coursework of significant breadth and depth. Lehigh students have attained entrance to law schools from diverse curricula in all three of the undergraduate colleges. Specifically law-related courses are offered in the College of Arts and Sciences (e.g., Constitutional Law and Politics, Civil Rights and Civil Liberties, Law and Order) and the College of Business and Economics (e.g., Introduction to Law and Legal Environment of Business).

In addition to formal academic instruction, Lehigh provides other opportunities for learning about the law and legal careers. The annual Tresolini Lecture series brings nationally recognized speakers to campus for extended interactions with faculty and students. Tresolini lecturers have included present and past U.S. and state Supreme Court justices and renowned legal scholars and practitioners. Lehigh also provides opportunities for gaining academic credit in several off-campus programs that provide practical experience in law and public affairs.

Advising is available to prospective pre-law students on a continuous basis from first-year orientation through the law school application process in the senior year. The pre-professional advisor in the Center
HEALTH PROFESSIONAL PROGRAMS

Schools of medicine, dentistry, optometry, podiatry, and veterinary medicine stress the importance of a strong liberal arts education as well as prescribed studies in the sciences. Although most pre-health students will choose a major in a pure or applied science, as long as candidates have the essential courses in biology, chemistry, physics, and mathematics, they may major in any of the three undergraduate colleges.

A health professions advisory committee, which includes the pre-professional advisor and faculty members from the sciences and social sciences, provides career and academic counseling and works closely with students from first-year orientation through the entire process of applying to professional schools. Students are urged to consult with the pre-professional advisor in the Center for Career and Professional Development as early as possible in their academic career. Those students interested in other allied health fields may also consult with the pre-professional advisor to obtain pertinent information to aid them in planning their college careers.

Combined-Degree Program in Medicine

In cooperation with Drexel University College of Medicine, Lehigh offers an accelerated program that enables selected students to earn both the baccalaureate degree (B.A.) with a major in premedical science and the M.D. degree after seven total years of study at the two institutions. In the first three academic years at Lehigh, credit hours are earned toward the 120 credits required for the baccalaureate degree. The next four years are spent in the regular program of medical education at Drexel University College of Medicine in Philadelphia. By successfully completing their first year at the medical school, students acquire the necessary additional credit hours for the Lehigh baccalaureate degree.

During their pre-professional years at Lehigh, students are expected to make satisfactory progress in academic areas as well as in the more subtle task of personal growth in those attributes ultimately needed as a physician. Drexel University College of Medicine receives student grades and monitors student progress through feedback from Lehigh. Students are expected to attain specified grade point averages and MCAT scores. Students’ undergraduate credentials are processed through the Admissions Committee of Drexel University College of Medicine before a final definitive acceptance is offered. The medical college reserves the right to withdraw an offer of acceptance on the grounds of academic or personal maturation concerns.

Application for admission to this program is made through Lehigh’s Office of Admissions. Application deadline is November 15.

Required Science and Math Courses

Chemistry

Select one of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit</th>
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</thead>
<tbody>
<tr>
<td>CHM 030 &amp; CHM 031</td>
<td>Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems</td>
<td>8</td>
</tr>
<tr>
<td>CHM 040 &amp; CHM 041</td>
<td>Honors General Chemistry I and Honors General Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td>CHM 110 &amp; CHM 111</td>
<td>Organic Chemistry I and Organic Chemistry Laboratory I</td>
<td>4</td>
</tr>
<tr>
<td>CHM 112 &amp; CHM 113</td>
<td>Organic Chemistry II and Organic Chemistry Laboratory II</td>
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Biology

Select one of the following:

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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit</th>
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<tbody>
<tr>
<td>BIOS 041 &amp; BIOS 042</td>
<td>Biology Core I: Cellular and Molecular Biology Core I: Cellular and Molecular Lab</td>
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<tr>
<td>BIOS 115 &amp; BIOS 116</td>
<td>Biology Core II: Genetics and Biology Core II: Genetics Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>BIOS 121 &amp; BIOS 122</td>
<td>Biology Core III: Integrative &amp; Comparative Biology and Biology Core III: Integrative and Comparative Lab</td>
<td>4</td>
</tr>
<tr>
<td>BIOS 371</td>
<td>Elements of Biochemistry I</td>
<td>3</td>
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PHYSICS

Select one of the following:

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<thead>
<tr>
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<th>Course Title</th>
<th>Credit</th>
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</thead>
<tbody>
<tr>
<td>PHY 010 &amp; PHY 012</td>
<td>General Physics I and Introductory Physics Laboratory I</td>
<td>5</td>
</tr>
<tr>
<td>PHY 011 &amp; PHY 012</td>
<td>Introductory Physics I and Introductory Physics Laboratory I</td>
<td>4-5</td>
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Math

Select one of the following:

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<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>MATH 012</td>
<td>Basic Statistics</td>
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Approved Electives

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<tbody>
<tr>
<td>MATH 012</td>
<td>Basic Statistics</td>
<td>4</td>
</tr>
<tr>
<td>&amp; MATH 022</td>
<td>Calculus I and Calculus II</td>
<td>7-8</td>
</tr>
<tr>
<td>MATH 051</td>
<td>Survey of Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>&amp; MATH 052</td>
<td>Survey of Calculus II</td>
<td>17-20</td>
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</table>

Total Credits

54-56

Combined-Degree Program in Dentistry

In cooperation with the School of Dental Medicine at the University of Pennsylvania, Lehigh offers an accelerated program that enables selected students to earn both the baccalaureate degree (B.A.) with a major in pre dental science and the doctor of dental medicine degree (D.M.D.) after seven years of study at the two institutions. In the first three academic years at Lehigh, credit hours are earned toward the 120 credits required for the baccalaureate degree. The next four years are spent in the regular program of dental education at the Penn School of Dental Medicine in Philadelphia. By successfully completing their first year at the dental school, students acquire the necessary additional credit hours for the Lehigh baccalaureate degree.

During their first three years at Lehigh, students are expected to make satisfactory progress in prescribed academic areas as well as in the area of personal growth, developing those attributes ultimately needed to become a dentist. Penn Dental School receives student grades and monitors student progress through feedback from Lehigh. Students are expected to attain specified grade point averages and DAT scores. Students’ undergraduate credentials are processed through the Admissions Committee of Penn Dental School before a final definitive acceptance is offered. The dental college reserves the right to withdraw an acceptance, or require that a student spend additional time on the undergraduate level, on the grounds of academic or personal maturation concerns.

Application for admission to this program is made through Lehigh’s Office of Admissions. Application deadline is January 1.
CHM 112 & CHM 113 Organic Chemistry II and Organic Chemistry Laboratory II 4

**Biology**

BIOS 041 & BIOS 042 Biology Core I: Cellular and Molecular and Biology Core I: Cellular and Molecular Lab 4

BIOS 115 & BIOS 116 Biology Core II: Genetics and Biology Core II: Genetics Laboratory 4

BIOS 121 & BIOS 122 Biology Core III: Integrative & Comparative Biology and Biology Core III: Integrative and Comparative Lab 4

BIOS 371 Elements of Biochemistry I 3

BIOS 372 Elements of Biochemistry II 3

**Physics**

Select one of the following: 5

<table>
<thead>
<tr>
<th>Subject</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math</td>
<td>MATH 012 Basic Statistics</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>MATH 021 Calculus I and MATH 022</td>
<td>7-8</td>
</tr>
<tr>
<td></td>
<td>MATH 051 Survey of Calculus I and MATH 052</td>
<td>11-12</td>
</tr>
</tbody>
</table>

**Total Credits** 54-56

**Required Non-Science Courses**

| First-Year Seminar | Credits | 3-4 |
| University Lit (I and II) | 6 |
| Humanities (two courses) | 8 |
| Social Sciences (two courses) | 8 |
| Junior Writing Intensive | 3-4 |
| Approved Electives | 11-12 |

**Total Credits** 39-42

**COMBINED-DEGREE PROGRAM IN OPTOMETRY**

In cooperation with the State University of New York College of Optometry in New York City, Lehigh offers an accelerated program in which students may earn both the baccalaureate degree (B.A.) with a major in behavioral neuroscience and the doctor of optometry degree (O.D.) after seven years of study at the two institutions. In the first three academic years at Lehigh, credit hours are earned toward the 120 credits required for the baccalaureate degree. The next four years are spent in the regular program of optometry education at SUNY College of Optometry. By successfully completing their first year at the optometry college, students acquire the necessary additional credit hours for the Lehigh baccalaureate degree.

SUNY College of Optometry receives student grades and monitors student progress through feedback from Lehigh. Students are expected to attain specified grade point averages and OAT scores. Students’ undergraduate credentials are processed through the Admissions Committee of SUNY Optometry before a final definitive acceptance is offered. The optometry college reserves the right to withdraw an offer of acceptance on the grounds of academic or personal maturation concerns.

Students may apply to this program during their initial application or during their enrollment at Lehigh. Application for incoming students is made through Lehigh’s Office of Admissions. Application deadline is January 1.

**Required Science and Math Courses**

**Chemistry**

Select one of the following: 8

<table>
<thead>
<tr>
<th>Subject</th>
<th>Course</th>
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<tbody>
<tr>
<td>CHM 030 &amp; CHM 031 Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems</td>
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<th>Subject</th>
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<tbody>
<tr>
<td>CHM 110 &amp; CHM 111 Organic Chemistry I and Organic Chemistry Laboratory I</td>
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**Biology**

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<tr>
<td>BIOS 121 &amp; BIOS 122 Biology Core III: Integrative &amp; Comparative Biology and Biology Core III: Integrative and Comparative Lab</td>
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<th>Subject</th>
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<td>BIOS 371 Elements of Biochemistry I</td>
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**Math**

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<th>Subject</th>
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<tr>
<td>MATH 012 Basic Statistics</td>
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<th>Subject</th>
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<th>Credits</th>
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<tbody>
<tr>
<td>MATH 021 Calculus I and MATH 022</td>
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<tr>
<th>Subject</th>
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<th>Credits</th>
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<tbody>
<tr>
<td>MATH 051 Survey of Calculus I and MATH 052</td>
<td>11-12</td>
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**Total Credits** 62-64

**Required Non-Science Courses**

| First-Year Seminar | Credits | 3-4 |
| University Lit (I and II) | 6 |
| Social Science (one course) | 8 |
| Writing Intensive | 3-4 |

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<tr>
<th>Subject</th>
<th>Course</th>
<th>Credits</th>
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<td>PSYC 001 Introduction to Psychology</td>
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<tr>
<th>Subject</th>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Humanities (two courses)</td>
<td>8</td>
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<tr>
<th>Subject</th>
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<tbody>
<tr>
<td>Junior Writing Intensive</td>
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<tr>
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</thead>
<tbody>
<tr>
<td>Approved Elective</td>
<td>4</td>
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</table>

**Total Credits** 32-34
EDUCATION MINOR

The education minor helps undergraduates explore career options in school teaching or other professional careers with elementary, secondary, or special education students. The minor may accelerate entry into a teaching career because appropriate credits from undergraduate coursework may be applied to one of Lehigh’s graduate-level Teacher Education Programs.

The minor offers a systematic background of professional education experiences, coordinating practicum activities with theory courses designed to provide a foundation for future educational studies. Its focus is exploratory.

The experiences of the minor are intended to enrich an individual’s understanding of education as a central intellectual activity of our culture and to provide self-understanding of one’s own potential as an educator.

An undergraduate may take these courses with the approval of the adviser and minimum GPA of 2.75. Completion of the minor does not assure admission to one of the Teacher Education Programs to become a certified elementary or secondary teacher.

Fifteen credit hours are required for the education minor. Completion of the minor does not guarantee subsequent admission into any of the College of Education degree or certification programs.

For more information about our Education Minor, visit http://coe.lehigh.edu/academics/disciplines/teachered or contact the Teaching, Learning and Technology Program Director at TLTProgram@Lehigh.edu or 610-758-3230.

FIVE-YEAR BACHELOR’S PLUS MASTER’S OF EDUCATION AND SECONDARY TEACHER CERTIFICATION

The College of Education offers a five-year degree program that is designed to allow students to earn both a bachelor’s degree and a master’s degree in five years instead of the traditional six.

The combined degree program leads to (1) a B.A./B.S. degree in an academic discipline from the College of Arts and Sciences, the P.C. Rossin College of Engineering and Applied Sciences, or the College of Business and Economics, and (2) an M.Ed. degree in elementary education or an M.Ed. or M.A. degree in secondary education. In addition, students also earn eligibility for an Instructional I teaching certificate from the Pennsylvania Department of Education (PDE). These PDE certification areas are:

- Biology 7-12
- Chemistry 7-12
- Earth and Space Science K-12
- English 7-12
- General Science 7-12
- Mathematics 7-12
- Physics 7-12
- PreK-4th grade
- Social Studies 7-12

Freshmen, sophomores and juniors with a minimum overall GPA of 2.75 may apply to the 5-year teacher education program. Those accepted typically begin education courses in the second semester of their sophomore year (junior year for those admitted later).

Criteria for admission to the program include:

- A demonstrable commitment to learning and intellectual growth
- An expressed interest in teaching as a career
- Previous experience in working with young people; this can be gained in the summers of freshman and sophomore years.

In the fall semester of their senior year, students must complete an application for admission to the graduate College of Education (elementary or secondary education) in order to continue in the program and complete the master's degree/Instructional Level I teacher certification eligibility portion of the program.

For more information about the 5-year Teacher Education Program, visit http://coe.lehigh.edu/academics/disciplines/teachered or contact the Teaching, Learning, and Technology Program Director at TLTProgram@Lehigh.edu or 610-758-3230.
Entrepreneurship Minor
The program aims to prepare students from all undergraduate colleges at Lehigh with the skill sets, attitudes, and understanding of the processes to realize their entrepreneurial goals in either an emerging or established company setting. The program is designed to be generally accessible to students from all disciplines with an emphasis upon innovation, the entrepreneurial process, and cross-functional integration. The minor can be added to any undergraduate degree at the university.

Integrated Real Estate Minor
Integrated Real Estate At Lehigh (ire@l) is a three or four year course of study designed to complement a wide range of majors, from art and architecture to civil engineering to environmental science to finance to marketing to economics. The mission of the ire@l program is to prepare the next generation of real estate leaders. Students completing the ire@l program will earn a minor in real estate.

Career Placement
The undergraduate programs in the College of Business and Economics provide the students with a strong foundation in business and economic principles necessary for success in business. Upon graduation, the majority of students from the College of Business and Economics enter business in many different professional positions including accounting, investment banking, advertising, marketing, management consulting, and information systems. Further professional studies in law, graduate business school or specialized graduate education in economics, operations research, or other related fields are additional options open to graduates.

Variety of Options
While preparing students for a career in business and economics, we recognize the importance of a well-rounded individual. At Lehigh, this important exposure to science, language and the arts and humanities is accomplished by distribution requirements, within which the student has wide choice. Students take 48 credits outside the College of Business and Economics.

The bachelor of science in business and economics may also lead to admission into the master of business administration program at Lehigh or another institution after graduates have at least 2-3 years of work experience. In addition, the college also offers the following graduate degrees: doctor of philosophy, master of business administration and engineering, master of business administration and educational leadership, master of science in accounting and information analysis, master of science in analytical finance, master of science in economics, and master of science in management.

BACHELOR OF SCIENCE IN BUSINESS AND ECONOMICS
The College of Business and Economics at Lehigh University prepares students to become business and community leaders in a broad range of organizations. Our undergraduate students acquire the knowledge and skills needed to excel in business. Overall, we expect our graduates to be able to successfully solve complex, unstructured business problems.

For the bachelor of science degree in business and economics, 124 credit hours are required. A writing requirement, which is included within the required 124 credit hours, is also a part of the college curriculum.

Planning Courses of Study

<table>
<thead>
<tr>
<th>First Year</th>
<th>CR</th>
</tr>
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<tbody>
<tr>
<td>ENGL 001</td>
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<tr>
<td>Select one of the following:</td>
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<tr>
<td>ENGL 002</td>
<td>3</td>
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<tr>
<td>ENGL 005</td>
<td></td>
</tr>
<tr>
<td>MATH 021 or 081</td>
<td>4</td>
</tr>
<tr>
<td>ECO 001</td>
<td>4</td>
</tr>
<tr>
<td>BUS 001 or 002</td>
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<tr>
<td>ECO 045</td>
<td>3</td>
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<tr>
<td>ECO 029</td>
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<tr>
<td>BUS 005</td>
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Second Year

<table>
<thead>
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<tbody>
<tr>
<td>ACCT 151</td>
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24

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3

Fourth Year

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<tbody>
<tr>
<td>MGT 301</td>
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</tbody>
</table>

Total Credits: 54

1 Excel competency must be successfully completed before ECO 045, ACCT 151, and BIS 111.

Major Programs (15 credits - 23 credits)
By the end of the second semester of the sophomore year, students select a major consisting of sequential or related courses in one of the following major programs: accounting, business economics, business information systems, economics, finance, management, marketing, and supply chain management. A GPA of 2.0 or higher in the major program is required for graduation.

Double Majors
Students in the College of Business & Economics may pursue a double major within the CBE according to college guidelines, which include the requirements of each of the majors and a minimum of 10 courses (30 credits) between the two combined majors. Students must declare a single major prior to declaring a second major. Students planning to pursue more than one major within the CBE must meet a prerequisite GPA of 2.0 or higher.

Globalization and Diversity Requirements
Each student must complete a minimum of 3 credits in Diversity and 3 credits in Globalization. These courses may simultaneously fulfill other CBE degree requirements.

Electives (52-55 credits) - depending on major
Students will earn 52-55 credits of electives. A minimum of 48 credits are to be taken outside the College of Business and Economics.

Students are required to take six (6) credits of humanities (HU), six (6) credits of social science (SS), and three (3) credits of science (NS) for a total of 15 credits of distribution requirements. Students should refer to the department in the catalog to determine which course offerings may be taken to satisfy these requirements.

In the College of Business and Economics, the pass-fail option is available for elective courses only. A student desiring Lehigh credit for a course taken at another institution must complete a transfer credit form and obtain approval from the appropriate Lehigh academic department in advance.

BUSINESS MINOR
The purpose of the business minor program is to enable non-CBE students to pursue a course of business studies which enables them to supplement their major studies and enhances their career options upon graduation. The overall learning objective of the program is to provide non-CBE students with the knowledge and skills with which to make more informed business decisions.

Courses offered in the business minor program are not open to students currently in the CBE, nor may these classes count as substitutes for CBE core classes should a student later decide to transfer into the CBE.
Program of Studies
The business minor consists of 14 credit hours. The courses are integrated across the entire program and must be taken in a stepped sequence. These 14 credit hours plus the prerequisite consist of the following courses:

Required prerequisite course
ECO 001 – Principles of Economics (4) ECO 001 can be taken in either the freshman or sophomore year and must be completed prior to entering the business minor program.

Required courses

<table>
<thead>
<tr>
<th>First Year</th>
<th>Credits</th>
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<th>Credits</th>
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<td>BUS 126</td>
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<td>BUS 226</td>
<td>3</td>
</tr>
<tr>
<td>BUS 326</td>
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</tbody>
</table>

Total Credits: 14

Recommended courses
Probability Theory and Statistics
For example:
- ECO 045: Statistical Methods (3)
- MATH 012: Basic Statistics (4)
- ISE 111: Engineering Probability (3)
- PSYC 110: Statistical Analysis of Behavioral Data (4)

An Integrated Learning Experience
For example:
- ME/BUS 211: Internship
- MGT 314: Small Business Consulting (3)

The courses required in the business minor program will be offered in a stepped sequence requiring completion of each course in the sequence before being able to continue to the next course. That is, students must first complete GBUS 401 and ECO 401 before taking BUS 127, BUS 127 before taking BUS 225, and BUS 225 before taking BUS 226. BUS 125 and BUS 326 are to be taken in conjunction with BUS 126 and BUS 226, respectively.

Program admission requirements
Each spring, 80 students will be accepted into the business minor program for the following fall. Applications to the program will be made by students and submitted to the program director by the last Friday in March. An admissions committee comprised of the business minor program director and the business minor curriculum committee will make admission decisions based on G.P.A., experience, and interest in pursuing business opportunities upon graduation from Lehigh (to be evaluated on the basis of a written essay). Students will be notified of admissions decisions by the first week in March to begin registration for the fall semester. Entrance into business minor classes will be controlled by restricted overrides by the director of business minor program. The Director of the Business Minor program is Robert Kuchta, Professor of Practice, Department of Management, 330 Rauch Business Center (rokb@lehigh.edu).

Graduate degree programs (p. 110) offered by the college include the Master of Business Administration, the Master of Science in Accounting and Information Analysis, the Master of Science in Economics, the Master of Science in Management, and the Ph.D. in Business and Economics. Interdisciplinary degree programs (p. 64) are offered through partnerships with other colleges: P.C. Rossin College of Engineering and Applied Science - Master of Business Administration and Engineering; P.C. Rossin College of Engineering and Applied Science and the College of Arts and Sciences-Master of Science in Analytical Finance; College of Education-Master of Business Administration and Educational Leadership.

College of Education

The university's College of Education offers opportunities for advanced study in the field of education.

GRADUATE DEGREES IN EDUCATION
Lehigh's College of Education offers primarily graduate degree programs. Additionally, undergraduates may apply to the college's 5-year Bachelor's plus Master of Education program or they can minor in education (p. 53). The five-year program is designed to allow students to earn both a bachelor's degree and a master's degree in elementary or secondary education in five years instead of the traditional six years. The Education minor allows upper level undergraduates to take selected coursework that combines practicum activities with theoretical work and is designed to provide a foundation for further educational studies at the graduate level. Students enrolled in the College of Education should check with their advisers for a list of regulations and requirements governing degree programs.

Financial assistance. Graduate assistantships and research assistantships are available in the college and in various administrative offices on campus. In addition, graduate students may be recommended for a limited number of fellowships and endowed scholarships that are awarded by the college.

Lehigh's Centennial School, a laboratory school for children with emotional behavior disorders, provides employment for some Lehigh education students. Graduate students may apply for teaching internships, which cover tuition and pay salaries.

MASTER OF EDUCATION (M.ED.)
This degree is offered in the following professional specializations: elementary education, secondary education, special education, educational leadership, counseling and human services, globalization and educational change, international counseling, school counseling and teaching and learning. Degree requirements vary from program to program.

MASTER OF ARTS (M.A.)
The master of arts is available in either teacher education (secondary education or the teaching and learning degree programs) or comparative and international education. The teacher education M.A. focuses on enhancing both pedagogical skill and subject matter expertise of teachers. The comparative and international education M.A. examines educational policy and theory on an international level, preparing its graduates to work in educational research and policy organizations, government offices, ministries of education, and international development organizations.

The teacher education student pursuing an M.A. must take graduate work in education plus 12 credits of graduate work in an academic field related to the area of teacher certification (typically, English, mathematics, political science, sociology, and physical and natural sciences). The comparative and international education student pursuing an M.A. must take graduate work in education plus 12 credits in one of four specific academic disciplines (sociology and anthropology, political science and international relations, economics, or history).

MASTER OF SCIENCE (M.S.)
The master of science degree is awarded in instructional technology or teaching, learning and technology. The M.S. in instructional technology focuses on the planning and use of instructional technology in preK-12 and post secondary settings and non-formal learning environments (such as museums and science centers). The program is targeted toward individuals from varied backgrounds who wish to help educators or learn themselves to design, develop, and incorporate technology applications more effectively in diverse educational settings including preK-12, post secondary education, and informal learning environments. This is an appropriate degree for those who teach in the classroom and online, technology specialists, informal educators, and others interested in effectively using information and communications technologies to enhance instruction. The program is designed to help develop skills.
that can be used to create new curriculum and learning activities to meet the demands of a changing technological society and the needs of new generations of students. As such, graduates may be designing online courses, enhance existing curriculum with emerging technologies, or may work as technology specialists, assisting with the integration of technology in academic and informal learning environments. The Instructional Technology graduate program is intended for both current professionals in the education field as well as those who are seeking an advanced degree to upgrade their skills and knowledge base related to technology. The M.S. in teaching, learning and technology is available only to students previously admitted to the TLT Ph.D. program and is a “fallback” for those who have completed the core coursework but are unable to progress through the culminating research projects.

**MASTER IN BUSINESS ADMINISTRATION/MASTER OF EDUCATION (MBA/M.ED.)**
The MBA and master’s of education joint degree program offers students the opportunity to acquire a solid foundation in both business and education. Designed to increase the administrative skill required in today’s educational systems, the MBA/M.Ed. provides a framework in which excellent education and sound business practices can flourish. The MBA/M.Ed. will provide an additional option for students for business and students of educational leadership. The program should enhance the student’s marketability in private and public sector education while providing students with an understanding of the cultures of both business and education.

**EDUCATIONAL SPECIALIST (ED.S.)**
Specialized post-master’s degree programs for practitioners are available in school psychology.

**CERTIFICATION PROGRAMS**
The College offers programs of study leading to eligibility for Pennsylvania state certifications in various professional specialties including elementary and secondary teacher education, including certification in special education; supervisor of special education, pupil services, or curriculum and instruction; superintendent; and K-12 principal. Certification programs vary in the number of credits required.

**POST-BACCALAUREATE CERTIFICATES**
The college also offers post-baccalaureate certificate programs in international counseling, international development in education, project management (jointly offered through the College of Business and Economics and the College of Education), special education, teacher leadership, teaching English as a second language, and technology use in the schools. Post-baccalaureate certificate programs differ from the above-described certifications issued by agencies external to Lehigh (such as the Pennsylvania Department of Education). Lehigh’s post-baccalaureate certificate programs are, instead, focused concentrations of 12 to 15 credits that students complete to enhance their professional credentials. Where appropriate, post-baccalaureate certificate programs may be included as part of the coursework of a degree program. [https://coe.lehigh.edu/admissions/apply/certificate](https://coe.lehigh.edu/admissions/apply/certificate)

**DOCTOR OF PHILOSOPHY (PH.D.)**
The College of Education also offers the Ph.D. degree to students enrolled in the fields of comparative and international education, counseling psychology, school psychology, special education, and teaching, learning and technology. The requirements for this degree are the same as those for the Ph.D. in the other colleges and as described in previous sections.

**DOCTOR OF EDUCATION (ED.D.)**
The doctor of education degree program provides specialized study in educational leadership. Successful professional experience is required for admission to candidacy. The requirements for the Ed.D. degree parallel those already stated for the Ph.D. degree.

**NON-DEGREE OPTIONS**
The non-degree options are designed for those individuals interested in taking a few courses in the College but not interested in pursuing a graduate degree. For information on the non-degree program, contact Donna Johnson at 610-758-3231 or email education@lehigh.edu. There are two non-degree options as well:

1. Regular non-degree and
2. Non-degree for external certification.

Regular non-degree admission is for students who wish to take up to 12 credits of graduate coursework at Lehigh University without seeking a degree. Any transcript or other record from the University will clearly indicate the student status as non-degree. Non-degree students are not permitted to audit courses. University admissions criteria for non-degree graduate students are (a) a bachelor’s degree from an accredited institution with an overall grade point average of at least 2.75 on a four-point scale (Applicants with undergraduate GPAs slightly below 3.0 may be admitted with approval from the department of Education and Human Services) or (b) to have achieved a GPA of 3.0 or higher on a four-point scale for a minimum of 12 graduate credits at another accredited institution. If English is not your first language, you must submit TOEFL scores.

Non-degree for external certification students are admitted to pursue coursework for the purpose of obtaining certification through an external accrediting agency. Applicants are expected to have an undergraduate GPA of 3.0 or higher on a four-point scale or to have achieved a GPA of 3.0 or higher on a four-point scale for a minimum of 12 graduate credits at another accredited institution. Applicants are assigned certification advisers on admissions and must work with the adviser to assure that they complete all requirements for certification satisfactorily. Students complete the coursework and any other required field experiences for the appropriate certification, with the number of credits and field experiences being dictated by the external accrediting agency. Given this external control of credit requirements, the number of credits will vary and will typically exceed the 12 credit limit for regular non-degree students. Certification involves qualitative components as well as credits; a non-degree student seeking such certification must meet the quality standards of the certification program, as well as completing the necessary coursework and field experiences.

**CHANGING FROM NON-DEGREE TO DEGREE STATUS**
Non-degree students of either type may seek admission to a degree program. Non-degree students who seek admission to a degree program must meet all regular admissions criteria, complete all regular application procedures, and present all documents normally required of degree-seeking applicants to that program. Courses taken by a non-degree student who later enters a degree program will count towards the completion of the program to the extent that those courses fall within the normal requirements of the program and to the extent that the student’s performance in the course(s) is acceptable for degree program purposes. Any course that is counted towards the completion of a degree must be completed within the established time limits for that degree, whether taken initially as a degree or non-degree course.

**Professor Of Practice.** Qiong Fu, PhD (University of Illinois at Chicago)

**Emeriti.** Raymond Bell, EdD (Lehigh University); Joseph P. Kender, EdD (University of Pennsylvania); Robert L. Leight, EdD (Lehigh University); J. Gary Luiz, EdD (Lehigh University); Alden J. Moe, PhD (University of Minnesota); Roland K. Yoshida, PhD (University Southern Calif)

**P.C. Rossin College of Engineering and Applied Science**

Stephen P. DeWeerth, dean
John P. Coulter, associate dean for graduate studies and research
Gregory L. Tonkay, associate dean for undergraduate studies

The P.C. Rossin College of Engineering and Applied Science offers the bachelor of science degree in 17 programs, combining a strong background in sciences and mathematics with requirements in humanities and social sciences. Students in college programs learn principles they can apply immediately in professional work; those who plan on further academic experience can design a curriculum centering on interests they will pursue in graduate school.

The mission of the college is to prepare undergraduate and graduate students to be critical thinkers, problem solvers, innovators, leaders and life-long learners in a global society and to create an environment where students pursue cutting-edge research in engineering and engineering science.
MAJOR PROGRAMS
The P.C. Rossin College of Engineering and Applied Science includes seven departments and offers undergraduate and graduate degree programs at the bachelor, master, and doctor of philosophy levels. The undergraduate degree programs leading to the bachelor of science degree are:

- Applied Science (p. 72)
- Bioengineering (p. 91)
- Chemical Engineering (p. 125)
- Chemistry (p. 132)
- Civil Engineering (p. 144)
- Computer Engineering (p. 165)
- Computer Science (p. 172)
- Computer Science And Business (p. 166)
- Electrical Engineering (p. 203)
- Engineering Mechanics (p. 323)
- Engineering Physics (p. 213)
- Environmental Engineering (p. 144)
- Industrial & Systems Engineering (p. 263)
- Integrated Business And Engineering (p. 280)
- Integrated Degree In Engineering, Arts And Sciences (p. 261)
- Materials Science And Engineering (p. 307)
- Mechanical Engineering (p. 323)

1 Accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org
2 Accredited by the Computing Accreditation Commission of ABET, http://www.abet.org
3 Accredited by the Computing Accreditation Commission of ABET, http://www.abet.org and AACSB, the Association to Advance Collegiate Schools of Business
4 Accredited by AACSB, the Association to Advance Collegiate Schools of Business

Programs in chemistry and physics have been approved by the faculty program review committee in these disciplines.

FIRST YEAR COURSES FOR ENGINEERING DEGREES

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<tr>
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<th>First Semester</th>
<th>Second Semester</th>
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<td>MATH 021</td>
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<tr>
<td>Select one of the following:</td>
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<td>6</td>
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<tr>
<td>CHM 030 &amp; ENGR 010</td>
<td>6</td>
<td>PHY 011 &amp; PHY 012</td>
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<td>PHY 011 &amp; PHY 012</td>
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<td>HSS Elective</td>
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<tr>
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Bioengineering students take CHM 030 and ENGR 010 in the fall along with BIOE 001 instead of ENGR 005. In the spring they take BIOS 041 (instead of HSS elective) along with PHY 011/PHY 012. The HSS elective is pushed to later semesters. Students in Computer Science and Business, Integrated Business and Engineering, and Integrated Degree in Engineering, Arts and Sciences follow a different first year curriculum.

MINIMUM HUMANITIES/SOCIAL SCIENCES (HSS) REQUIREMENTS FOR ALL ENGINEERING PROGRAMS

Basic Requirement
Economics and English. Three courses totaling a minimum of ten credit hours: Students must complete all three:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>ECO 001</td>
<td>Principles of Economics</td>
</tr>
</tbody>
</table>

Advanced Requirement
A minimum of four multi-credit courses and a minimum of 13 credits in courses designated as HU (humanities) or SS (social science), with the following restrictions:

1. Depth: At least eight credits must be in a common discipline and from the same department or program. At least three of these credits must be at the 100-level or above, or at the intermediate level or above for a single modern foreign language.
2. Breadth: At least three credits in a discipline different from, and not cross-listed with, the discipline employed to satisfy the depth requirement.
3. At least three credits must be designated as HU.
4. None of the courses used for HSS can be taken Pass/Fail.
5. None of the course can be one-credit courses.

FREE ELECTIVES
The college, through its advisers, is prepared to help students to use the credit hours of “free electives” that, along with other electives in the curriculum, may be used to develop a program of personal interest. Free electives may be satisfied by taking regular course offerings or up to six credit hours from each of the following from Mus 21-79, from Jour 1-8, or up to six credit hours of advanced ROTC courses.

INTERDISCIPLINARY DEGREES

Computer science & business
The College of Business and Economics and the Computer Science and Engineering department in the P.C. Rossin College of Engineering and Applied Science jointly offer the Computer Science and Business (CSB) program. It is a four-year program that is fully accredited by AACSB International, the Association to Advance Collegiate Schools of Business, and by the Computing Accreditation Commission of ABET, http://www.abet.org.

Integrated Business & Engineering Honors Program
The Integrated Business and Engineering Honors Program (IBE) is offered jointly by the P.C. Rossin College of Engineering and Applied Science and the College of Business and Economics. The program recognizes the need for today’s leaders in business and industry to have a sound foundation in both commerce and technology.

After four years and a minimum of 137 credits, students will receive a single Bachelor of Science Degree in Integrated Business and Engineering. The program meets the accreditation standards of the American Assembly of Collegiate Schools of Business. Students are expected to maintain a minimum GPA of 3.25 in order to remain in the program.

A second option is the five-year dual degree program. This option allows students to obtain a second Bachelor of Science degree in engineering by completing course work in the engineering field chosen by the student as their IBE major. Students enrolled in the four year IBE Honors Program and in satisfactory standing are able to transfer to a dual-degree at any time, and stay within the honors program cohort. The additional time necessary to complete the second degree will depend on the curriculum selected, and the number of advanced placement credits. The number of additional credit hours will typically be in the range of 20 to 30.

Students in the IBE Honors Program can major in nearly any area of engineering or business that Lehigh offers. After their freshman year, each student will declare a major in either the P. C. Rossin College of Engineering and Applied Science or the College of Business and Economics.
Admission to the Integrated Business and Engineering Program is highly selective, with annual admission limited to approximately 50 students. The University’s Office of Admissions can explain the procedure for applying to the program. It is possible that a small number of exceptional students may be admitted to the program following the completion of their freshman year. Admission at this point would be highly competitive and based upon freshman year GPA, faculty recommendations, and space availability.

The Co-Directors of the IBE Honors Program are Robert H. Storer, Professor of Industrial and Systems Engineering (rhs2@lehigh.edu) and Stephen G. Buell, Professor of Finance (sgb2@lehigh.edu). For additional information, see the IBE Honors Program or visit the IBE web site at www.lehigh.edu/~inibep/inibep.html.

Integrated Degree Engineering, Arts and Sciences (IDEAS) Honors Program

The B.S. in Integrated Engineering, Arts and Sciences (IDEAS) provides students with a unique opportunity to combine the breadth and depth of two focus areas, one from engineering and one from arts and sciences in a four-year experience. More information is available in the IDEAS entry in this catalog, or online at www.lehigh.edu/ideas.

Jointly administered by the College of Arts and Sciences and the P.C. Rossin College of Engineering and Applied Science, IDEAS is a four-year honors program that allows students to earn a bachelor's degree with concentrations in both colleges. In close collaboration with IDEAS advisors and faculty directors, students admitted to this highly selective honors program develop an individualized academic plan tailored to their interests.

IDEAS allows students to study diverse interests such as bioengineering and religion, computer science and graphic design, industrial engineering and international relations, bioengineering and molecular biology, and music and computer science. Key features of the program include:

- Rigorous honors program: Each year, IDEAS accepts 30-40 highly qualified first-year student candidates who have indicated an interest in the program. Students must maintain a 3.25 grade point average to continue.
- Team-based and individual projects: Each student builds toward a capstone research project and thesis in their senior year, developed through a combination of team-based and individualized instruction.
- Communication as key to bridging disciplines: IDEAS courses are writing-intensive and presentation-oriented. Participation in the program substitutes for some first-year courses in both colleges.

IDEAS graduates are awarded a Bachelor of Science degree, conferred by both colleges. Students interested in pursuing a professionally accredited degree in their selected engineering disciplines may choose to do so in an optional fifth year of study. Some programs of study in the College of Arts and Sciences, mainly in the sciences, may also require further study to complete certification.

OTHER OPTIONS FOR ENGINEERING STUDENTS

Cooperative Education (Co-Op)

Co-op is available for undergraduates in the P.C. Rossin College of Engineering and Applied Science; the program provides eight months of paid, full-time work experience, bridging the gap between engineering theory and application and allowing students to graduate within a four year time-frame. Because of the rigorous academic schedule, the program is selective.

The Co-op schedule provides for interviews and selection by the companies in the spring semester of the sophomore year. Those students selected attend Lehigh for a challenging summer schedule of junior-level coursework, then begin their first work rotation with the sponsoring company in mid-August. This rotation will last until mid-January when the student returns to Lehigh for the second semester coursework of the junior year. The Co-Op experience is completed with a second work rotation the following summer (mid-May through August). Students earn three, free elective credits per successful work assignment for a total of six free elective credits. These six credits are in ENGR 200 (p. 215) and are taken as P/F (Pass/Fail).

Technical Minor (Available to all students but most require prerequisites from engineering curricula)

<table>
<thead>
<tr>
<th>Technical Minor</th>
<th>Department</th>
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Interdisciplinary Minors (For engineering students)

A minor in Engineering Leadership provides students with knowledge, experiences and interaction with successful business managers in order to become more effective leaders. For more information about this minor: http://www.lehigh.edu/~ineleader/curriculum.html

The College of Business and Economics offers a minor in Business for students in the College of Arts and Sciences and the P.C. Rossin College of Engineering and Applied Science to provide students with knowledge and skills to allow them to make informed business decisions. A sequential sequence of courses is designed to integrate such traditional topics as accounting, finance, marketing, and management. For more information about this minor: http://cbe.lehigh.edu/academics/undergraduate/degree-programs/business-minor. There is also a minor in Real Estate: http://cbe.lehigh.edu/academics/undergraduate/degree-programs/real-estate-minor and a minor in Entrepreneurship: http://cbe.lehigh.edu/academics/undergraduate/degree-programs/entrepreneurship-minor. The courses in the latter treat subjects such as intellectual property, creativity and innovation, venture capital, positioning of products and services, and understanding the entrepreneurial mindset.

Students in engineering can also earn a minor in various humanities or social sciences by using their humanities and social science electives coupled with their free electives.

Engineering Minor (for non-engineering students)

The College of Engineering enables undergraduate students enrolled in the Colleges of Arts and Sciences and in the College of Business and Economics to earn a minor in engineering. This unique program provides students with insight into the world of engineers: who they are, what they do, and how they think. Students pursuing the Engineering Minor develop an understanding of the tools and techniques engineering use on a day-to-day basis.

The mission of the minor is to educate non-engineering students about engineering methodology, specifically how engineers solve problems; how they design, manufacture, and analyze problems; and how other factors such as economics, safety, ethics, and environmental issues affect the engineering design process. Fifteen credit hours of required and elective coursework are required to fulfill the engineering minor. For more information about this minor: http://www.lehigh.edu/~inegmnrr/index.html

Music Option

Music and Engineering is not a major in itself. However, Lehigh attracts many engineering and science students who wish to continue their active involvement in music and the music department. For those students who are interested in pursuing this option, music can be taken as a second degree, minor or through free electives.

Undergraduate research through Centers and Institutes

Faculty and students in the college also have research and scholarship activities in a number of centers and institutes, where graduate and undergraduate students work closely with faculty members. These include: Center for Advanced Technology for Large Structural Systems, Biopharmaceutical Technology Institute, Chemical Process Modeling.
and Control Center, Emulsion Polymers Institute, Energy Research Center, Enterprise Systems Center, Fritz Laboratory, Sherman Fairchild Center for Solid-State Studies, Polymer Science and Engineering Center, Structural Stability Research Council, Council on Tall Buildings and Urban Habitat, Center for Manufacturing Systems Engineering, Ben Franklin Technology Partners, Manufacturers Resource Center, Center for Advanced Materials and Nanotechnology, and Center for Optical Technologies.

Interdisciplinary Undergraduate Study

The university’s interdisciplinary programs are designed to cross the boundaries between colleges to accommodate new and developing fields as well as the interests of students.

Interdisciplinary Graduate Study and Research

In addition to offering graduate degrees within academic departments, Lehigh University offers interdisciplinary graduate degrees in the fields of American studies, analytical finance, business administration and educational leadership, business administration and engineering, energy systems engineering, environment policy design, manufacturing systems engineering, photonics, polymer science and engineering, and technical entrepreneurship.

Lehigh University also offers graduate certificate programs in certain specialized fields of study. Graduate certificates consist of a minimum of twelve credits, at least six of which must be at the 400-level. Such certificates are specific to Lehigh and do not constitute official certification, as might be required to be employed professionally. Students are admitted to certificate programs in the same way as to degree programs. More specific information on admission criteria and completion requirements are available from certificate program administrators.

In addition, Lehigh’s interdisciplinary research centers and institutes address the research needs of government, industry, and society. Organized to recognize research efforts in interdisciplinary problem areas, they supplement the university’s academic departments. Graduate students pursuing M.S. and Ph.D. degrees in academic departments, as well as students enrolled in interdisciplinary degree programs, may pursue research opportunities in the various centers.

A complete listing of research centers, institutes, and other research organizations appears following the section on interdisciplinary graduate programs.

FINANCIAL ASSISTANCE

Teaching assistantships and fellowships are provided by individual academic departments, while research assistantships are available through both academic departments and research centers. Students interested in research are encouraged to seek appointments with members of the faculty working in their areas of special interest, with department chairpersons, or with center or institute directors.

Accounting

The Department of Accounting provides a variety of courses to support College of Business and Economics (CBE) core requirements and to provide an undergraduate major in accounting and a M.S. degree in accounting.

The mission of Lehigh University’s Accounting Department is to provide outstanding accounting education and networking opportunities that prepare students (1) to enter the accounting profession upon graduation, (2) to assume positions of leadership in the global business community later in their careers, and (3) to be socially responsible and ethical business professionals. We will also advance the profession of accountancy globally to serve the public interest by producing and disseminating original accounting research and cross-disciplinary scholarship. We are guided by the missions of Lehigh University and the College of Business and Economics (CBE). The Accounting Department continuously seeks to be recognized as one of a select group of programs in the United States where an educational experience of the highest possible quality is obtainable.

Within the accounting major, there is an opportunity to explore the various career opportunities within the broad field of accounting: Public Accounting Assurance and Tax Services, Financial Services and Corporate Accounting, and Information Systems. In addition to the undergraduate program, the Master of Science in Accounting and Information Analysis degree (see Master of Science in Accounting and Information Analysis program (p. 110)) offers an outstanding opportunity to prepare graduate students for a career in today’s demanding field of accounting. Lehigh’s unique program recognizes the impact of technology on business processes and the value chain while paying respect to the time honored usefulness of accounting information. The Accounting Program recognizes the learning objectives set forth by the College of Business and Economics as an integral part of the curriculum, as well as the importance of providing students with a strong foundation in liberal arts, humanities, and science as set out in the CBE core curriculum. In addition to the CBE core curriculum, the accounting curriculum is designed to foster the following learning objectives:

- Preparing and understanding general purpose financial statements for parties outside the firm.
- Using accounting information for decision-making inside the firm.
- Understanding the information systems governing the flow of and control over financial information inside the firm.

To the extent that the above objectives are achieved, Accounting graduates will be well-prepared for positions in public accounting, industry, not-for-profit organizations, and graduate school. Although preparation for professional examinations is not a primary objective, graduates will have the background to take professional examinations in accounting.

Professors. C Bryan Cloyd, PhD (Indiana State Univer); Parveen P. Gupta, PhD (The Pennsylvania State University); James A. Hall, PhD (Oklahoma State University); Heibatollah Sami, PhD (Louisiana State University); Kenneth P. Sinclair, PhD (University of Massachusetts Amherst)

Associate Professor. Marietta Peytcheva, PhD (Rutgers University Newark)

Assistant Professors. Tamara A. Lambert, PhD (Drexel University); Neal Snow, PhD (University of South Florida); Leo Tang, MS (Columbia University)

Lecturer. David J. Hinrichs, MS (Lehigh University)

Professors Of Practice. Robert E. Duquette, MBA (University Maine); Joseph M. Manzo, MBA (Lehigh University)

Emeriti. Dunham R. Bainbridge, PhD (Lehigh University); Karen M. Collins, PhD (Virginia Polytechnic Institute and State University); James A Largay, III, PhD (Texas Tech University); Frank F. Luh, PhD (Ohio State University); John W. Paul, PhD (Lehigh University)

THE ACCOUNTING MAJOR

The undergraduate program in accounting is accredited by AACSB - The International Association for Management Education. This achievement places the program within a small group of schools which have satisfied a rigorous examination of the program, faculty, and students that extend beyond the accreditation standards applied to the entire College of Business and Economics undergraduate and graduate programs.

Sophomore Prerequisites

ACCT 151 Introduction to Financial Accounting 3

ACCT 152 Introduction to Managerial Accounting 3

Core Requirements, typically taken junior year

ACCT 315 Intermediate Accounting I 3

ACCT 316 Intermediate Accounting II 3

ACCT 311 Accounting Information Systems 3

ACCT 324 Cost Accounting 3

Concentration, typically taken senior year

Concentration, three courses, one of which is accounting (See below) 9

Total Credits 27

Concentrations

Public Accounting Assurance and Tax Services
This concentration is suited for students interested in entering public accounting.

ACCT 307 Fundamentals of Federal Income Taxation 3
ACCT 320 Fundamentals of Auditing 3
ACCT 317 Advanced Financial Accounting 3

Total Credits 9

Financial Services and Corporate Accounting
This concentration may appeal to students seeking accounting positions at financial services firms and industrial corporations. For some time representatives from these companies have sought Lehigh students with a strong accounting background. External constituencies suggest that a dose of finance will strengthen these students and make them more attractive.

FIN 323 Investments 3
FIN 328 Corporate Financial Policy 3
ACCT 318 Analysis of Financial Statements 3

Total Credits 9

Information Systems
Public accounting firms seek graduates for the rapidly growing area of global risk management (GRM). Students entering GRM will be responsible for assessing accounting system and computer risks that impact the financial statements of the organization and for evaluating internal controls in place to minimize such risks. Their findings become an important element in the conduct of the financial audit. This new career path thus requires students who possess strong systems skills and an understanding of financial accounting, management accounting, and auditing. Taxes and advanced financial accounting topics are less important in this setting. Therefore, the following courses comprise this concentration.

ACCT 320 Fundamentals of Auditing 3
BIS 311 Managing Information Systems 3
Analysis and Design

Select one of the following:
BIS 335 Application Development for Business 3
BIS/SCM 342 e-Business Enterprise Applications
BIS 360 Business Information Systems Practicum

Total Credits 9

The description and requirements of the Master of Science in Accounting and Information Analysis Program are found under Graduate Study and Research.

Course descriptions for the College of Business and Economics graduate courses can be found under Business and Economics Graduate courses (p. 110).

Courses
ACCT 108 Fundamentals of Accounting 3 Credits
A one-semester survey of accounting principles and practices designed for those students which includes an introduction to industrial cost systems designed for those non-CBE students planning to take only one accounting course. Other students should take the Acct 151-152 sequence.

ACCT 151 Introduction to Financial Accounting 3 Credits
The organization, measurement and interpretation of economic information. Introduction to accounting theory, concepts and principles, the accounting cycle, information processing, and financial statements. Exposure to controversial issues concerning income determination and valuation. Must have sophomore standing.
Prerequisites: Must have Excel competency

ACCT 152 Introduction to Managerial Accounting 3 Credits
An introduction to internal accounting information for all levels of management. Topics include cost flow in a manufacturing operation; planning, evaluating and controlling through budgeting and standard costing; and decision-making using cost-volume-profit analysis, direct costing, and relevant costs.
Prerequisites: ACCT 151

ACCT 307 Fundamentals of Federal Income Taxation 3 Credits
An introductory study of the principles and concepts of federal income taxation of individuals, corporations, partnerships, and fiduciaries; and federal gift and estate taxes. Determination of tax liabilities and opportunities for planning are emphasized. Problem-solving using the source materials of tax law and tax research are important components of the course.
Prerequisites: ACCT 151

ACCT 309 Advanced Federal Income Taxation 3 Credits
An advanced study of the taxation of business organizations, estates, trusts, and wealth transfer taxes. Planning and research are the basic components of the course. Problem-solving and written research are emphasized.
Prerequisites: ACCT 307

ACCT 311 Accounting Information Systems 3 Credits
An introduction to the concepts underlying information systems as they relate to organizational structure, managerial decision making and accounting. The course acquaints students with the reports and documents generated by information systems, as well as procedures and controls employed in a variety of business applications. Students apply these concepts, techniques and procedures to the planning, analysis and design of manual and computer-based information systems.
Prerequisites: ACCT 152 and BIS 111

ACCT 315 Intermediate Accounting I 3 Credits
Intensive study of the basic concepts and principles of financial accounting, emphasizing the problems of fair presentation of an entity's financial position, operating results and cash flows. Understanding of the conceptual framework of accounting, review of the accounting process, and recognition, measurement, valuation and disclosure of current assets, fixed assets, and intangibles. Problem-solving skills and critical analysis are stressed.
Prerequisites: ACCT 152

ACCT 316 Intermediate Accounting II 3 Credits
The sequel to Accounting 315, this course continues with intensive study of recognition, measurement, valuation and disclosure issues relating to such topics as investments, liabilities, leases, pensions, income-taxes, share-based payments, revenue issues, earnings per share, and complexities related to the statement of changes in financial position. Analysis and interpretation of financial statements and problem-solving skills are integral parts of the course.
Prerequisites: ACCT 315

ACCT 317 Advanced Financial Accounting 3 Credits
A study of specialized topics in financial accounting, including partnership accounting, business combinations and consolidated financial statements, segment and interim reporting, foreign currency transactions and translation, and accounting and reporting for governmental and other nonprofit organizations. Involves considerable problem-solving and critical evaluation of controversial theoretical issues.
Prerequisites: ACCT 315 or ACCT 316

ACCT 318 Analysis of Financial Statements 3 Credits
This course uses financial statement information to analyze companies' profitability and risk. Understanding the form, content and relationships among the financial statements is integrated with the use of ratios and analytic adjustments to augment the information in published financial reports. Current developments, business strategies and off-balance-sheet financing are linked to assessments of companies, performance. Case studies, team projects and presentations involve actual companies, financial statements. Open only to graduating seniors.
Prerequisites: ACCT 316
Can be taken Concurrently: ACCT 316
ACCT 320 Fundamentals of Auditing 3 Credits
An introduction to auditing theory, objectives, and practices related largely to the responsibilities of independent professional accountants. The auditing environment, generally accepted auditing standards, internal control theory, and reporting alternatives are considered. Exposure to operational auditing is provided.
Prerequisites: (ACCT 311 or CSB 311) and (ACCT 315)

ACCT 324 Cost Accounting 3 Credits
An in-depth study of cost concepts appropriate for product costing in a manufacturing operation, planning and controlling routine operations, and nonroutine decision-making. Topics include job order and process costing, joint and by-products, cost allocation, budgeting, standard costing, direct costing, cost-volume-profit analysis, and relevant costs for decisions.
Prerequisites: ACCT 152

ACCT 371 Directed Readings 1-3 Credits
Readings and research in various fields of accounting; designed for superior students who have a special interest in some topic or topics not covered by the regularly rostered courses. Written term paper(s) required. Must have preparation acceptable to the department chair.
Repeat Status: Course may be repeated.

ACCT 372 Special Topics 1-3 Credits
Special problems and issues in accounting for which no regularly scheduled course work exists. When offered as group study, coverage varies according to interests of the instructor and students. Must have preparation in accounting acceptable to the department chair.

ACCT 442 Financial Reporting and Analysis 3 Credits
This course focuses on the organization, measurement, and interpretation of economic information in corporate financial reports. It emphasizes the use and interpretation of the financial statements issued by business organizations, along with the preparation of accounting information. Topics include: accounting concepts and principles, accrual accounting, accounting cycle, revenue, expense, asset, liability and equity accounts. Students are exposed to balance sheet valuation, income determination, cash flow analysis, accounting judgment, profit manipulation, and evaluation of earnings quality.
Prerequisites: Must have Excel competency

ACCT 444 Accounting for Decision Making 2 Credits
This course emphasizes the organization, measurement and interpretation of internal accounting information that managers use to make business decisions. Students learn techniques such as cost analysis, budgeting, performance evaluation, and employee motivation. Topics include: cost flows in service and manufacturing enterprises; product and process costing; transfer pricing; resource planning, evaluation and control through budgeting, make-or-buy decisions; activity-based costing; standard costing, and variance analyses; pricing and production decision making using cost-volume-profit analysis.
Prerequisites: ACCT 442

Africana Studies

Program Director: James Peterson, Ph. D. (University of Pennsylvania)
Email: jbp211@lehigh.edu  # Phone: 610-758-5695
Website: http://aas.cas2.lehigh.edu/
Supported by the Office of Interdisciplinary Programs, 610-758-3996; incasip@lehigh.edu
Williams Hall, 31 Williams Drive

Core Faculty
Saladin Ambar, Ph.D. (Department of Political Science); Lyndon Dominique, Ph.D. (Department of English); Natanya Duncan, Ph.D. (Department of History); Imaani El-Burki, Ph.D. (Department of Journalism and Communication); Kwarne Essien, Ph.D. (Department of History); Susan Kart, Ph.D. (Department of Art, Architecture and Design); Monica Miller, Ph.D. (Department of Religion Studies); Seth Moglen, Ph.D. (Department of English); James Peterson, Ph.D. (Department of English); Stephanie Watts, Ph.D. (Department of English); Bruce Whitehouse, Ph.D. (Department of Sociology and Anthropology); Darius Williams, Ph.D. (Department of Theatre)

Emeritus Faculty
William Scott, Ph.D. (Department of History) and Ted Morgan, Ph.D. (Department of Political Science)

The purpose of the Africana Studies Program is to engender in Lehigh students an intellectual appreciation of the life and culture of peoples of sub-Saharan Africa and the worldwide diaspora, especially in the Americas (the United States and Canada, the Caribbean, Central and South America), thereby enriching the Lehigh curriculum and increasing its relevance to a culturally diverse society and world. In the best tradition of a liberal arts education, Africana Studies expands Lehigh students’ critical understanding of their own heritage in interaction with other cultures.

The major and minor in Africana Studies constitute an interdepartmental and comparative program of study for undergraduates who wish to integrate the insights and methods of several disciplines to understand the history, culture, social, and political experience of people of African descent globally.

Associate Professor. Monica R. Miller, PhD (Chicago Theological Seminary)
Assistant Professors. Kwame Essien, PhD (University Texas, Austin); Susan E. Kart, PhD (Columbia University); Darius Williams, PhD (Ohio State University)

THE MAJOR
The major in Africana Studies consists of a minimum of ten (10) courses, constituting at least 30 credit hours and no less than four (4) upper level courses. It entails training across disciplinary lines as well as concentrated study in a single discipline.
AAS 003 Introduction to Africana Studies 4
Humanities (3 courses) 9-12
Social Sciences (3 courses) 9-12
Disciplinary Concentration (3 courses) 8-12
Total Credits 30-40

Departmental Honors
Africana Studies majors who attain a 3.5 grade point average in the major and a 3.2 grade point average overall may apply for departmental honors. Students must receive permission of the program director and complete a minimum of 4 credits of AAS 390 Honors Thesis.

THE MINOR
The minor consists of a minimum of four (4) courses, constituting at least 15 hours of study that includes an introductory course and no less than two upper level courses in the field. To declare a minor in Africana Studies, students must complete a minor declaration form (http://catalog.lehigh.edu/coursesprogramsandcurricula/artsandsciences/africanastudies/Africana_Studies_Minor_Declaration_Form_2016.pdf).
AAS 003 Introduction to Africana Studies 4
Electives 2 11-12
Total Credits 15-16

1 Additional courses may be substituted for the Introductory course with Program Director permission
2 Must include at least two upper level courses

CORE AND ELECTIVE COURSES
Core courses concentrate on subject material directly relevant to the study of past and present experiences of people of African descent.
Each semester, a complete list of Africana Studies course offerings can be found on the Africana Studies web site or in the Office of Interdisciplinary Programs, Williams Hall, Suite 101. In addition, students are encouraged to pursue independent study opportunities to enhance their knowledge of specific aspects of Africana Studies.
AAS 003 Introduction to Africana Studies 4
AAS/HIST 005 African Civilization 4
AAS/REL 025 Introduction to Black Religions and Hip-Hop 4
AAS/ENGL 038 Introduction to African Literature 3
AAS 039 Special Topics in Africana Studies 4
AAS/THTR 059 West African Dance 2
AAS/THTR 062 Black Theatre 4
AAS/ENGL/REL/JST 102 Promised Lands: Jewish and African American Children's Literature 4
AAS/SOC 103 Race and Ethnicity in the Contemporary U.S. 4
AAS/LAS/SOC 106 Race and Ethnicity in Latin America and the Spanish Speaking Caribbean 4
AAS/PHIL 117 Race, Racism, and Philosophy 4
AAS/ENGL 121 Topics in African-American Literature 4
AAS/ART/GS 124 Arts of the Black World 16th-20th Centuries 4
AAS/ART/GS 125 Art and Architecture of Africa from Colonial to Contemporary Times 4
AAS/MUS 128 Jazz History I 3
AAS/MUS 129 Jazz History II 3
AAS/HIST 130 African American History 4
AAS/THTR 132 Hip Hop Theatre 4
AAS/MLL/LAS/FREN/HIST/POLS 133 Lehigh in Martinique: Globalization and Local Identity 4
AAS/HIST 134 History and Cultures of Ghana 4
AAS/ENGL 138 Introduction to African American Literature 4
AAS 139 Special Topics in Africana Studies 4
AAS/THTR 140 African American Theatre 4
AAS/SOC 144 Global Hip Hop and Social Change 4
AAS/WGSS 145 African American Women Writers 4
AAS/SOC/LAS 155 Afro-Latino Social Movements in Latin America & the Caribbean 4
AAS/SOC 163 Sociology of Hip Hop Culture 4
AAS/SOC 166 Wealth and Poverty in the United States 4
AAS/SOC 177 Cuba: Race, Revolution and Culture 4
AAS/HIST 179 Black Political Thought in America 4
AAS/ANTH 183 Peoples and Cultures of Africa 4
AAS/POLS 205 The Political Development of American Race Relations 4
AAS/ART/GS 221 Global Contemporary: Recent Art Movements Around the World 4
AAS/POLS 230 Social Movements and Legacies of the 1960s 4
AAS 239 Special Topics in Africana Studies 4
AAS 263 Caribbean Artistic and Cultural Traditions 4
AAS/COMM 276 Media and Race 4
AAS/COMM 277 Race Representations & News Media 4
AAS/SOC/WGSS 310 Gender, Race and Sexuality: The Social Construction of Differences 4
AAS/FREN 312 Modernity in the Maghreb 4
AAS/SOC 313 Social Movements 4
AAS/ENGL 318 African-American Literature and Culture 3-4
AAS/ANTH/GS 324 Globalization and Development in Africa 4
AAS/HIST 330 Africans and the Atlantic World 4
AAS/HIST 331 United States and Africa 4
AAS/HIST 332 Slavery and the American South 4
AAS 339 Special Topics in Africana Studies 4
AAS/ASIA/GS/POLS 343 Global Politics of Race: Asia and Africa 4
AAS/SOC 345 Colonialism and the Black Radical Tradition 4
AAS 371 Independent Study 1-3
AAS 372 Independent Study 2-3
AAS/COMM/WGSS 376 New Media, Race and Gender 4
AAS/SOC 379 Race and Class in America 4
AAS 381 Special Topics 1-3
AAS 382 Seminar on a topic in Africana Studies 1-4
AAS 390 Honors Thesis 1-4
ARTS 250 Communications, Cultures, Behaviors and Attitudes 4
HIST 329 Global Africa: Aid, Volunteerism, NGOs and International Studies 3,4
HIST 334 American City in the Twentieth Century 4
MUS 130 Jazz Masters 3

Courses
AAS 003 Introduction to Africana Studies 4 Credits
AAS 005 (HIST 005) African Civilization 4 Credits
AAS 025 (REL 025) Introduction to Black Religions and Hip-Hop 4 Credits
AAS 038 (ENGL 038) Introduction to African Literature 3 Credits
AAS 039 Special Topics in Africana Studies 4 Credits
AAS 059 (THTR 059) West African Dance 2 Credits
AAS 062 (THTR 062) Black Theatre 4 Credits
AAS 066 (THTR 066) Hip Hop Dance 2 Credits

AAS 303 Introduction to Africana Studies 4 Credits
An interdisciplinary examination of the roots, culture, and politics of the modern black world through study of classic works in Africana Studies with emphasis on the continuities among African peoples worldwide and the social forces that have shaped contemporary black life in Africa and the Americas.

Attribute/Distribution: SS

AAS 005 (HIST 005) African Civilization 4 Credits
Sub-Saharan Africa through the millennia of the ancient world to the present. Human origins, state and non-state systems, the external slave trade; colonialism, resistance to European rule; independence movements; neo-colonialism.

Attribute/Distribution: SS

AAS 025 (REL 025) Introduction to Black Religions and Hip-Hop 4 Credits
Rapper KRS ONE once stated that, "Rap is something you do and Hip-Hop is something you live." This course thinks through the global evolution of Hip-Hop culture and the public and academic study of Black Religions as responses to structural and historical inequality and the search for meaning in culture by considering themes of resistance, constraint, power, the body, deviance, and morality over and against race, class, gender, and sexuality from a range of academic and cultural sources.

Attribute/Distribution: HU

AAS 038 (ENGL 038) Introduction to African Literature 3 Credits
Sub-Saharan African literary themes and styles, historical and social contexts, African folk tales, oral poetry, colonial protest literature, postcolonial writing, films on contemporary Africa.

Attribute/Distribution: HU

AAS 039 Special Topics in Africana Studies 4 Credits
Study of a subject or issue in Africana Studies not covered in other courses. May be repeated for credit as subtitle varies.

Repeat Status: Course may be repeated.

AAS 059 (THTR 059) West African Dance 2 Credits
This course will explore the dance movement and rhythms of West Africa. Students will learn African-based dance technique, characteristics, and the fundamental connection between the drums and the dance. Although some videos will be viewed, this is primarily a studio course; students should come prepared to move.

Repeat Status: Course may be repeated.

Attribute/Distribution: HU

AAS 062 (THTR 062) Black Theatre 4 Credits

Attribute/Distribution: HU

AAS 066 (THTR 066) Hip Hop Dance 2 Credits
Techniques, vocabulary, and history behind the various elements of the Hip Hop Movement. Focus upon the cultural influence of Hip Hop dance styles, and the overall social influence of the Hip Hop Movement.

Attribute/Distribution: HU
AAS 095 1-4 Credits
Repeat Status: Course may be repeated.

AAS 102 (ENGL 102, JST 102, REL 102) Promised Lands: Jewish and African American Children's Literature 4 Credits
In the Hebrew Bible, Psalm 137 asks, "How can we sing the Lord's song in a strange land?" For Jews, blacks, and black Jews, this was and is a poignant question. This course examines how these two rich, often overlapping and interacting groups tell their stories in literature for children and young adults, with a particular focus on the mediation of traumatic pasts. What does it mean to imagine promised lands beyond such pasts—and can they be reached?
Attribute/Distribution: HU

AAS 103 (SOC 103) Race and Ethnicity in the Contemporary U.S. 4 Credits
Examines race and ethnicity from a sociological perspective. Focus on the role of the major racial and ethnic communities in modern American society. Explores the roles of race and ethnicity in identity, social relations, and social inequality. Topics include racial and ethnic communities, minority/majority groups, assimilation, prejudice/discrimination, identity and the social construction of the concept of "race."
Attribute/Distribution: SS

AAS 106 (LAS 106) Race and Ethnicity in Latin America and the Spanish Speaking Caribbean 4 Credits
A sociological examination of race and a look at an individual's experience. We consider how concepts like "race" and "ethnicity" have been defined and how they have been institutionalized in law, government, social policy, social thought, and economic structures. We consider the importance of concepts like "race," "cultures," and "mestizaje" to our understanding of citizenship and national identity, and we address contemporary African and indigenous movements against racial inequality.
Attribute/Distribution: SS

AAS 117 (PHIL 117) Race, Racism, and Philosophy 4 Credits
An introduction to the philosophy born of struggle against racism and white supremacy. We will read the work of philosophers, mostly European, who quietly made modern racism possible by inventing the category of race, but we will concentrate on the work of philosophers, mostly of African descent, who for 200 years have struggled to force a philosophical critique of the category of race and the practice of white supremacy.
Attribute/Distribution: HU

AAS 120 (ENGL 120) Literature from Developing Nations 4 Credits
Contemporary literature from Africa, Central and South America, and Asia. Must have completed six hours of freshman English. Cannot be taken pass/fail.
Attribute/Distribution: HU

AAS 121 (ENGL 121) Topics in African-American Literature 4 Credits
Selected works of African American literature and/or the literatures of the African Diaspora. Must have completed six hours of first-year English. Cannot be taken pass/fail.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

AAS 124 (ART 124, GS 124) Arts of the Black World 16th-20th Centuries 4 Credits
This course covers artistic practices originating in Africa that subsequently influenced countless world cultures. The material covers artistic production and theory of arts of the enslaved populations in the AnteBellum South, early African American painting through the Harlem Renaissance, the religious arts of Haiti (Vodou) and Cuba (Santeria), and contemporary production from Black Brazilian, American and European artists. Students should be prepared to attend Museums/galleries during the semester.
Attribute/Distribution: HU

AAS 125 (ART 125, GS 125) Art and Architecture of Africa from Colonial to Contemporary Times 4 Credits
This course is structured around case studies of art and architecture from early traditions up through the present. The focus is on cultural production, religious and architecture (local as well as Christian and Muslim traditions), craftsmanship, style, materials, trade, and international exhibition of art objects in Museums. The literature draws from art historical, anthropological, and historical analyses as well as museum studies. Students should be prepared to attend Museums/galleries during the semester.
Attribute/Distribution: HU

AAS 128 (MUS 128) Jazz History I 3 Credits
A study of the roots of jazz. Starting in West Africa, the course traces the synthesis of African and European elements to 1945. Musicians covered are Gottshalk, Bolden, Morton, Armstrong, Hawkins, Basie, Ellington, and others.
Attribute/Distribution: HU

AAS 129 (MUS 129) Jazz History II 3 Credits
A survey of modern jazz from 1945 to present. Musicians covered include Parker, Gillespie, Monk, Davis, Coltrane, Hancock, and Coleman. Can be taken independently of Jazz History I, but the first course would be helpful.
Attribute/Distribution: HU

AAS 130 (HIST 130) African American History 4 Credits
Blacks in America from the first importation of Africans to the implementation of civil rights laws. West African origins, slave trade, slavery, free blacks and emancipation and study of Reconstruction, segregation, urbanization, and the struggle for racial equality.
Attribute/Distribution: SS

AAS 132 (THTR 132) Hip Hop Theatre 4 Credits
Introduction to the creation and performance of Hip Hop Theatre. Exploration of the history and culture of Hip Hop through original written material, live performance, music, film, video and web based content. Public Performances. Must have audition. Consent given by instructor.
Attribute/Distribution: HU

AAS 133 (FREN 133, HIST 133, LAS 133, MLL 133, POLS 133) Lehigh in Martinique: Globalization and Local Identity 3-4 Credits
This course is structured around case studies of art and architecture from early traditions up through the present. The focus is on cultural production, religious and architecture (local as well as Christian and Muslim traditions), craftsmanship, style, materials, trade, and international exhibition of art objects in Museums. The literature draws from art historical, anthropological, and historical analyses as well as museum studies. Students should be prepared to attend Museums/galleries during the semester.
Attribute/Distribution: HU

AAS 138 (ENGL 138) Introduction to African American Literature 4 Credits
Survey of African American prose narrative and poetry from the 18th century to the present. Features writers from the Harlem Renaissance, the Black Arts Movement, and the post Black Power era.
Attribute/Distribution: HU

AAS 139 Special Topics in Africana Studies 4 Credits
Study of a subject or issue in Africana Studies not covered in other courses. May be repeated for credit as subtitle varies.
Repeat Status: Course may be repeated.

AAS 140 (THTR 140) African American Theatre 4 Credits
Attribute/Distribution: HU
AAS 144 (SOC 144) Global Hip Hop and Social Change 4 Credits
Hip Hop has become a global phenomenon. We will analyze how and why socially Conscious Hip Hop, as a tool for social change, has expanded to Latin America, Africa, and the Middle East.
Attribute/Distribution: SS

AAS 145 (WGSS 145) African American Women Writers 4 Credits
Literature by African American women writers with a focus on the experiences and images of black women in the U.S. Explores the written portraits and voices of 20th century black female novelists and poets, including Hurston, Petry, Morrison, Angelou, and Walker.
Attribute/Distribution: SS

AAS 155 (LAS 155, SOC 155) Afro-Latino Social Movements in Latin America & the Caribbean 4 Credits
This focuses on Afro-Latinos who make up nearly 70% of the population of the Americas. Despite the large amount of people of African descent living in the Americas, Afro-Latinos are an understudied population who face significant amounts of racial discrimination in their countries. Who are Afro-Latinos? Where do they live? How are they challenging the racism that they face? These are questions we will tackle in this course.
Attribute/Distribution: SS

AAS 163 (SOC 163) Sociology of Hip Hop Culture 4 Credits
Hip Hop culture is a complex form of artistic practices reflecting and impacting the environments in which they were produced. Through readings, music and video, this class will uncover the origins of Hip Hop by examining the musical history of the Afro-diaspora in the 20th century. Further study will reveal how the young Bronx, NY underclass in the 1970s fused elements of past musical styles with their own personal and political expression that sparked a worldwide phenomenon and culture industry.
Attribute/Distribution: SS

AAS 166 (SOC 166) Wealth and Poverty in the United States 4 Credits
Examines the sociology of wealth and poverty affluence and disadvantage, "rags and riches" in American Society. Focus is a critical analysis of the wealth gap, its causes, consequences and social context. We will consider the roles of wealth and poverty in determining life chances and structuring opportunity, as well as their roles in the perpetuation of social inequality across generations. We will address contemporary debates surrounding public policy, tax laws, antipoverty programs and other reform efforts aimed at decreasing the gap between the "Haves" and the "Have-Nots."
Attribute/Distribution: SS

AAS 177 (LAS 177, SOC 177) Cuba: Race, Revolution and Culture 4 Credits
This course analyzes the role of race & "culture" in the Afro Cuban struggle for equality. By focusing on the arts: particularly music, film & literature, this course will analyze the development of race during Cuba’s colonial period; the Afro Cuban challenge to the "race blind" political and cultural movements of the Cuban Republic. We will then wrap up the semester by addressing the significance of contemporary cultural movements that challenge the social issues currently facing Afro Cubans.
Attribute/Distribution: SS

AAS 179 (HIST 179) Black Political Thought in America 4 Credits
Black leadership, organizations, and philosophy in America from Reconstruction to the Civil Rights Era; ideas and programs of Booker T. Washington, W.E.B. DuBois, Marcus Garvey, Malcolm X and Martin Luther King, Jr.
Attribute/Distribution: SS

AAS 183 (ANTH 183) Peoples and Cultures of Africa 4 Credits
Studies African modernity through a close reading of ethnographies, social stories, novels, and African feature films.
Attribute/Distribution: SS

AAS 205 (POLIS 205) The Political Development of American Race Relations 4 Credits
This course examines the distinctive role race has played in shaping the political history of the United States.
Attribute/Distribution: SS

AAS 221 (ART 221, GS 221) Global Contemporary: Recent Art Movements Around the World 4 Credits
This course introduces contemporary artworks from around the world and artists that produce them. Topics include movements emerging in the last 40 years, some of which are: Revolutionary arts, Globalism, EcoArt, Postcolonial arts, phenomenological, experiential and new media arts. Global feminist projects, design/build production, graffiti and popular arts will be covered regularly. The Dakar, Venice and Sao Paulo Art Biennials as well as Documenta are explored as vectors for international artistic exchange and dissemination. Rotating case studies on the international on international built environment (e.g. : Qatar, Dubai, Singapore, Dakar) will be featured. Art Theory will be explored through iconographic, formal and contextual (political, social, financial) analysis. Movements will be situated against their historical frameworks as well as explored for their international scope and value.
Attribute/Distribution: SS

AAS 230 (POLIS 230) Social Movements and Legacies of the 1960s 4 Credits
The lessons and legacies of 1960s social and political movements. Students examine civil rights, black power movements, the New Left, campus protests, the Vietnam war and antipartheid movement, the counterculture, women’s ecology movements and assess their connection to democracy, today’s world and their own lives.
Attribute/Distribution: SS

AAS 239 Special Topics in Africana Studies 4 Credits
Study of a subject or issue in Africana Studies not covered in other courses. May be repeated for credit as subtitle varies.
Repeat Status: Course may be repeated.

AAS 263 Caribbean Artistic and Cultural Traditions 4 Credits
Representation of contemporary popular culture in the Caribbean in literature, music, painting and other artistic expressions. Major attention is devoted to the influences on tradition, folklore and religion in modern Caribbean life.
Attribute/Distribution: SS

AAS 276 (COMM 276) Media and Race 4 Credits
Examines the representation of various races and ethnicities in news media as well as the impact of such portrayals upon public opinion, public policy and interpersonal life. Considers the role of print, broadcast and online media that perpetuate stereotypes and dominant understandings of various groups.
Attribute/Distribution: SS

AAS 277 (COMM 277) Race Representations & News Media 4 Credits
This course examines the representation of racial and ethnic minorities in American media and media outlets globally. It begins with a comparative analysis of majority/minority representations. It further analyzes the impact of such portrayals upon public opinion, public policy, and interpersonal life within the U.S. and abroad. Class discussions and assignments will address the role of print, broadcast and online media in shaping the contemporary dominant understandings of various racial groups in a globalized world and social constructions of reality.
Attribute/Distribution: SS

AAS 310 (SOC 310, WGSS 310) Gender, Race and Sexuality: The Social Construction of Differences 4 Credits
Students will engage with current debates about the meaning and use of racial and sexual classification systems in society. We will examine the historical and sociological contexts in which specific theories of racial and sexual differences emerged in the U.S. We will also explore the ways in which changes in the images have implications on the role racial, gender, and sexual identity plays in our understanding of the relationship between difference and inequality.
Prerequisites: SOC 103 or SSP 103
Attribute/Distribution: SS
AAS 312 (FREN 312) Modernity in the Maghreb 4 Credits
Emergence of the modern self through a comparative study of textual as well as visual representations of postcolonial subjects by male and female writers and film makers. Study of the way the sociopolitical context of countries such as Morocco, Algeria and Tunisia informs the constitution of subjectivity within a multicultural and multilingual community. Issues such as patriarchy, nationalism, colonialism, post colonialism, identity, gender, and Islam in North African literature and film from Franco-Arab traditions.
Attribute/Distribution: HU

AAS 313 (SOC 313) Social Movements 4 Credits
Explores the origins, dynamics, and consequences of social movements through both sociological theory and empirical case studies. Covers questions of what constitutes a social movement, where and when social movements arise, who joins a social movement, and how social movements are able to contribute to change. Answers to these questions highlight issues of social movement recruitment and leadership, interactions between movements and the media, the state, and the broader public, ideology, strategies and tactics, and the factors contributing to the success and failure of social movements. Course readings drawn from case studies on civil rights, women’s rights, gay rights, the environment, American Indians, abortion, globalization, antiapartheid, democratization, peace, and Islamic fundamentalism. Must have completed one 100-level SSP course.
Attribute/Distribution: SS

AAS 318 (ENGL 318) African-American Literature and Culture 3,4 Credits
Special Topics in African American culture and/or the cultures of the African diaspora. Topics may be focused by period, genre, thematic interest or interdisciplinary method including, for example, “Nineteenth-century African American Literature and Politics”, “African-American Folklore”, “Black Atlantic Literature”, “The Harlem Renaissance”, “African-American Women Writers”.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU, SS

AAS 324 (ANTH 324, GS 324) Globalization and Development in Africa 4 Credits
This course examines the challenges Africa presents to expectations of modernization and development. It poses these questions: Have African societies been left behind by globalization, shut out from it, or do they merely reflect an unexpected side of globalization processes? What is Africa’s place in the neoliberal world order? What role does “African culture” play in generating or blocking social change? And, how can anthropology illuminate prospects for change on what has long been regarded as the “dark continent”? 
Attribute/Distribution: SS

AAS 330 (HIST 330) Africans and the Atlantic World 4 Credits
This course chronicles the history of Africans and the Atlantic world from the fifteenth century. It explores cross-cultural interactions and exchanges between Africans and Europeans and covers major themes including trade, religion, slavery, abolition, identity, colonialism, gender, the "Back-to-Africa" movements and impact of Africans on Atlantic world history.
Attribute/Distribution: HU

AAS 331 (HIST 331) United States and Africa 4 Credits
Reciprocal relationships between North America and the African continent from the slave trade in the seventeenth century to the twentieth century Afrocentric movement; impact of Americans on shaping of modern Africa, Pan-African relations; influence of African Americans on U.S. policies toward Africa.
Attribute/Distribution: SS

AAS 332 (HIST 332) Slavery and the American South 4 Credits
The emergence and demise of the “peculiar institution” of African American slavery in British North America and the Old South. African background, colonial beginnings, 19th century slave community, the ruling race and preslavery ideology, the death of slavery and its aftermath, slavery and freedom in a comparative context.
Attribute/Distribution: SS

AAS 333 Special Topics in Africana Studies 4 Credits
Study of a subject or issue in Africana Studies not covered in other courses. May be repeated for credit as subtitle varies.
Repeat Status: Course may be repeated.

AAS 343 (ASIA 343, GS 343, POLS 343) Global Politics of Race: Asia and Africa 4 Credits
An examination of the concept of “race” and its impact on domestic and international politics.
Attribute/Distribution: SS

AAS 345 (SOC 345) Colonialism and the Black Radical Tradition 4 Credits
Karl Marx was not the only figure who developed an influential theory of social revolution. A cadre of theorists from the Global South have extensively theorized about the issues facing their particular nations, and they have developed social theories that have challenged social and global inequality. This course is a theory based course that will focus on the anti-colonial and post-colonial thought of radical black intellectuals from the Black America, the Caribbean, and West Africa.
Attribute/Distribution: SS

AAS 371 Independent Study 1-3 Credits
Independent study in advanced areas of Africana Studies. Independent research with an individual faculty member in the Africana Studies program. Consent of director.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

AAS 372 Independent Study 2-3 Credits
Independent study in advanced areas of Africana Studies. Independent research with an individual faculty member in the Africana Studies program. Consent of director.
Attribute/Distribution: ND

AAS 376 (COMM 376, WGSS 376) New Media, Race and Gender 4 Credits
This class explores the relationship among race, gender and new media. It examines depictions of racial minorities and women online; how users access and use new media across race and gender (including a look at the digital divide); and differences in use of social media websites across race and gender. The goal is for students to understand how existing racial and gender categorizations are not transmitted to the online community and do not become extensions of present social hierarchy.
Attribute/Distribution: SS

AAS 379 Race and Class in America 4 Credits
The ways in which race and class intersect in the social, economic, and political structures of American society. Through sociological literature, fiction, nonfiction, film, and other media we will explore the place of race and class in American society. We will examine how race and class operate on a personal, “micro” level, while at the same time operating on a large-scale, “macro” level.
Attribute/Distribution: SS

AAS 381 Special Topics 1-3 Credits
Attribute/Distribution: ND

AAS 382 Seminar on a topic in Africana Studies 1-4 Credits
Attribute/Distribution: ND

AAS 390 Honors Thesis 1-4 Credits
Directed undergraduate research thesis required of Africana Studies majors who apply for and qualify for graduation with program honors. Students must complete a minimum of 4 Honors Thesis credits and attain a 3.5 grade point average in the major and a 3.2 grade point average overall. Permission of the program director required.
Repeat Status: Course may be repeated.

AAS 391 Special Topics 3,4 Credits
American Studies

Website: http://american.cas2.lehigh.edu/
Offered at the graduate level, American Studies is the interdisciplinary study of American thought, literature, and culture—both past and present. Born in the early years of the Cold War and with an implied commitment to American exceptionalism, American Studies has since transformed itself into a multifaceted critical examination of United States society. Comparative frameworks along with close attention to applying cultural and literary theory to such matters as violence, citizenship, democracy, community, poverty and prosperity, politics, race, and gender in the United States make American Studies an intellectually sophisticated yet practical course of graduate study.

M.A. IN AMERICAN STUDIES

A Master of Arts degree in American Studies is offered in the College of Arts and Sciences. Candidates for the master’s degree must complete at least 30 credit hours, 18 of which must be at the 400 level.

AMST 400 American Studies: Theory and Method 3
Two humanities courses 1 6
Two social science courses 1 6
AMST 401 Special Topics in American Studies 3

Remaining courses for the master’s degree will be divided between:

AMST 490 Master’s Thesis 2

Other American Studies courses chosen at the student’s discretion and with the approval of the program director

Total Credits 30

1 Humanities courses include those offered in the departments of English, Art and Architecture, and Religion Studies. Social Studies courses include those offered in the departments of History, Political Science, Sociology and Anthropology, and Journalism and Communications.

2 To fulfill the thesis requirement students will write a long work of scholarship or two shorter papers, or create a documentary film.

GRADUATE CERTIFICATE IN DOCUMENTARY FILM

Designed to augment social science and humanities graduate students’ education and training for employment inside and outside of the academy, this certificate program covers 1) the historical development and distinctive attributes of documentary film, including the genre’s state of the art analytical techniques and computing technology; and with that, communicating research-based knowledge to general publics; and 2) the production of documentary text—from conceiving of a topic and “storyboarding” a narrative; to taking interviews; to composing and filming a variety of shots; and to editing visual and audio material into final digital form.

The program broadly defines documentary film to facilitate understanding and production of texts from Youtube-like social media to feature-length theatrically-released films.

Completion of 12 credits, no more than 6 credits at the 300-level.

AMST 425 Community Study Through Documentary Film 3
AMST 433 Documentary Film Production 3
Two courses in consultation with Graduate Certificate Director; possible courses include:

HIST 438 Techniques in Public History
HIST 305 Public History
HIST 336 Bethlehem and the Lehigh Valley
HIST 337 History and Community Memory

JOUR 325 Seminar in Journalism and Communication Issues

Total Credits 12

Courses

AMST 347 (PHIL 347, REL 347) American Religious Thinkers 4
This course provides an examination of the writings of key figures in the history of American religious thought (such as Edwards, Emerson, Bushnell, Peirce, James, Royce, Dewey and the Niebuhrs). Attention will be directed both to the historical reception of these writings and to their contemporary significance.

AMST 400 American Studies: Theory and Method 3 Credits
An introduction to the theoretical orientations and methodological strategies of American Studies. Seminar involves extensive reading as well as application of theory and method to students’ research.

AMST 401 Special Topics in American Studies 1-3 Credits
Graduate seminar focused on one particular subject area in American Culture.

AMST 402 Independent Study 3 Credits
Individually supervised course in the area of American Culture. Consent of the program director required.

AMST 425 Community Study Through Documentary Film 3 Credits
A film production course concentrating on lighting, sound, shooting interviews (among other types of shots), and Final Cut Pro editing matched with producing a team-made thirty-minute documentary film on a local historical or contemporary topic of critical interest.

AMST 433 Documentary Film Production 3 Credits
An independent study mode of course awarding credit for the production of a 30-minute documentary film that meets two standards: 1) high production value, and 2) scholarly content based on detailed research and driven by critical analysis.

AMST 471 Special Topics 3 Credits
AMST 481 Independent Study 1-3 Credits
AMST 482 Independent Study 1-3 Credits
AMST 490 Master’s Thesis 1-6 Credits
Independent work, with a faculty member, on a single master’s thesis or two thesis papers. Topic approved by individual faculty member. Typically taken in the last semester of course work.

Repeat Status: Course may be repeated.

American Studies

This interdisciplinary Master of Arts degree in American Studies is offered by a variety of departments in the humanities and social sciences across the College of Arts and Sciences. Candidates for the master’s degree must complete at least 30 credit hours. In addition to an introductory Theory and Methods course that all incoming students take in their first fall semester, students take two humanities and two social science courses, along with three additional courses of their choosing. Students also take six thesis credits to fulfill the MA thesis requirement. The final thesis can take the form of a long work of scholarship, two shorter papers, or a documentary film.

For more information visit American Studies.

Analytical Finance

ANALYTICAL FINANCE

This program provides students with a strong education in advanced finance and quantitative financial analysis tools to develop graduates who can create innovative solutions for real financial problems, using state of the art analytical techniques and computing technology. Students with undergraduate degrees in computer science, economics, engineering, finance, mathematics and the hard sciences should have the quantitative background needed for success in this field.

This program equips students with the necessary skill set to prepare for the Financial Risk Manager® examination offered by The Global Association of Risk Professionals (GARP). (http://www.garp.org)
Introduction to Financial Accounting 3

Stochastic Models and Applications 3

Total Credits 30

Note: Students with equivalent courses from an undergraduate degree program will be given credit for fulfilling the field requirement and will be permitted to replace the credits from the list of approved electives. The program director(s) must approve courses for each student’s choice of electives. Typically, a finance elective will be used to substitute for a finance course waiver; a computational elective to substitute for a statistics/econometric course, and programming elective for a computing course.

ADMISSIONS

Applications may be made through the Graduate Programs Office in the College of Business & Economics or through the Graduate Office of the P. C. Rossin College of Engineering and Applied Science. Applicants must take either the GRE or GMAT. International students must have 16 years of schooling with four years at the University level to be considered for admission. Applicants whose native language is not English are required to take the Test of English as a Foreign Language (TOEFL). Deadline for international students to apply is February 15. U.S. Citizens may apply until July 15.

Further information about the M.S. in Analytical Finance Program may be obtained by visiting http://cbe.lehigh.edu/msaf, contacting the Graduate Programs Office of the College of Business and Economics or one of the following Co-Directors:

Dr. Richard Kish, Perella Department of Finance, College of Business and Economics, Lehigh University, 621 Taylor Street, Bethlehem, PA 18015, phone (610) 758-4205, email: rjk7@lehigh.edu

Dr. Daniel Conus, Department of Mathematics, Lehigh University, 14 E. Packer Avenue, Bethlehem, PA 18015, phone (610) 758-3749, email: dac311@lehigh.edu

Dr. Luis Zuluaga, Department of Industrial and Systems Engineering, Lehigh University, 200 W. Packer Avenue, Bethlehem, PA 18015, phone (610) 758-5182 (http://catalog.lehigh.edu/coursesprogramsandcurricula/interdisciplinarygraduatestudyandresearch/analyticalfinance/tel: %28610%29%20758-5182), email: luis.zuluaga@lehigh.edu

Applied Science

Director, Associate Dean of the P.C. Rossin College of Engineering and Applied Science

The Applied Science Program enables students to create interdisciplinary specialties that prepare them for careers in a world that increasingly bridges academic disciplines. Students pursue subject-area concentrations that represent academic interests they wish to integrate into a meaningful program. The core offers students the intellectual tools to identify connections between the concentrations and engage in interdisciplinary problem-solving and critical thinking.

The program leads to the Bachelor of Science in Applied Science. Each student’s curriculum combines a general engineering education with a carefully customized concentration in engineering and/or science as well as another area of emphasis, which may include courses taken inside the P.C. Rossin College of Engineering & Applied Science and may also include courses taken in one or more of the other three Colleges within the University.

In order to ensure the success of this individualized approach to education, Applied Science places primary emphasis on advisement. Each student is teamed with an advisor who helps the student plan the
course of study and who supervises independent study and internships. The advisor remains the student’s advisor throughout his or her undergraduate career.

Unlike students in the traditional college programs, students in the Applied Science program of individualized study do not declare a major in a particular academic department. Instead, they develop a concentration that may combine study in several areas. Students are encouraged by their advisor to develop the concentration in such a way that the student will be well prepared for further study in graduate school or for pursuing a particular career path. While the chosen concentration can be highly customized in consultation with the advisor, examples of concentrations include: Technical Communications, Digital Media, Entertainment Science, Technology/Science and Education, Technology/Science and Pre-law, Technology/Science and Pre-Medicine, Technology Management, Technology Marketing, and Engineering and Architecture. Many other combinations are possible.

The requirements for a BS in Applied Science program are a minimum of 128 credit hours including:

### First Year Courses

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<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ENGL 001</td>
<td>Critical Reading and Composition</td>
<td>3</td>
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<tr>
<td>ENGL 002</td>
<td>Research and Argument</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 005</td>
<td>Introduction to Engineering Practice</td>
<td>2</td>
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<tr>
<td>ENGR 010</td>
<td>Applied Engineering Computer Methods</td>
<td>2</td>
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<tr>
<td>CHM 030</td>
<td>Introduction to Chemical Principles</td>
<td>4</td>
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<tr>
<td>PHY 011</td>
<td>Introductory Physics I</td>
<td>5</td>
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<tr>
<td>&amp; PHY 012</td>
<td>and Introductory Physics Laboratory I</td>
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<tr>
<td>MATH 021</td>
<td>Calculus I</td>
<td>4</td>
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<tr>
<td>MATH 022</td>
<td>Calculus II</td>
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### Other Natural Science

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<tbody>
<tr>
<td>EES 002</td>
<td>Introduction to Environmental Science</td>
<td>3</td>
</tr>
<tr>
<td>CHM 031</td>
<td>Chemical Equilibria in Aqueous Systems</td>
<td>4</td>
</tr>
<tr>
<td>EES 022</td>
<td>Exploring Earth</td>
<td>1</td>
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<tr>
<td>BIOS 041</td>
<td>Biology Core I: Cellular and Molecular</td>
<td>3</td>
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<tr>
<td>PHY 021</td>
<td>Introductory Physics II</td>
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<tr>
<td>&amp; PHY 022</td>
<td>and Introductory Physics Laboratory II</td>
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### Other Mathematics

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<tr>
<td>MATH 021</td>
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<td>MATH 022</td>
<td>Calculus II</td>
<td>4</td>
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<tr>
<td>MATH 023</td>
<td>Calculus III</td>
<td>4</td>
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<tr>
<td>MATH 205</td>
<td>Linear Methods</td>
<td>3</td>
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<tr>
<td>MATH 231</td>
<td>Probability and Statistics</td>
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### Required HSS courses

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<tbody>
<tr>
<td>ECO 001</td>
<td>Principles of Economics</td>
<td>4</td>
</tr>
<tr>
<td>PHIL 128</td>
<td>Philosophy Of Science</td>
<td>4</td>
</tr>
<tr>
<td>or HIST 008</td>
<td>Technology in Modern America</td>
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<tr>
<td>or HIST 145</td>
<td>Introduction to the History of Science</td>
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<tr>
<td>or POLS 106</td>
<td>Environmental Values and Ethics</td>
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<tr>
<td>PSYC 001</td>
<td>Introduction to Psychology</td>
<td>4</td>
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### Humanities & Social Science electives

Select 13 additional credits subject to college requirements. 13

### Major electives

Select 24 credits 24

### Approved electives

Select 18 credits 18

### Total Credits

128

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**Art, Architecture, and Design**

The three primary disciplines of the Department of Art, Architecture and Design share a common focus on design, visual literacy, the creative process and the making of the built environment. The emphasis on design as a broad concept begins to shape aesthetic principles, and initiates the structuring of the individual’s creative process. To that end, the department offers undergraduate Bachelor of Arts degrees in four majors: art, architecture, design, and art history. Minor programs are available in studio art, architecture, graphic design, product design, history of the visual arts, history of architecture, and museum studies.

Many studio courses require department permission. The student interested in enrolling in any of the department’s courses should contact the program coordinator to schedule an appointment with an advisor well before preregistration so that he or she can be rostered at the appropriate time.

An art major centers on studio education wherein principal disciplines such as drawing, sculpture, painting and photography are explored. The student is required to engage in an intense concentration in studio work at Lehigh and when appropriate at other Lehigh Valley colleges that offer complementary courses. Studio work is enhanced by courses in history and theory, both within the department and throughout the university.

For the student interested in becoming a creative artist, the major provides a foundation for a life in art, or more immediately the potential path into a graduate degree program in fine art. A major in art may be combined with theater for those interested in costume design, or with architecture and theater for those who aspire to be set designers. A major in art combined with a minor in education is available for students interested in becoming primary, secondary or special education art teachers.

The architecture major is a pre-professional course of study focused on architectural design studies, complemented by art studios, history and theory courses, and introductory materials and building technology courses. The major results in a Bachelor of Arts degree.

The architecture major is a comprehensive undergraduate education that is the first step in a series of educational and apprenticeship requirements leading to professional registration. Architecture majors regularly go on to the most respected graduate schools of architecture, with Harvard, the University of Pennsylvania, University of Virginia, and Washington University in St. Louis, among scores of institutions, actively seeking Lehigh graduates for their programs.

Alternatively, many architecture majors choose to work in fields allied to the discipline, such as interior design, adaptive reuse building, historic preservation, construction management, real estate development, etc. Since for such paths professional architectural registration is not required, the Lehigh degree alone is the springboard to various careers that involve the making of the built environment.

(The Bachelor of Arts degree with a major in architecture should not be confused with the Bachelor of Architecture, a professional five-year degree. Those students who major in architecture and graduate with the Bachelor of Arts degree wish to pursue a professional career in architecture will be required to obtain a Master of Architecture from an institution offering a graduate program in architecture.)

The Arts-Engineering program, a five-year, dual-degree course of study, allows students to link complementary disciplines of engineering and architecture. The result is two degrees from two different colleges within Lehigh, one a professional degree in engineering, one the pre-professional degree in architecture.

A design major engages students with new technologies, materials and media in developing the creative processes and critical thinking necessary for the modern designer. The major centers on studio wherein an emphasis on visual communication through digital media is complemented by the traditional focus on art making. Courses in art and design history and theory and in specific media techniques supplement the series of required studios.

A student may take a range of department courses in design or may choose a specific concentration in either graphic design or product design. The graphic design concentration introduces students to the tools and media related to print applications, web-based media, exhibition design, publishing and advertising. Product design concerns the creation of objects used in industrial applications, art objects, furniture, toys, exhibits and trade design, electronic products, household items and recreational equipment.

An art history major provides students with a comprehensive education in the history of art and architecture, and an opportunity to learn about the changing form and status of the visual arts and built environment in
Culture and society. Through introductory and advanced coursework, as well as museum and site visits, students learn how to examine, evaluate, and interpret works of art and architecture, and acquire a working knowledge of the methods, theories and research practices of art historical analysis.

The study of art and its history is a vital and fundamental part of a liberal arts education, and art history is unique among academic fields in the breadth and diversity of its objects of study: drawing, painting, sculpture, and printmaking; architecture, design, and urban planning; photography and film; material culture; as well as a variety of other cultural forms. Students majoring in art history go on to careers in art, architecture, design, curating, communications, imaging, advertising, education, and many other fields. The major also provides an important foundation for students who plan to pursue advanced graduate studies in the arts and humanities. Art history majors choose one of three areas of concentration: history of the visual arts, history of architecture, or museum studies.

All programs are philosophically cross-disciplinary, as students are encouraged to take advantage of the many learning environments that constitute a university. Significant resources for all disciplines in the department include the Lehigh University permanent art collection and archives as well as the numerous on-campus galleries and the Zoellner Art Center. Students are encouraged to make use of the collections and facilities to enhance and enrich studios and courses, and to help shape their own creative work.

The department offers minor programs in studio art, architecture, graphic design, product design, history of the visual arts, history of architecture, museum studies that are available to all undergraduate students. The purpose of these minor programs is to enable students from any major to be introduced to the studio practices of art, architecture, and design, and to help form an understanding of the role that art plays in human history and culture.

**DEPARTMENTAL HONORS**

Exceptional students in art, architecture or design may apply for department honors at the end of their junior year or the beginning of their senior year. To be eligible, a student must have attained a 3.5 GPA in the major program and a minimum overall GPA of 3.0. Candidates should submit to the department chair a written proposal, prepared in consultation with a faculty member who will serve as honors sponsor. The project could result in a research paper, design project, or exhibition. Successful completion of the project will result in a “Department Honors” designation being affixed to the student’s transcript.

**Professors.** Berrisford W. Boothe, MFA (Maryland Institute College of Art); Lucy C Gans, MFA (Pratt Institute); Ricardo Viera, MFA (Rice Island School of Design); Anthony Viscardi, MArch (Georgia Institute of Technology)

**Associate Professors.** Anna Chupa, MFA (University of Delaware); Amy Forsyth, MArch (Princeton University); Brian Wesley Heiss, MArch (Rice University); Marilyn Jane Jones, MFA (Marywood University); Nicholas Sawicki, PhD (University of Pennsylvania); J. Bruce Thomas, PhD (University of California Berkeley)

**Assistant Professors.** Hyun-Tae Jung, PhD (Columbia University); Susan E. Kart, PhD (Columbia University); Nikolai P. Nikolov, MArch (Rice University)

**Lecturer.** Jason E. Travers, MFA (University of Pennsylvania)

**Professor Of Practice.** Christine E. Ussler, MArch (Columbia University)

**Emeriti.** Carlos Alvare, MArch (Yale University); Tom F. Peters, DSc (ETH Zurich); Richard J. Redd, MFA (University of Iowa); Ivan Zaknic, MArch (Princeton University)

**ART MAJOR**

44 credit hours required

**Foundation**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ART 001</td>
<td>Art and Architecture History: Ancient to Medieval</td>
</tr>
<tr>
<td>ART 002</td>
<td>Art History: Renaissance to Present</td>
</tr>
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</table>

**History**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>ART 220</td>
<td>20th Century Art</td>
</tr>
<tr>
<td>OR</td>
<td></td>
</tr>
<tr>
<td>ART 221</td>
<td>Global Contemporary: Recent Art Movements Around the World</td>
</tr>
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</table>

**Studio - Two entry level discipline specific art studios**

<table>
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<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>ART 007</td>
<td>Digital Photography I</td>
</tr>
<tr>
<td>ART 011</td>
<td>Drawing I</td>
</tr>
<tr>
<td>ART 013</td>
<td>Sculpture I</td>
</tr>
<tr>
<td>ART 015</td>
<td>Figure I</td>
</tr>
<tr>
<td>ART 034</td>
<td>Plein Air Painting</td>
</tr>
<tr>
<td>ART 035</td>
<td>Painting I</td>
</tr>
<tr>
<td>ART 052</td>
<td>Introduction to Video Recording and Editing</td>
</tr>
</tbody>
</table>

**Two ART 217 Studio Workshops**

<table>
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<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>ART 217</td>
<td>Studio Workshop (Repeate twice for the major program)</td>
</tr>
</tbody>
</table>

**One Capstone**

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<th>Title</th>
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<tbody>
<tr>
<td>ART 317</td>
<td>Art Capstone</td>
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</tbody>
</table>

**Total Credits**

44

**ART HISTORY MAJOR**

37-40 credit hours are required.

**Foundation**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>ART 001</td>
<td>Art and Architecture History: Ancient to Medieval</td>
</tr>
<tr>
<td>ART 002</td>
<td>Art History: Renaissance to Present</td>
</tr>
<tr>
<td>ART 003</td>
<td>Two-Dimensional Design</td>
</tr>
<tr>
<td>ART 004</td>
<td>Three-Dimensional Design</td>
</tr>
<tr>
<td>ART 011</td>
<td>Drawing I</td>
</tr>
</tbody>
</table>

**Concentration and Electives - Six classes**

Concentration - Select one of the following concentrations:

**History of the Visual Arts**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ART 220</td>
<td>20th Century Art</td>
</tr>
<tr>
<td>ART 221</td>
<td>Global Contemporary: Recent Art Movements Around the World</td>
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**History of Architecture**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>ARCH 002</td>
<td>Architectural History II</td>
</tr>
<tr>
<td>ARCH 210</td>
<td>20th Century Architecture</td>
</tr>
<tr>
<td>ARCH 107</td>
<td>History of American Architecture</td>
</tr>
</tbody>
</table>

**Museum Studies**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>ART 175</td>
<td>Introduction to Museum Work</td>
</tr>
<tr>
<td>ART 275</td>
<td>Museums: Research, Collections Management and Exhibition Planning</td>
</tr>
<tr>
<td>ART 276</td>
<td>Museums: Education, Communication and Exhibition Design</td>
</tr>
<tr>
<td>ART 375</td>
<td>Museum Internship</td>
</tr>
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</table>

**Electives**

See footnote instructions, and choose from any of the courses listed above, as well as the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>ART 069</td>
<td>Special Topics in Art History</td>
</tr>
<tr>
<td>ART/WGSS 121</td>
<td>Women in Art</td>
</tr>
<tr>
<td>ART 124</td>
<td>Arts of the Black World 16th-20th Centuries</td>
</tr>
<tr>
<td>ART 125</td>
<td>Art and Architecture of Africa from Colonial to Contemporary Times</td>
</tr>
<tr>
<td>ART 169</td>
<td>Special Topics in Art History</td>
</tr>
<tr>
<td>ART/ARCH/ANTH/CLSS 174</td>
<td>Greek Archaeology</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ART/HIST 183</td>
<td>France from Medieval to Modern: Politics, Society and Art</td>
</tr>
<tr>
<td>ART/ARCH/ANTH/CLSS 176</td>
<td>Roman Archaeology</td>
</tr>
<tr>
<td>ART 222</td>
<td>Seminar in Art History</td>
</tr>
<tr>
<td>ART 227</td>
<td>Latino Visual Arts and Culture in American Art</td>
</tr>
<tr>
<td>ART 228</td>
<td>Photography as Contemporary Art</td>
</tr>
<tr>
<td>ART 269</td>
<td>Special Topics in Art History</td>
</tr>
<tr>
<td>ART 370</td>
<td>Special Topics in Museum and Curatorial Studies</td>
</tr>
<tr>
<td>ART 389</td>
<td>Honors Project</td>
</tr>
<tr>
<td>ARCH 134</td>
<td>Architecture and Urbanism of New York City</td>
</tr>
<tr>
<td>ARCH 209</td>
<td>Architecture and Ideas</td>
</tr>
<tr>
<td>ARCH 212</td>
<td>The Architecture of Carlos Scarpa/ Theory and Practice</td>
</tr>
<tr>
<td>ARCH 214</td>
<td>Architecture and the City since WWII</td>
</tr>
<tr>
<td>ARCH 253</td>
<td>Paris: Plan of Metropolises</td>
</tr>
<tr>
<td>ARCH 271</td>
<td>Special Topics in Architecture</td>
</tr>
<tr>
<td>ARCH 335</td>
<td>Issues in Contemporary Architecture</td>
</tr>
<tr>
<td>DES 066</td>
<td>Design History</td>
</tr>
<tr>
<td>DES/THTR 129</td>
<td>History of Fashion and Style</td>
</tr>
<tr>
<td>DES 266</td>
<td>History of Contemporary Design</td>
</tr>
<tr>
<td>ANTH 172</td>
<td>North American Archaeology</td>
</tr>
<tr>
<td>ANTH 112</td>
<td>Doing Archaeology</td>
</tr>
<tr>
<td>ANTH 175</td>
<td>Britain After the Romans</td>
</tr>
<tr>
<td>ANTH 177</td>
<td>Britain Before the Romans</td>
</tr>
<tr>
<td>ANTH 178</td>
<td>Mesoamerican Archaeology</td>
</tr>
<tr>
<td>ANTH 340</td>
<td>Archaeological Theory</td>
</tr>
<tr>
<td>ANTH 370</td>
<td>Historical Archeology</td>
</tr>
<tr>
<td>HIST 333</td>
<td>American City to 1900</td>
</tr>
<tr>
<td>HIST 334</td>
<td>American City in the Twentieth Century</td>
</tr>
<tr>
<td>HIST 339</td>
<td>Managing Nonprofit Organizations</td>
</tr>
<tr>
<td>HIST 350</td>
<td>19th Century Paris and the Invention of Modernity</td>
</tr>
<tr>
<td>LAS/SPAN 265</td>
<td>Spanish and Latin American Cinema</td>
</tr>
<tr>
<td>PHIL 123</td>
<td>Art, Beauty, and Aesthetic Experience</td>
</tr>
<tr>
<td>PHIL 223</td>
<td>Figures/Themes In Aesthetics</td>
</tr>
<tr>
<td>MLL 100</td>
<td>Introduction to International Film</td>
</tr>
<tr>
<td>MLL 073</td>
<td>Film, Fiction, and Gender in Modern China</td>
</tr>
<tr>
<td>GERM 231</td>
<td>New German Cinema</td>
</tr>
<tr>
<td>SPAN 265</td>
<td>Spanish and Latin American Cinema</td>
</tr>
<tr>
<td>FREN 322</td>
<td>Contemporary French Films</td>
</tr>
</tbody>
</table>

1 Elective requirements normally consist of three courses (9-12 credit hours). For students in the museum studies concentration, elective requirements consist of two courses (6-8 credit hours).

**ARCHITECTURE MAJOR**

62-64 credit hours are required.

**Foundation**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ART 001</td>
<td>Art and Architecture History: Ancient to Medieval</td>
</tr>
<tr>
<td>ART 002</td>
<td>Architectural History II</td>
</tr>
<tr>
<td>ART 003</td>
<td>Two-Dimensional Design</td>
</tr>
<tr>
<td>ART 004</td>
<td>Three-Dimensional Design</td>
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</table>

**Architecture Studios**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>ARCH 043</td>
<td>Architectural Design I</td>
</tr>
<tr>
<td>ARCH 143</td>
<td>Architectural Design II</td>
</tr>
<tr>
<td>ARCH 243</td>
<td>Architectural Design III</td>
</tr>
<tr>
<td>ARCH 343</td>
<td>Architectural Design IV</td>
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</table>

**Additional Studios**

Select three of the following: 11-12

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>ART 007</td>
<td>Digital Photography I</td>
</tr>
<tr>
<td>ART 011</td>
<td>Drawing I</td>
</tr>
<tr>
<td>ART 013</td>
<td>Sculpture I</td>
</tr>
<tr>
<td>ART 015</td>
<td>Figure I</td>
</tr>
<tr>
<td>ART 034</td>
<td>Plein Air Painting</td>
</tr>
<tr>
<td>ART 035</td>
<td>Painting I</td>
</tr>
<tr>
<td>ART 052</td>
<td>Introduction to Video Recording and Editing</td>
</tr>
<tr>
<td>ART 111</td>
<td>Drawing II</td>
</tr>
<tr>
<td>ART 113</td>
<td>Sculpture II</td>
</tr>
<tr>
<td>ART 115</td>
<td>Figure II</td>
</tr>
<tr>
<td>ART 135</td>
<td>Painting II</td>
</tr>
<tr>
<td>DES 148</td>
<td>Furniture Design I</td>
</tr>
<tr>
<td>DES 248</td>
<td>Furniture Design II</td>
</tr>
<tr>
<td>ARCH 033</td>
<td>Architectural Drawing</td>
</tr>
<tr>
<td>ARCH 123</td>
<td>Visualization and Fabrication in Architecture</td>
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<tr>
<td>ARCH 211</td>
<td>Architectural Drawing/Analysis and Expressions</td>
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**History and Theory**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>ARCH 210</td>
<td>20th Century Architecture</td>
</tr>
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</table>

Select two of the following: 7-8

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>ARCH 107</td>
<td>History of American Architecture</td>
</tr>
<tr>
<td>ARCH 159</td>
<td>Modern History and Sustainable Architecture in Munich</td>
</tr>
<tr>
<td>ARCH 174</td>
<td>Greek Archaeology</td>
</tr>
<tr>
<td>ARCH 134</td>
<td>Architecture and Urbanism of New York City</td>
</tr>
<tr>
<td>ARCH 176</td>
<td>Roman Archaeology</td>
</tr>
<tr>
<td>ARCH 187</td>
<td>Synthetic Space</td>
</tr>
<tr>
<td>ARCH 209</td>
<td>Architecture and Ideas</td>
</tr>
<tr>
<td>ARCH 212</td>
<td>The Architecture of Carlos Scarpa/ Theory and Practice</td>
</tr>
<tr>
<td>ARCH 214</td>
<td>Architecture and the City since WWII</td>
</tr>
<tr>
<td>ARCH 342</td>
<td>Theory of Form and Materials</td>
</tr>
<tr>
<td>ARCH 335</td>
<td>Issues in Contemporary Architecture</td>
</tr>
<tr>
<td>PHIL 123</td>
<td>Art, Beauty, and Aesthetic Experience</td>
</tr>
<tr>
<td>HIST 334</td>
<td>American City in the Twentieth Century</td>
</tr>
<tr>
<td>DES 066</td>
<td>Design History</td>
</tr>
<tr>
<td>ART 124</td>
<td>Arts of the Black World 16th-20th Centuries</td>
</tr>
<tr>
<td>ART 125</td>
<td>Art and Architecture of Africa from Colonial to Contemporary Times</td>
</tr>
<tr>
<td>ART 221</td>
<td>Global Contemporary: Recent Art Movements Around the World</td>
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</table>

**Materials and Technology**

<table>
<thead>
<tr>
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<th>Course Title</th>
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<tbody>
<tr>
<td>ARCH 157</td>
<td>Architectural Technology I</td>
</tr>
<tr>
<td>ARCH 158</td>
<td>Architectural Technology II</td>
</tr>
</tbody>
</table>

**Total Credits** 62-64

For the Architecture Major, students must fulfill the mathematics and physical science requirements with the following:

**Mathematics Requirement**

Select one of the following: 5-8

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>MATH 021</td>
<td>Calculus I</td>
</tr>
<tr>
<td>MATH 022</td>
<td>Calculus II</td>
</tr>
<tr>
<td>MATH 051</td>
<td>Survey of Calculus I</td>
</tr>
<tr>
<td>MATH 052</td>
<td>Survey of Calculus II</td>
</tr>
<tr>
<td>MATH 075</td>
<td>Calculus I, Part A</td>
</tr>
<tr>
<td>MATH 076</td>
<td>Calculus I, Part B</td>
</tr>
<tr>
<td>MATH 022</td>
<td>Calculus II</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 075</td>
<td>Calculus I, Part A</td>
</tr>
<tr>
<td>&amp; MATH 076</td>
<td>and Calculus I, Part B</td>
</tr>
<tr>
<td>&amp; MATH 052</td>
<td>and Survey of Calculus II</td>
</tr>
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### Physical Science Requirement

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>PHY 012</td>
<td>Introductory Physics Laboratory I</td>
</tr>
</tbody>
</table>

Select one of the following:

- PHY 010 | General Physics I
- or PHY 011 | Introductory Physics I

A typical first-year might consist of:

<table>
<thead>
<tr>
<th>First Year</th>
<th>First Semester</th>
<th>Credits</th>
<th>Second Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Art and Architecture History: Ancient to Medieval</td>
<td>ART 001</td>
<td>4</td>
<td>ARCH 002</td>
<td>4</td>
</tr>
<tr>
<td>MATH 021 or MATH 051</td>
<td>MATH 021 or MATH 051</td>
<td>4</td>
<td>MATH 022 or MATH 052</td>
<td>4</td>
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<tr>
<td>ENGL 001</td>
<td>3</td>
<td>PHY 010 or PHY 011 (Or</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>ART 003</td>
<td>4</td>
<td>ART 004</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-year seminar</td>
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<td></td>
<td></td>
<td>ENGL 002</td>
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Total Credits: 32

### Design Major

#### Foundation

<table>
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<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
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<td>Art and Architecture History: Ancient to Medieval</td>
</tr>
<tr>
<td>ART 002</td>
<td>Art History: Renaissance to Present</td>
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<tr>
<td>ART 003</td>
<td>Two-Dimensional Design</td>
</tr>
<tr>
<td>ART 004</td>
<td>Three-Dimensional Design</td>
</tr>
<tr>
<td>ART 011</td>
<td>Drawing I</td>
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#### History

<table>
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<th>Course Title</th>
<th>Credit</th>
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<tbody>
<tr>
<td>ART 220</td>
<td>20th Century Art</td>
<td>4</td>
</tr>
<tr>
<td>or ART 221</td>
<td>Global Contemporary: Recent Art Movements Around the World</td>
<td></td>
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#### Core Concentration

**Graphic Design**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>DES 053</td>
<td>Introduction to Graphic Design</td>
</tr>
<tr>
<td>DES 153</td>
<td>Graphic Design: Word and Image</td>
</tr>
<tr>
<td>DES 253</td>
<td>Graphic Design: Brand Experience</td>
</tr>
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Plus three elective studios from following:

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
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<tbody>
<tr>
<td>ART 007</td>
<td>Digital Photography I</td>
</tr>
<tr>
<td>ART 035</td>
<td>Painting I</td>
</tr>
<tr>
<td>DES 040</td>
<td>Product Design I: Form, Process and Concept</td>
</tr>
<tr>
<td>DES 070</td>
<td>Web Design I</td>
</tr>
<tr>
<td>DES 170</td>
<td>Web Design II</td>
</tr>
<tr>
<td>DES 385</td>
<td>Fusion: Design Practice</td>
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**Product Design**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>DES 040</td>
<td>Product Design I: Form, Process and Concept</td>
</tr>
<tr>
<td>DES 140</td>
<td>Product Design II: Designing for Others</td>
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<tr>
<td>DES 240</td>
<td>Product Design III: Materials to Market</td>
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</tbody>
</table>

Plus three elective studios from following:

<table>
<thead>
<tr>
<th>Course Code</th>
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</thead>
<tbody>
<tr>
<td>ART 013</td>
<td>Sculpture I</td>
</tr>
<tr>
<td>DES 053</td>
<td>Introduction to Graphic Design</td>
</tr>
<tr>
<td>DES 070</td>
<td>Web Design I</td>
</tr>
<tr>
<td>DES 148</td>
<td>Furniture Design I</td>
</tr>
</tbody>
</table>

Total Credits: 48

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### Architecture Courses

**ARCH 002 Architectural History II 4 Credits**

Survey of architecture from the Renaissance to the present, examined in the context of culture formation, design concepts, and the built environment.

**Attribute/Distribution:** HU

**ARCH 010 (CEE 010) Engineering/Architectural Graphics and Design 3 Credits**

Graphical communication of civil engineering or architectural projects using manual techniques and commercial state-of-the-art computer software. Topics include visualization and sketching; orthographic, isometric and other drawings; points, lines and planes in descriptive geometry; site design; overview of geographical information systems and 3D applications. Teamwork on design projects with oral and graphical presentations. Open to a limited number of architecture, design arts or other students with project roles consistent with students’ background. Not available to students who have taken MECH 19.

**Attribute/Distribution:** ND

**ARCH 033 Architectural Drawing 4 Credits**

Introduction to architectural hand drawing including orthographic, paraline, and perspective drawing types. Studio course.

**Attribute/Distribution:** HU

**ARCH 043 Architectural Design I 4 Credits**

Fundamental design studio for architecture majors. Composition, spatial concepts; precedent; materials and detail; light and color in architecture. Instruction in basic communication techniques.

**Repeat Status:** Course may be repeated.

**Prerequisites:** ART 004

**ARCH 071 Special Topics in Architecture 1-4 Credits**

Directed projects for students in architecture. Student must initiate contact with sponsoring professor. Permission of Instructor required.

**Repeat Status:** Course may be repeated.

**Attribute/Distribution:** HU

**ARCH 107 History of American Architecture 4 Credits**

Survey of American building from European colonization to the present.

**Prerequisites:** ART 001 and ARCH 002

**Attribute/Distribution:** HU

**ARCH 123 Visualization and Fabrication in Architecture 4 Credits**

This course concentrates on visualization and fabrication in architecture. Students are introduced to advanced architectural diagramming and model-making as well as conventional and digital representation skills. This course investigates architectural graphics as an active means of communication and as a generative element in organizing architectural space. Precedents and examples are extensively researched. All exercises are designed to enhance students’ ability to imagine and visualize complex architectural forms and spaces. Various architectural materials are employed and tested.

**Attribute/Distribution:** HU

**ARCH 134 Architecture and Urbanism of New York City 4 Credits**

This course deals with the architecture and urbanism of New York City. It focuses on the twentieth century and occasionally covers other historical periods as well. With the direction of the instructor, students visit and analyze, formally and historically, important structures and places of the city such as museums, transportation hubs, offices, parks and other landmarks of interest. Cultural and sociological as well as architectural readings are offered and discussed. There are six mandatory field trips to New York City led by the instructor. Consent of instructor required.

**Attribute/Distribution:** HU

**ARCH 143 Architectural Design II 4 Credits**

Studio format, introductory course in architectural design which introduces students to new ways of thinking about architecture and the perception of space, three-dimensional composition, drawing, and model-making. Previous or concurrent courses in studio art and/or architectural history are recommended.

**Repeat Status:** Course may be repeated.

**Prerequisites:** ARCH 043

**Attribute/Distribution:** HU
ARCH 157 Architectural Technology I 4 Credits
The two-course sequence (ARCH 157 & ARCH 158) introduces the use of building materials, components and systems (slabs, walls, trusses, facade systems, etc.) while providing students with the knowledge to design and construct comfortable, technically sound and aesthetically pleasing buildings.
Attribute/Distribution: HU

ARCH 158 Architectural Technology II 4 Credits
The two-course sequence (ARCH 157 & ARCH 158) introduces the use of building materials, components and systems (slabs, walls, trusses, facade systems, etc.) while providing students with the knowledge to design and construct comfortable, technically sound and aesthetically pleasing buildings.
Attribute/Distribution: HU

ARCH 159 Modern History and Sustainable Architecture in Munich 3 Credits
This Lehigh faculty-led study abroad program allows students from an array of majors to earn three credits over winter break. The program will explore the history, culture, and architecture of Munich, a capital and center of the southern state of Germany, Bavaria. The program of study does not require German language skills.
Attribute/Distribution: HU, SS

ARCH 161 (THTR 161) Performing Arts Venue Design and Technology 4 Credits
Designing theatres. Theatre equipment systems and acoustics. Function and form.
Attribute/Distribution: HU

ARCH 171 Special Topics in Architecture 1-4 Credits
Directed projects for students in architecture. Student must initiate contact with sponsoring professor. Must have major standing in department and/or consent of instructor.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ARCH 174 (ANTH 174, ART 174, CLSS 174) Greek Archaeology 4 Credits
Ancient Greek cultures from the neolithic to hellenistic periods. Reconstructions of Greek social dynamics from study of artifacts.
Attribute/Distribution: SS

ARCH 176 (ANTH 176, ART 176, CLSS 176) Roman Archaeology 4 Credits
Cultures of the Roman Empire. Reconstructions of social, political, and economic dynamics of the imperial system from study of artifacts.
Attribute/Distribution: SS

ARCH 187 Synthetic Space 4 Credits
This course addresses formal concerns in contemporary architecture. Synthetic space exists between the actual and the virtual, between the analogue and the digital. The course will be a pure exploration of the possibilities of space, through animation and creative model making and deployment of parametric modeling software, film sets and motion graphics. Software tutorials will be given as needed.
Attribute/Distribution: HU

ARCH 209 Architecture and Ideas 4 Credits
Examination of philosophical, technological, and cultural forces shaping Western architecture and urbanism. Writing intensive.
Prerequisites: ART 001 and ARCH 002
Attribute/Distribution: HU

ARCH 210 20th Century Architecture 4 Credits
History and theories of modern and contemporary architecture. Analysis of buildings, architects, theories and manifestos from the early 20th century to the present.
Prerequisites: ART 001
Attribute/Distribution: HU

ARCH 211 Architectural Drawing/Analysis and Expressions 3 Credits
This studio course is part of the Lehigh in Italy summer program and will utilize several different architectural drawing techniques to study aspects of architecture from analysis of a piazza to architecture in detail. It will employ pencil sketching, charcoal drawing, and watercolor. These drawings will act as a way of seeing the Italian urban landscape and supplement the study and analysis of the Italian architects’ contemporary work. Fulfills an art studio elective requirement.
Attribute/Distribution: HU

ARCH 212 The Architecture of Carlos Scarpa/Theory and Practice 3 Credits
This course which is part of the Lehigh in Italy summer program will survey several of the Venetian architect's most famous works. Meet with architects who worked with Scarpa and completed his unfinished projects. Explore thematic principles behind Scarpa's work, their origin and roll in his unique process of design.
Attribute/Distribution: HU

ARCH 214 Architecture and the City since WWII 4 Credits
Architectural and urban theories and projects from 1945 to the present. Analysis of the relationship between architecture and the city.
Prerequisites: (ARCH 002 or ART 002)
Attribute/Distribution: HU

ARCH 234 Architectural Design III 4 Credits
Continuation of ARCH 143. Design principles of space and form stressed in earlier studios to issues of “materiality,” “structure,” “modes of representation” and the “process of making.”
Repeat Status: Course may be repeated.
Prerequisites: ART 001 and ARCH 143
Attribute/Distribution: HU

ARCH 253 (GS 253, HIST 253) Paris: Plan of Metropolis 3 Credits
The splendor of modern Paris is due in large part to bold, large scale modernization and changes in the city’s patterns during the 19th century. This course, which is part of the Lehigh in Paris summer program, will cover a century of change and focus on the major accomplishments of its visionary planners.
Attribute/Distribution: HU

ARCH 254 Modern Architecture in France: New Directions 3 Credits
The course, which is part of the Lehigh in Paris summer program, will cover the most important contributions to modern architecture in the Paris region including Centre Pompidou, Musee d’Orsay, Le Grand Louvre, Parc de la Villette, La Defense, and the new satellite towns around Paris.
Attribute/Distribution: HU

ARCH 271 Special Topics in Architecture 1-4 Credits
Directed projects for advanced students in architecture or architectural criticism. Must have major standing in the department or permission of the instructor. Student must contact sponsoring professor and complete a contract sheet at preregistration.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ARCH 300 Apprentice Teaching 1-4 Credits
Supervised participation in various aspects of the teaching of a course. Transcript will identify department in which apprentice teaching was performed. Consent of department chair required. The transcript will reflect the subject area in which the teaching was done.
Repeat Status: Course may be repeated.

ARCH 311 Portfolio 1 Credit
The concept, layout, and preparation of a portfolio for graduate school application or employment search, including graphic techniques and reproduction method. Student must contact sponsoring professor.
Prerequisites: ARCH 243
Attribute/Distribution: HU
ARCH 335 Issues in Contemporary Architecture 4 Credits
Seminar on selective architectural topics from the 1960s to the present. Analysis of important architectural projects and theories. Interaction among architecture and social, economic, political and technological changes.
Prerequisites: ART 001 and ARCH 002
Attribute/Distribution: HU

ARCH 342 Theory of Form and Materials 4 Credits
Study of the genesis of form, its representation and its interrelationship to related artistic disciplines. Formal notions will be studied, compared and manipulated through the role of time, scale, perceptual analysis and material transformation. Consent of instructor required.
Attribute/Distribution: HU

ARCH 343 Architectural Design IV 4 Credits
The design of buildings and building groups, with the emphasis on urban design and the city.
Repeat Status: Course may be repeated.
Prerequisites: ARCH 243
Attribute/Distribution: HU

ARCH 389 Honors Project 1-8 Credits
Repeat Status: Course may be repeated.

Art Courses

ART 001 Art and Architecture History: Ancient to Medieval 4 Credits
Survey of art and architecture around the globe, from the world's earliest artistic and architectural production through the 14th century. European, Middle Eastern, Asian, African and Central and South American works are covered. The course also serves as an introduction to the vocabulary, concepts, and methods of art and architectural history.
Attribute/Distribution: HU

ART 002 Art History: Renaissance to Present 4 Credits
Survey of art and architecture from the Renaissance through the contemporary era. Examining developments in printing, sculpture, and built environment, as well as the rise of media such as printmaking and photography, the course explores the changing form and status of the visual arts in modern culture and society.
Attribute/Distribution: HU

ART 003 Two-Dimensional Design 4 Credits
This class will present the foundations necessary to understand, discuss and create in the two-dimensional visual world. Using variety of materials and techniques and digital media, students will explore the concepts of line, form, shape, value, texture, space and color. Required for all Architecture, Art, Art History and Design majors.
Attribute/Distribution: HU

ART 004 Three-Dimensional Design 4 Credits
An introduction to the basic elements and principles of design. Involves use of various materials to solve 3D design problems in studio and computer lab. Problem solving in variety of materials for 3D design including assemblages, models, constructions, and conceptual forms. Required for all majors in department.
Attribute/Distribution: HU

ART 007 Digital Photography I 4 Credits
Intensive work in photography as fine art using digital input and output. Lectures, demonstrations, critiques.
Attribute/Distribution: HU

ART 011 Drawing I 4 Credits
Projects directed toward developing design in sculpture. Exploration of materials and their application. Emphasis on sculptural form as it relates to techniques.
Attribute/Distribution: HU

ART 015 Figure I 4 Credits
Drawing and modeling in clay from direct observation of the human figure. Fundamental principles of drawing, and two- and three-dimensional design through analysis of the human form. Inclass exercises cover basic scale, proportion, structure, drawing media and techniques, and clay modeling. Emphasis on personal expression, the human figure as vehicle for narrative, abstract or formal drawings or sculpture.
Attribute/Distribution: HU

ART 034 Plein Air Painting 4 Credits
Students will paint outdoors during weekly excursions to local sites. An additional lecture and critique period will present the fundamentals of materials and technique. Summers. No prior experience required.
Attribute/Distribution: HU

ART 035 Painting I 4 Credits
Painting in oil beginning with color mixing and basic layering techniques. Students learn the basic mechanisms for creative expression. Emphasis on understanding the physical nature of the materials. Studio.
Prerequisites: ART 003 or ART 004 or ART 011
Attribute/Distribution: HU

ART 037 Survey of Printmaking 4 Credits
An introduction to the fundamentals of printmaking. Students will gain an understanding of the technical processes and the visual language of different printmaking techniques. Students examine historical approaches and context while exploring contemporary modes of expression. Students are encouraged to complete a drawing studio before taking this course.
Prerequisites: ART 003
Attribute/Distribution: HU

ART 052 Introduction to Video Recording and Editing 4 Credits
We will consider the interaction of image, sequence, motion, time and audio with video to create associative, abstract, documentary and narrative videos. Workshops in camera use, editing, concept development, lighting, sound and DVD authoring.
Attribute/Distribution: HU

ART 068 Color Theory 4 Credits
Application of color in design. Color in graphics, product, digital imaging, and all related fields of design.
Attribute/Distribution: HU

ART 069 Special Topics in Art History 1-4 Credits
Directed projects for students in the history of art or architecture. Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ART 073 Introductory Studio Practice 1-4 Credits
An introduction to the methods and techniques of studio art. Designed to acquaint the student with general studio practice, covering topics not covered in other specific studio course listings.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ART 111 Drawing II 4 Credits
Projects in creative drawing designed to build on concepts and practices initiated in basic drawing and life drawing.
Prerequisites: ART 011
Attribute/Distribution: HU

ART 113 Sculpture II 4 Credits
Development of principles and techniques in Sculpture I. Modeling, casting, fabrication and carving. Emphasizes an approach to sculptural form and an exploration of the evolution of modern sculpture.
Prerequisites: ART 013
Attribute/Distribution: HU

ART 115 Figure II 4 Credits
Projects in figure modeling and drawing from direct observation of the human figure, designed to build on concepts and practices initiated in Figure I. Students may elect to concentrate in one particular medium, although the primary investigation of form will always incorporate both two and three dimensional work.
Prerequisites: ART 015
Attribute/Distribution: HU
ART 121 (WGSS 121) Women in Art 4 Credits
A history of women artists from Renaissance to present day, with emphasis on artists of the 20th and 21st century from a global perspective. We explore attitudes toward women artists and their work as well as the changing role of women in art world. There may be required visits to museums and/or artists' studios.
Attribute/Distribution: HU

ART 124 (AAS 124, GS 124) Arts of the Black World 16th-20th Centuries 4 Credits
This course covers artistic practices originating in Africa that subsequently influenced countless world cultures. The material covers artistic production and theory of arts of the enslaved populations in the AnteBellum South, early African American painting through the Harlem Renaissance, the religious arts of Haiti (Vodou) and Cuba (Santeria), and contemporary production from Black Brazilian, American and European artists. Students should be prepared to attend Museums/galleries during the semester.
Attribute/Distribution: HU

ART 125 (AAS 125, GS 125) Art and Architecture of Africa from Colonial to Contemporary Times 4 Credits
This course is structured around case studies of art and architecture from early traditions up through the present. The focus is on cultural production, religious art and architecture (local as well as Christian and Muslim traditions), craftsmanship, style, materials, trade, and international exhibition of art objects in Museums. The literature draws from art historical, anthropological, and historical analyses as well as museum studies. Students should be prepared to attend Museums/galleries during the semester.
Attribute/Distribution: HU

ART 135 Painting II 4 Credits
A sustained exploration of paint media. Students concentrate on developing a body of related images using various media and approaches.
Prerequisites: ART 035
Attribute/Distribution: HU

ART 152 Experimental Animation and Video 4 Credits
An exploration of time, motion and interactivity in a series of conceptual and technical projects dealing with advanced digital imaging and nonlinear video editing. We will consider the interaction of image, sequence, motion, animation, and audio with video.
Prerequisites: ART 052
Attribute/Distribution: HU

ART 169 Special Topics in Art History 1-4 Credits
Directed projects for students in the history of art or architecture. Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ART 173 Special Topics in Studio Practice 1-4 Credits
Directed projects in art. Permission of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ART 174 (ANTH 174, ARCH 174, CLSS 174) Greek Archaeology 4 Credits
Ancient Greek cultures from the neolithic to hellenic periods. Reconstructions of Greek social dynamics from study of artifacts.
Attribute/Distribution: SS

ART 175 Introduction to Museum Work 4 Credits
Introduction to the world of museums, surveying theory and practice through readings and class discussions in all aspects of museums (A to Z), art galleries and art/historical management. The course combines in situ (LUAG/Museum Operation) instruction, conversations with museum professionals and hands-on experience. Students complete several interactive (PB & CL) exercises/projects.
Attribute/Distribution: HU

ART 176 (ANTH 176, ARCH 176, CLSS 176) Roman Archaeology 4 Credits
Cultures of the Roman Empire. Reconstructions of social, political, and economic dynamics of the imperial system from study of artifacts.
Attribute/Distribution: SS

ART 183 (GS 183, HIST 183) France from Medieval to Modern: Soc., Pol. & Art 3 Credits
France's artistic, cultural, social, artistic and political development from early kingship and dominance of the Church in the Middle Ages to the grandeur of Versailles in the Age of Absolutism; radical transformations of culture and society during the French Revolution and advent of the Modern Nation-State; to twentieth century developments including the two World Wars, imperialism and impact of post-war globalization. Offered in summer only through Lehigh Study Abroad Office as part of Lehigh in Paris program.
Attribute/Distribution: HU

ART 213 Sculpture Workshop 4 Credits
An advanced studio emphasizing sculpture within a contemporary context. Through the exploration of various concepts, material processes and rigorous critique, the student works toward developing their own unique vision and practice.
Repeat Status: Course may be repeated.
Prerequisites: ART 013 and (DES 004 or ART 004)
Attribute/Distribution: HU

ART 215 Figure III 4 Credits
Further exploration of the human figure as the subject of art. More advanced students may elect to concentrate in either two or three dimensional representations in any media. The emphasis will be on personal interpretation and independent work with the instructor.
Prerequisites: ART 115
Attribute/Distribution: HU

ART 217 Studio Workshop 4 Credits
Studio Workshop is available to any student who has completed a first level discipline specific art studio such as Drawing I, Figure I, Painting I, Digital Photography I or Sculpture I and is designed for intermediate to advanced work in a specified medium. Course may be repeated.
Repeat Status: Course may be repeated.
Prerequisites: ART 011 or ART 013 or ART 015 or ART 035
Attribute/Distribution: HU

ART 220 20th Century Art 4 Credits
Introduction to the major developments of 20th century art, including cubism, futurism, surrealism, abstract expressionism, pop, performance and new media art. The course merges classroom lectures with discussion and museum visits.
Prerequisites: ART 002
Attribute/Distribution: HU

ART 221 (AAS 221, GS 221) Global Contemporary: Recent Art Movements Around the World 4 Credits
This course introduces contemporary artworks from around the world and artists that produce them. Topics include movements emerging in the last 40 years, some of which are: Revolutionary arts, Globalism, EcoArt, Postcolonial arts, phenomenological, experiential and new media arts. Global feminist projects, design/build production, graffiti and popular arts will be covered regularly. The Dakar, Venice and São Paulo Art Biennials as well as Documenta are explored as vectors for international artistic exchange and dissemination. Rotating case studies on the international on international built environment (e.g.: Qatar, Dubai, Singapore, Dakar) will be featured. Art Theory will be explored through iconographic, formal and contextual (political, social, financial) analysis. Movements will be situated against their historical frameworks as well as explored for their international scope and value.
Attribute/Distribution: HU

ART 222 Seminar in Art History 4 Credits
In this seminar students undertake sustained and focused study of select themes and topics from the history of art. Particular attention is devoted to learning the methods, theories, and research practices that art historians use to interpret and understand art. Seminar topics change annually.
Repeat Status: Course may be repeated.
Prerequisites: ART 002 or ART 001
Attribute/Distribution: HU
ART 227 (LAS 227) Latino Visual Arts and Culture in American Art 4 Credits
Because art has no country, but the artist does, is contemporary art a product of globalization? Is Latino and Latin American art, culture and art criticism a nationalistic platform of cultures. Who’s who in the current Latino and Latin American art world? Students will utilize works from the university (LUAG) collection and/or research and interview a contemporary artist at his or her studio (if possible) for essays or media projects.
Attribute/Distribution: HU

ART 228 (LAS 228) Photography as Contemporary Art 4 Credits
A history of photography in an in-situ class, at the LUAG Teaching Collection Visual Laboratories and Integrated Open Storage classroom. The course will explore the power of photographs as a dominant 21st Century universal visual art form, emphasizing Latino and Latin American photography. The students will progressively work their way through today’s explosive array of digital, one channel video, photobase and conceptual discourses of our remix culture through evolutionary image-making of the 20th and 19th Century, and the uses of photographic processes that have enriched our perceptions and our world. Readings, group discussions and individual research. The course will conclude with a final project/paper: a one figure or theme paper and a small group/team project (to be determined later). This will constitute the transformative approach to study the state of photography today.
Attribute/Distribution: HU

ART 269 Special Topics in Art History 1-4 Credits
ART 269. Special Topics in Art History (1-4) Directed projects for advanced students in the history of art or architecture. Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ART 273 Special Topics in Studio Practice 1-4 Credits
Individually directed projects for advanced students capable of undertaking independent creative work in studio art. Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ART 275 Museums: Research, Collections Management and Exhibition Planning 4 Credits
Theory and practice in contemporary museums and galleries through readings and class discussion. Practicum at the LUAG/Museum Operation dealing with care of museum collections, collection management, intellectual and practical tasks of preparing and communicating through exhibitions, and the professional responsibilities of the curator and curatorial staff. Students will complete a number of exercises and a research report or equivalent.
Repeat Status: Course may be repeated.
Prerequisites: ART 175
Attribute/Distribution: HU

ART 276 Museums: Education, Communication and Exhibition Design 4 Credits
Theory and practice in contemporary museums and galleries through readings and class discussions. Practicum in the LUAG/Museum Operation dealing with design and installation of exhibitions; educational programming and the community; organization, principles of management and strategic planning; museum advocacy. Students complete a number of exercises and a research report or equivalent.
Prerequisites: ART 175
Attribute/Distribution: HU

ART 317 Art Capstone 4 Credits
Art Capstone is offered to senior art majors and is taught collectively by the studio art faculty. Students focus on understanding and articulating their own interests and vision through research, written work, creation of new works of art, and critique. Instructor permission required.
Attribute/Distribution: HU

ART 350 Special Topics in Graphic Design and Theory Seminar 1-4 Credits
Current topics in graphic communication theory and practice. will cover preparation, production, and formulation of individual portfolio. Selected readings and discussions in professional ethics as well as legal issues in the field will be covered.
Repeat Status: Course may be repeated.
Prerequisites: ART 253 or DES 253
Attribute/Distribution: ND

ART 356 Advanced Seminar in Art History 4 Credits
In this upper level seminar, students undertake advanced study of select themes and topics from the history of art. Special emphasis is accorded to the practical application of art historical methods, theories, and research practices. Students pursue advanced research projects related to the seminar topic, which changes annually.
Prerequisites: ART 201 and ART 202 and ART 220
Attribute/Distribution: HU

ART 370 Special Topics in Museum and Curatorial Studies 1-4 Credits
Special project and/or internship for graduate and advanced undergraduates.
Repeat Status: Course may be repeated.
Prerequisites: ART 275 or ART 276
Attribute/Distribution: HU

ART 373 Studio Art Internship 1-4 Credits
Practical infield experience in an artist’s studio or art-related apprenticeship opportunity. Requires approval a semester in advance by instructor and host organization.
Attribute/Distribution: ND

ART 375 Museum Internship 1-4 Credits
Internship under professional supervision in all areas of museums and/or related organizations, regionally, nationally or abroad in well established or accredited institutions. Students must initiate contact/application. A contractual agreement or letter of acceptance is required. Consent of department required.
Prerequisites: ART 276 or ART 275
Attribute/Distribution: ND

ART 389 Honors Project 1-8 Credits
Repeat Status: Course may be repeated.

Design Courses
DES 040 Product Design I: Form, Process and Concept 4 Credits
Introduction to the field of Industrial Design. Through research, analysis, drawing and prototyping, students will acquire an understanding of the various aesthetic, technological, and business issues a designer must consider when creating a product. Consent of department required.
Prerequisites: (ART 003 or ART 011) and ART 004
Attribute/Distribution: HU

DES 053 Introduction to Graphic Design 4 Credits
This course serves as an introduction to the graphic design process, with a primary focus on concept development and craft. Students examine how to identify and resolve visual problems and learn the basics of design and typography. Creative solutions will be encouraged for projects with practical applications. Topics include logo development and execution, professional typography, image basics and resolution, print production, studio skills and professional practices. Digital applications include Photoshop, Illustrator and In-design.
Prerequisites: ART 003
Attribute/Distribution: HU

DES 066 Design History 4 Credits
History of product design, graphic design and time-based media in artistic, cultural, technological, and business contexts.
Attribute/Distribution: HU
DES 070 Web Design I 4 Credits
Introduction to the design and fabrication of web pages. Students will learn how to create pages using HTML and web fabrication software, with an emphasis on aesthetic and structure.
Prerequisites: ART 003
Attribute/Distribution: HU

DES 073 Special Topics in Design 1-4 Credits
An introduction to methods and techniques of design studio. Designed to acquaint the student with general design elements, covering topics not covered in other specific studio course listings. Instructor permission required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

DES 079 (ASIA 079) Digital Bridges 2 Credits
Run as an independent study: research ancient Chinese bridges, gardens, and pavilions. Digitize images and website design. Create photographic documentation of the Bridge Project. Produce documentary from historical materials concerning history of Chinese students at Lehigh. Bridge Project students could continue project work in Shanghai and Beijing.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

DES 087 Design for the Theatre 4 Credits
Introduction to the process of creating integrated designs in theatre production. The study and practice of the principles of visual representation, historical and conceptual research and the study of theatrical styles.
Attribute/Distribution: HU

DES 111 (THTR 111) Sound Design 2 Credits
Techniques, materials, and methods of designing sound for theatrical production.
Attribute/Distribution: HU

DES 129 (THTR 129, WGSS 129) History of Fashion and Style 4 Credits
Dress and culture in the Western Hemisphere from prehistory to today. The evolution of silhouette, garment forms and technology. The relationship of fashion to politics, art and behavior. Cultural and environmental influences on human adornment.
Attribute/Distribution: HU

DES 138 Introduction to Metalworking 3 Credits
An introduction to welding and metal forming through a series of practical design projects. Exploration of metal as a medium in both art and design. Practical application of design process, presentation and craft. Acquired skills in stick arc welding, MIG welding, plasma torch and other metal bending and forming techniques.
Attribute/Distribution: HU

DES 140 Product Design II: Designing for Others 4 Credits
This course will expose students to client based projects and issues of branding relevant to the product designer. Special emphasis will be given to functionality from a user centered perspective. Projects will also include the use of 3D digital prototyping software and computer based fabrication techniques.
Prerequisites: DES 040
Attribute/Distribution: HU

DES 148 Furniture Design I 4 Credits
Design methodology, fabrication techniques, and methods of design presentation.
Prerequisites: ART 004
Attribute/Distribution: HU

DES 153 Graphic Design: Word and Image 4 Credits
This course explores techniques of image making in relation to analyzing and creating meaning in graphic and typographic messages. Students solve visual communication problems with visual, conceptual and social impact. Assignments may include book covers, posters, music packaging, and promotional materials. Students will work in both traditional and digital media. May be repeated for credit once under different instructor.
Repeat Status: Course may be repeated.
Prerequisites: ART 053 or DES 053
Attribute/Distribution: HU

DES 154 (THTR 154) Scene Painting 4 Credits
Study and practice of basic and advanced methods of painting for the theatre. Includes basic elements and principles of design, color theory, the influence of light, atmosphere and aesthetics for the theatre.
Attribute/Distribution: HU

DES 155 (THTR 155) Model Building and Rendering 4 Credits
The art and practice of model building and rendering for the stage. Special techniques including scale furniture, soldering, acrylic painting and hand drafting.

DES 164 Ergonomics 4 Credits
Introduction to physical, emotional, and psychological ways design interacts with people. Analyze real design problems and create solutions.
Attribute/Distribution: HU

DES 170 Web Design II 4 Credits
Creation of dynamic content in web design. Various 2D animation software applications and simple scripting will be explored.
Prerequisites: DES 070
Attribute/Distribution: HU

DES 173 Special Topics in Design 1-4 Credits
Directed projects in design with selected readings as required. Student must initiate contact with sponsoring professor. Instructor permission required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

DES 186 (THTR 186) Lighting Design 4 Credits
An introduction to the art and practice of lighting design for the theatre. Script analysis, research, and the interplay of lighting technology and design. Students will develop a sense of the dramatic while creating a portfolio of lighting designs.
Attribute/Distribution: HU

DES 188 (THTR 188) Scenic Design 4 Credits
An introduction to the art and practice of scenic design for the theatre. Script analysis, research, drafting and modeling techniques. Students will develop a sense of the dramatic while creating a portfolio of scenic designs.
Attribute/Distribution: HU

DES 189 (THTR 189) Costume Design 4 Credits
An introduction to the art and practice of costume design for the theatre. Script analysis, research, and rendering techniques. Students will develop a sense of the dramatic while creating a portfolio of costume designs.
Attribute/Distribution: HU

DES 212 (BUS 212, ENGR 212) Integrated Product Development (IPD) 2 2 Credits
Business, engineering, and design arts students work in cross disciplinary teams of 4-6 students on the detailed design including fabrication and testing of a prototype of the new product designed in the IPD course 1. Additional deliverables include a detailed production plan, marketing plan, detailed base case financial models, project and product portfolio. Teams work on projects with external sponsors, from student start-ups to global industries, mentored by faculty or graduate student advisers. Oral presentations and written reports.
Prerequisites: BUS 211 or DES 211 or ENGR 211 or ME 211
Attribute/Distribution: ND

DES 240 Product Design III: Materials to Market 4 Credits
In this advanced level studio students will research fabrication techniques and materials, develop ideas into prototypes, outsource production and sell their designs in a competitive retail market. This course confronts the financial realities of being an independent designer while offering an opportunity to create innovative and desirable domestic products.
Prerequisites: DES 040
Attribute/Distribution: HU

DES 248 Furniture Design II 4 Credits
Advanced fabrication. Contemporary art issues and furniture history.
Repeat Status: Course may be repeated.
Prerequisites: DES 148
Attribute/Distribution: HU
DES 253 Graphic Design: Brand Experience 4 Credits
Students examine the basic principles of corporate identity and develop a clear understanding of the process of creating brands. Projects will offer a framework for looking at business strategy as it relates to the creative process of design. Emphasis will be placed on creating visual elements that support a brand and the steps a designer takes to create a consistent brand. In addition, students will develop self-promotion materials and identity systems. May be repeated for credit once under different instructor.
Repeat Status: Course may be repeated.
Prerequisites: DES 053
Attribute/Distribution: HU

DES 260 Exhibit Design 4 Credits
Team projects in development of exhibits for museums, conferences, or educational centers. Project work is supplemented by lectures and demonstrations. Teams will produce real and virtual exhibit prototypes and will design and maintain an exhibit website.
Attribute/Distribution: HU

DES 266 History of Contemporary Design 4 Credits
History of modern design from mid 19th century to the present. Studies and discussion of contemporary issues and technology in Design Arts. Topics will include green design, digital technology, current legal and ethical principles, and other issues.
Attribute/Distribution: HU

DES 268 Advanced Design Projects 1-4 Credits
Advanced projects or studies applying Design Arts practices or theories. Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

DES 300 Apprentice Teaching 1-4 Credits

DES 311 Design Portfolio 1-4 Credits
The concept, layout, and preparation of a portfolio for graduate school application or employment search, including graphic techniques and reproduction method. Student must contact sponsoring professor.
Repeat Status: Course may be repeated.
Prerequisites: DES 240 or DES 253

DES 348 Furniture Design III 4 Credits
Advanced fabrication, contemporary art issues and furniture history.
Prerequisites: DES 248
Attribute/Distribution: HU

DES 370 Special Topics in Design 1-4 Credits
Current topics in design, with selected readings, discussions, and studio work as required. Must have completed two 100-level Design courses. Consent of department required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

DES 375 Design Internship 1-4 Credits
Practical experience following apprenticeship model. Requires approval of instructor and host prior to beginning of the term, with a memorandum of understanding outlining student work responsibilities and educational objectives for the experience.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

DES 385 Fusion: Design Practice 4 Credits
Fusion offers students the opportunity to apply graphic design skills to a wide variety of real world projects. Run as a design agency, students work in teams, interact with clients, explore the creative process and gain valuable experience. Design assignments include branding & Identity, poster & promotion design, exhibition design, and a multitude of other opportunities, including interdisciplinary and self-initiated design projects. The focus is on strategic design thinking, project management and collaborative teamwork.
Repeat Status: Course may be repeated.
Prerequisites: DES 053
Attribute/Distribution: HU

DES 387 (THTR 387) Scenography II 4 Credits
Advanced projects in theatrical design. Portfolio readiness and resume preparation.
Prerequisites: (THTR 087 or DES 087) and (THTR 186 or DES 186 or THTR 188 or DES 188 or THTR 189 or DES 189)
Attribute/Distribution: HU

DES 389 Honors Project 1-8 Credits
Repeat Status: Course may be repeated.

Arts-Engineering

Program director. Bruce Thomas, Ph.D., (University of California, Berkeley), associate professor of architecture, College of Arts and Sciences. The Arts-Engineering program provides the student with an opportunity to experience the breadth of an arts education and simultaneously follow the focused curriculum of an engineering major. This is a five-year, dual degree program administered by the College of Arts and Sciences. An Arts-Engineering graduate is awarded two bachelors degrees, one from the College of Arts and Sciences and another from the College of Engineering and Applied Science, the latter a professional degree.

A typical freshman year class schedule for an Arts-Engineer is shown below. Note that an Arts-Bioengineering program has a different freshman year class schedule.

First Year
First Semester CR Second Semester CR
ENGL 001 3 ENGL 002 3
MATH 021 4 MATH 022 4
PHY 011 5 ENGR 005 2
& PHY 012 (Dept) 90 College Seminar 1-4 CHM 030 4
or FYC ENGR 010 2 Humanities /Social Science Elective 3-4

Total Credits: 31-35

Selection of a major in the College of Engineering and Applied Science occurs prior to beginning the sophomore year. A major leading to a degree in the College of Arts and Sciences should be chosen prior to beginning the junior year.

Arts-Engineering candidates should recognize that pursuit of a bachelor of science degree (e.g., biology, chemistry, biochemistry, earth and environmental sciences, mathematics, and physics) or a bachelor of arts program with larger than average credit requirements (e.g., art, architecture, physical sciences, cognitive science, international careers, among others) will severely restrict choices of free electives.

Courses selected must fulfill major and distribution requirements of both the College of Arts and Sciences and the College of Engineering and Applied Science.

For all students, very careful planning of the academic program done in consultation with advisers in both colleges is necessary to guarantee completion of all major, distribution and total credit requirements for the two degrees in five years.

When selected properly, courses meet distribution requirements in the College of Arts and Sciences while also satisfying distribution requirements of the College of Engineering and Applied Science.

A course of study in Arts-Engineering may link any College of Engineering and Applied Science discipline degree program with any College of Arts and Sciences major. Please see individual departments for details concerning required courses and sequences for completing discipline – specific degrees and combinations of degree requirements for Arts Engineering. Below is a template listing all courses required for a civil engineering-architecture combination (the most common Arts-Engineering linkage). Please note that the large number of required credits for both degrees means that this combination results in a larger number of total credits than is required for some other combinations.
CIVIL ENGINEERING - ARCHITECTURE

A total of 164-169 credits is needed for the Bachelor of Science in Civil Engineering and the Bachelor of Art in Architecture degrees.

**First Year**

<table>
<thead>
<tr>
<th>First Semester</th>
<th>CR</th>
<th>Second Semester</th>
<th>CR</th>
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</thead>
<tbody>
<tr>
<td>ENGL 001</td>
<td>3</td>
<td>ENGL 002</td>
<td>3</td>
</tr>
<tr>
<td>MATH 021</td>
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<td>MATH 022</td>
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<td>PHY 011</td>
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<td>CHM 030</td>
<td>4</td>
</tr>
<tr>
<td>PHY 012</td>
<td>1</td>
<td>ENGR 010</td>
<td>2</td>
</tr>
<tr>
<td>(Dept) 90 College Seminar or FYC</td>
<td>1</td>
<td>Humanities /Social Science Elective</td>
<td>3-4</td>
</tr>
<tr>
<td>ENGR 005</td>
<td>2</td>
<td></td>
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</tr>
</tbody>
</table>

**Total Credits: 15-18**

**Second Year**

<table>
<thead>
<tr>
<th>First Semester</th>
<th>CR</th>
<th>Second Semester</th>
<th>CR</th>
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<tbody>
<tr>
<td>MATH 023</td>
<td>4</td>
<td>MATH 205</td>
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<tr>
<td>CEE 003</td>
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<td>CEE 059</td>
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</tr>
<tr>
<td>CEE 010</td>
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<td>PHY 021 &amp; PHY 022</td>
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<tr>
<td>ART 001</td>
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<td>ART 002</td>
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<tr>
<td>ART 003</td>
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<td>ART 004</td>
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**Total Credits: 16-17**

**Third Year**

<table>
<thead>
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<th>CR</th>
<th>Second Semester</th>
<th>CR</th>
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<tbody>
<tr>
<td>CEE 123</td>
<td>3</td>
<td>CEE 117</td>
<td>2</td>
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<tr>
<td>CEE 011</td>
<td>1</td>
<td>CEE 222</td>
<td>3</td>
</tr>
<tr>
<td>CEE 012</td>
<td>2</td>
<td>ARCH 143</td>
<td>4</td>
</tr>
<tr>
<td>CEE 121</td>
<td>3</td>
<td>ECO 001</td>
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<tr>
<td>ARCH 043</td>
<td>4</td>
<td>Architectural History Elective$^1$</td>
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</tr>
</tbody>
</table>

**Basic Science Elective$^4$** 3

**Total Credits: 18-19**

**Fourth Year**

<table>
<thead>
<tr>
<th>First Semester</th>
<th>CR</th>
<th>Second Semester</th>
<th>CR</th>
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</thead>
<tbody>
<tr>
<td>CEE 142</td>
<td>3</td>
<td>CEE 202</td>
<td>3</td>
</tr>
<tr>
<td>CEE 159</td>
<td>4</td>
<td>CEE 242</td>
<td>3</td>
</tr>
<tr>
<td>ARCH 243</td>
<td>4</td>
<td>CEE 262 or 264</td>
<td>3</td>
</tr>
<tr>
<td>ARCH 157</td>
<td>4</td>
<td>ARCH 343</td>
<td>4</td>
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<td></td>
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<td>ARCH 210</td>
<td>4</td>
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**Total Credits: 16**

**Fifth Year**

<table>
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<th>First Semester</th>
<th>CR</th>
<th>Second Semester</th>
<th>CR</th>
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</thead>
<tbody>
<tr>
<td>CEE 203</td>
<td>2</td>
<td>CEE 170</td>
<td>4</td>
</tr>
<tr>
<td>Civil Engineering Approved electives$^6$</td>
<td>8-9</td>
<td>CEE 290$^3$</td>
<td>3</td>
</tr>
</tbody>
</table>

**Architectural History Elective$^1$** 4

**Civil Engineering Approved elective$^6$** 6

**Art Studio Elective** 4

**Total Credits: 15-17**

**Total Credits: 164-169**

1. One Architectural History elective should be filled by a course designated (SS) in order to fulfill the social science distribution requirement.
2. Of 17 CEE approved elective credits required for Civil Engineering three credits are satisfied by ARCH 343.
3. Multidisciplinary teaming versions of CEE 205 or CEE 381 can be substituted with departmental permission.
4. Basic Science Elective - List of approved courses is available from the CEE department.

**Asian Studies**

**Program Director:** Kiri Lee, Ph. D. (Harvard)

**Email:** kjl2@lehigh.edu  #  **Phone:** 610-758-4490

**Website:** http://asia.cas2.lehigh.edu/

**Supported by the Office of Interdisciplinary Programs 610-758-3996; incasip@lehigh.edu**

**Williams Hall, 31 Williams Drive**

**Core Faculty**

- Ricki Bliss, Ph.D. (Department of Philosophy); Connie Cook, Ph.D. (Department of Modern Languages and Literatures); Nandini Deo (Department of Political Science); Yinan He (Department of International Relations); Kiri Lee, Ph.D. (Department of Modern Languages and Literatures); Rob Rozehnal, Ph.D. (Department of Religion Studies); Nicola Tannenbaum, Ph.D. (Department of Sociology and Anthropology); Yuping Zhang, Ph.D. (Department of Sociology and Anthropology)

The Asian Studies program provides undergraduates an opportunity to acquire a systematic knowledge of East Asia, Southeast Asia, and South Asia. The program focuses on the rich historical and cultural heritage of the countries of Asia, as well as their growing importance in world affairs.

The overall program is administered by the Asian Studies Committee, an interdisciplinary body of faculty with special interests in the region. This committee oversees both the formal academic work within the program as well as extracurricular activities. It also cooperates with the Asian Cultural Society and other student organizations involved in Asian Studies.

The courses listed are regularly offered in the program and new ones are currently under development in several subject areas. (Consult the Registrar’s Schedule of Classes for specific offerings in any particular semester.)

Courses offered at other LVAIC institutions may be taken for credit by Lehigh students. Students are encouraged to participate in a variety of extracurricular activities that are offered by the Asian Studies Program, such as special lectures and seminars, films, performances, and exhibits.

**MAJOR IN ASIAN STUDIES**

The Asian Studies major is designed to accomplish three goals: to ground the student in a regional language and culture, to survey various disciplines in Asian Studies more broadly, and to provide advanced research opportunities. The program, when successfully completed, prepares the student for further graduate work, professional education, or employment in the public or private sector. There is an increasing demand for graduates who combine a major in a disciplinary field (e.g., business, economics, international relations) with a second major (or minor) in Asian Studies, including Chinese or Japanese language competence.

The major in Asian Studies requires a minimum of 35 credits. Students are required to demonstrate the intermediate language proficiency (Intermediate II) in an Asian language in addition to required course work as described below. The academic advisor is the director of the Asian Studies Program. Students may also request an advisor from among the Asian Studies faculty.

**Core Requirements**

**Intermediate language proficiency**

**Humanities and Social Science** 1

Six courses (minimum 24 credits) from the Humanities/Social Sciences course list or other courses approved by the Asian Studies program director. Minimum one course must be at 300 level, one course may be an advanced Asian language course 2
Study Abroad 3

Capstone Project. Students are required to exhibit using primary source of materials under supervision of faculty member.

Pre-thesis (spring) 4
Senior thesis (fall) 4

Total Credits 35-36

1 Other suitable courses at LVAIC or other approved institutions in the United States or courses in approved study abroad programs in Asia may be substituted with the Director’s approval.
2 Courses in Chinese, Japanese or other Asian language may apply as program electives with approval of the Program Director.
3 If study abroad is difficult academically or financially, other arrangements can be made upon major advisor’s approval.

MINOR IN ASIAN STUDIES

The minor in Asian Studies is intended to complement a student’s major field of study and it is flexible according to individual needs. Students are free to survey the field broadly or concentrate in a specific area such as Chinese or Japanese studies. The minor comprises a minimum of 4 courses (16 credits) in Asian studies, chosen from an approved list in consultation with the director of the Asian Studies Program.

While students minoring in Asian Studies are encouraged to study languages, only 8 credits of language study count towards the Asian Studies minor. Students interested only in language study are encouraged to minor in Chinese or Japanese language (see MLL (p. 336)). To declare a minor in Asian Studies, students must complete a minor declaration form (http://catalog.lehigh.edu/coursesprogramsandcurricula/artsandsciences/asianstudies/Asian_Studies_Minor_Declaration_Form_2015.pdf).

HUMANITIES and SOCIAL SCIENCES COURSES

Each semester, a complete list of Asian Studies course offerings can be found on the web site or available in the Office of Interdisciplinary Programs, Williams Hall, Suite 101.

ASIA/PHIL/REL 010 Intro to Buddhism: Love Death and Freedom 4
ASIA/REL 012 Mountains, Buddhas, Ancestors: Introduction to East Asian Religions 4
ASIA/REL 060 Religions of South Asia 4
ASIA/IR 061 East Asian International Relations 4
ASIA/IR 063 U.S.-China Relations 4
ASIA/MLL 068 Japanese Language: Past and Present 4
ASIA/MLL/WGSS 073 Film, Fiction, and Gender in Modern China 4
ASIA/MLL 074 Chinese Cultural Program 1-8
ASIA/HIST/MLL 075 Chinese Civilization 4
ASIA/HIST/MLL 076 Understanding Contemporary China 4
ASIA/GS/REL 077 The Islamic Tradition 4
ASIA/MLL 078 Asian-American Studies 4
ASIA 091 Elementary Asian Language and Culture Abroad 1-8
ASIA/SOC 114 Social Issues in Contemporary China 4
ASIA/GS/REL 119 The Podcast and the Lotus 4
ASIA/MLL 125 Immortal Images: Traditional Chinese Literature in Translation 4
ASIA/MLL 127 ORIENTations: Approaches to Modern Asia 4
ASIA/PHIL 140 Eastern Philosophy 4
ASIA/PHIL 142 Zen and Art of the Everyday 4
ASIA/REL/GS 145 Islam and the Modern World 4
ASIA/REL/GS 147 Pilgrims, Bandits, Traders, Nuns: Traveling Religious Identities in Asia 4
ASIA/REL 162 Zen Buddhism 4
ASIA/IR 163 U.S.-China Relations 4
ASIA/IR 164 Japan in a Changing World 4
ASIA/MLL 165 Love and Revolution in Shanghai 4
ASIA/REL 166 Religious Nationalism in South Asia 4
ASIA/REL 167 Engaged Buddhism 4
ASIA/HIST 170 The Last Samurai 4
ASIA/REL 172 Tibetan Buddhism and Society 4
ASIA/MLL 177 China Enters the Modern Age 4
ASIA/ANTH 187 Peoples and Cultures of Southeast Asia 4
ASIA/ANTH 188 Southeast Asian Migrants and Refugees 4
ASIA 191 Intermediate Asian Language and Culture Abroad 1-8
ASIA/POLS/GS 201 Democracy and Dictatorship in South Asia 4
ASIA/REL 220 Poet, Mediator, King: Classics of East Asian Religion 4
ASIA/REL 221 Topics in Asian Religions 4
ASIA/PHIL 240 Figures/Themes in Eastern Philosophy 4
ASIA/GS/REL 247 Islamic Mysticism 4
ASIA/REL/ES 254 Buddhism and Ecology 4
ASIA/REL/ANTH 337 Buddhism and Society 4
ASIA/POLS/GS 339 The Rise of the State in Modern East Asia 4
ASIA/HIST 340 Japanese Industrialization 3-4
ASIA/GS/POLS/AAS 343 Global Politics of Race: Asia and Africa 4
ASIA/IR 364 Chinese Foreign Policy 4

STUDY ABROAD PROGRAMS

Students are encouraged to spend a summer, semester, or year in an approved study program in China, Japan, Korea, Thailand, India, or elsewhere in Asia. Students who wish to study abroad, who wish to have the academic work taken in that program count toward a Lehigh degree, must have a GPA of 2.7 or higher, or a 2.7 average over the last two regular (spring or fall) semesters. Any student with a lower GPA may petition the Committee on the Standing of Students for an exception to this rule before applying to an approved study abroad program. These programs are open to all LVAIC students subject to the regulations of their home institutions. For details on all programs, consult Study Abroad Office, Coxe Hall, 32 Sayre Dr, 610-758-3351, (www.lehigh.edu/studyabroad) Asian Studies offers a limited number of study abroad travel grants.

Courses
ASIA 010 (PHIL 010, REL 010) Intro to Buddhism: Love Death and Freedom 4 Credits

This course will introduce students to Buddhist practices, philosophical systems, and cultural forms, from Buddhism’s Indian origins to its spread in East Asia and Tibet. Students will explore how Buddhists have approached the problem of death, the possibility of freedom, and the forms of social and individual love and concern. Course materials include poetry, biographies, philosophical writings, art and film.

Attribute/Distribution: HU

ASIA 012 (REL 012) Mountains, Buddhas, Ancestors: Introduction to East Asian Religions 4 Credits

This course explores the principal religions of East Asia, including Buddhism, Daoism, Confucianism, Shinto, and Shamanic Traditions. What is each tradition’s view of human potential? How is ultimate reality depicted and experienced? What do home altars, boisterous festivals, and silent meditation halls have in common? Several primary texts are read in translation.

Attribute/Distribution: HU

ASIA 060 (REL 060) Religions of South Asia 4 Credits

A thematic introduction to the foundational religious traditions of South Asia: Hinduism, Jainism, Buddhism, Sikhism and Islam. Students explore the social and spiritual dimensions of these religious worlds through scripture, ritual practices, narrative and teaching traditions, music and art.

Attribute/Distribution: HU
ASIA 061 (IR 061) East Asian International Relations 4 Credits
Introduction to East Asian international relations, with emphasis on post-1945 period; historical background of Asian international system; Cold War conflicts; China’s rise and regional responses; Japan’s changing international role; the two Koreas; ASEAN and Asian regionalism; U.S. and Russian policies; current and future issues.
Attribute/Distribution: SS

ASIA 062 (IR 062) US-China Relations 4 Credits
Introduction and analysis of the historical context and key aspects of contemporary US-China relations: Korean War, Vietnam War, and US containment; rapprochement and diplomatic normalization; Taiwan controversy; post-Tiananmen twists and turns; economic interdependence and frictions; security relations; human rights and environmental issues.
Attribute/Distribution: SS

ASIA 063 (IR 063) U.S.-China Relations 4 Credits
Introduction and analysis of the historical context and key aspects of contemporary US-China relations: Cold War US containment, rapprochement and diplomatic normalization; American arms sale and the Taiwan controversy; conflict and cooperation in the Korean Peninsula; economic interdependence and frictions; human rights and security relations; Asian regional disputes. Students may not receive credit for both IR/ASIA 063 and IR/ASIA 163.
Attribute/Distribution: SS

ASIA 068 (MLL 068) Japanese Language: Past and Present 4 Credits
Study of the struggle for an individual “modern” identity out of traditionally defined roles for men and women as depicted by Chinese writers and filmmakers. Class, texts, and films in English. Students interested in setting up a corollary Chinese language component for credit as CHIN 371 or CHIN 251, may discuss this possibility with the professor.
Attribute/Distribution: HU

ASIA 072 (MLL 072, WGSS 072) Film, Fiction, and Gender in Modern China 4 Credits
Explore age-old themes in literature as diverse as pre-modern novels, ghost stories, poetry, divination manuals, and medical texts. Students interested in setting up a corollary Chinese language component for credit as CHIN 251, may discuss this possibility with the professor.
Attribute/Distribution: HU

ASIA 073 (MLL 073, HIST 073) Understanding Contemporary China 4 Credits
An overview of recent history, politics, economy, religion, problems of modernization, popular culture, and attitudes. Contemporary Chinese society viewed against the backdrop of tradition and the tumultuous history of twentieth-century China.
Attribute/Distribution: SS

ASIA 077 (GS 077, REL 077) The Islamic Tradition 4 Credits
A thematic introduction to Islamic history, doctrine and practice. Topics include: Qur’an; prophecy and sacred history; ritual practices; community life; legal interpretation; art and aesthetics; mysticism; politics and polemics.
Attribute/Distribution: SS

ASIA 078 (MLL 078) Asian-American Studies 4 Credits
A survey of issues concerning Asians living in the United States from the perspectives of history, language, literature, and film.
Attribute/Distribution: SS

ASIA 079 (DES 079) Digital Bridges 2 Credits
Run as an independent study; research ancient Chinese bridges, gardens, and pavilions. Digitize images and website design. Create photographic documentation of the Bridge Project. Produce documentary from historical materials concerning history of Chinese students at Lehigh. Bridge Project students could continue project work in Shanghai and Beijing.
Repeat Status: Course may be repeated.

ASIA 091 Elementary Asian Language and Culture Abroad 1-8 Credits
Elementary language and culture abroad other than Chinese or Japanese.
Attribute/Distribution: HU

ASIA 114 (SOC 114) Social Issues in Contemporary China 4 Credits
Dramatic Economic, cultural and social changes are underway in China today and have aroused much debate among social scientists East and West. The following social issues are critical for understanding China’s development trajectory: inequality and poverty; rapid demographic shifts; provision of health care services; provision of education services; and becoming an “information society.” We will explore how these issues intersect with old hierarchies in China, urban-rural differences, and gender differences.
Attribute/Distribution: SS

ASIA 119 (GS 119, REL 119) The Podcast and the Lotus 4 Credits
Buddhism is increasingly a global phenomenon. Contemporary Buddhist teachers stay in touch with students via podcasts, WeChat, Twitter and Facebook. Buddhists from Singapore, Tibet, Japan, Mexico, Taiwan or Pennsylvania now meet via new technology. This class asks, how is Buddhism now a global religion? what effect has this had? How is Buddhism a “modern” religion? Students explore issues of conversion, modernity, globalization, new technology, migration and travel. Sources include autobiography, film, travel writing, political essays, interviews, social media, ethnography.
Attribute/Distribution: SS

ASIA 125 (MLL 125) Immortal Images: Traditional Chinese Literature in Translation 4 Credits
Explore age-old themes in literature as diverse as pre-modern novels, ghost stories, poetry, divination manuals, and medical texts. Students interested in setting up a corollary Chinese language component for credit as CHIN 251, may discuss this possibility with the professor.
Attribute/Distribution: HU

ASIA 127 MLL 127 ORIENTations: Approaches to Modern Asia 4 Credits
A survey of the rapid economic, political, and social changes occurring in East, South, and Southeast Asian countries. How do the contemporary societies and historical traditions of Asian countries differ from the West? What distinguishes our perspectives on politics, individual liberties, civic responsibility, religious faith, the “pursuit of happiness”? How are Asians represented (or misrepresented) in the West, and how will the ongoing process of globalization change, and be changed by, Asian cultures?
Attribute/Distribution: SS

ASIA 140 (PHIL 140) Eastern Philosophy 4 Credits
Survey of selected texts and issues in the eastern philosophical traditions. Attention will be given to the development and interrelations of these traditions as well as a comparison of western and eastern treatments of selected issues. Areas of focus may include Confucianism, Taoism, and Zen Buddhism.
Attribute/Distribution: HU

ASIA 142 (PHIL 142) Zen and Art of the Everyday 4 Credits
The Japanese conception of beauty is strikingly different to our own: it is associated with impermanence, imperfection, and austerity. Moreover, attention to beauty pervades even everyday activities in Japan, such as wrapping purchases at the dollar store or putting out garbage. This course explores principles that guide the Japanese aesthetic sensibility with an eye to its expression in Japanese literature, film, and traditional arts, such as the tea ceremony and gardening.
Attribute/Distribution: HU
ASIA 145 (GS 145, REL 145) Islam and the Modern World 4 Credits
Examines how numerous Muslim thinkers-religious scholars, modernists, and Islamists-have responded to the changes and challenges of the colonial and post-colonial eras. Special emphasis is placed on the public debates over Islamic authority and authenticity in contemporary South Asia.
Attribute/Distribution: HU

ASIA 147 (GS 147, REL 147) Pilgrims, Bandits, Traders, Nuns: Traveling Religious Identities in Asia 4 Credits
This course examines religious networks linking Chinese, Tibetan, Himalayan, and Inner Asian people, places, and institutions to Asia and the world. We explore examples of 19th, 20th century and present day transnational religious identities, emerging from trade, religious travel and pilgrimage, refugee migrations, labor migrations, and modern day leisure travel. We consider religious identity, nationalism, transnationalism, and globalization, using literary, historical, and ethnographic sources, and film, video, and popular media.
Attribute/Distribution: HU

ASIA 162 (REL 162) Zen Buddhism 4 Credits
Attribute/Distribution: HU

ASIA 163 (IR 163) U.S.-China Relations 4 Credits
Introduction and analysis of the historical context and key aspects of contemporary US-China relations: Cold War US containment, rapprochement and diplomatic normalization; American arms sale and the Taiwan controversy; conflict and cooperation in the Korean Peninsula; economic interdependence and frictions; human rights and security relations; Asian regional disputes. This is an advanced course on US-China relations. Students may not receive credit for both IR/ASIA 063 and IR/ASIA 163.
Prerequisites: IR 010 or IR 061
Attribute/Distribution: SS

ASIA 164 (IR 164) Japan in a Changing World 4 Credits
This course explores Japanese foreign policy through its historical and international context; domestic determinants; foreign and security policymaking process; policy to major regional players; foreign economic policy; current grand strategic debates.
Prerequisites: IR 010 or IR 061
Attribute/Distribution: SS

ASIA 165 (MLL 165) Love and Revolution in Shanghai 4 Credits
This project-based course will examine human relationships and political-economic changes in Shanghai through the lens of literature, film, and a selection of other readings. Students will discuss the conflicts between and influences of pre-communist, communist, and capitalist systems as played out in the Shanghai urban arena.
Attribute/Distribution: HU

ASIA 166 (GS 166, REL 166) Religious Nationalism in South Asia 4 Credits
This course explores the conflation and conflict of religion and politics in one of the most complex, dynamic and volatile regions on the planet (South Asia). Through literature, film and scholarly writings, students will examine the history of cooperation and conflict between the Muslim and Hindu communities in South Asia-from the movements for national independence to twenty-first century identity politics.
Attribute/Distribution: HU

ASIA 167 (REL 167) Engaged Buddhism 4 Credits
Examines a contemporary international movement that applies Buddhist teachings and practices to social, political, and environmental issues. Topics include: important thinkers, forms of engagement, and areas of controversy.
Attribute/Distribution: HU

ASIA 168 (REL 168) Buddhism in the Modern World 4 Credits
Explores contemporary Buddhism in Asia, America, and Europe. Topics include the plight of Tibet, Buddhist environmentalism, and the emergence of a socially engaged Buddhism. How are Westerners adapting this ancient tradition to address present day concerns.
Attribute/Distribution: HU

ASIA 170 (HIST 170) The Last Samurai 4 Credits
Explores the revolutionary character of the political upheaval in 1868 that led to the fall of the ruling shogun and the dissolution of the elite samurai class. Examines both the causes of these major political and social changes and their continuing impact upon Japanese culture and society.
Attribute/Distribution: HU

ASIA 172 (REL 172) Tibetan Buddhism and Society 4 Credits
This course examines the history, rituals, practices and art of the Tibetan Buddhist world, and the interaction of Tibetan Buddhism with the Tibetan Bon religion and Tibetan Islam. Students will explore film, autobiography, visual arts, and religious writings, asking, How has Tibetan Buddhism shaped Tibetan societies, as well as neighboring cultures in East Asia and Inner Asia? In what ways is Tibetan Buddhism now a global religion?
Attribute/Distribution: HU

ASIA 177 (MLL 177) China Enters the Modern Age 4 Credits
The collapse of the imperial order and China’s agonizing transformation into a modern nation-state over the past 150 years. The impact of imperialism, war, radical social change, and protracted revolution on Chinese traditions, values, and institutions.
Attribute/Distribution: HU, SS

ASIA 187 (ANTH 187) Peoples and Cultures of Southeast Asia 4 Credits
Peoples and cultures of Burma, Laos, Cambodia, Thailand, Malaysia, Singapore, Indonesia, and the Philippines. World view, religion, economy, politics, and social organization.
Attribute/Distribution: SS

ASIA 188 (ANTH 188) Southeast Asian Migrants and Refugees 4 Credits
Focus on migrants and refugees from Southeast Asia to the United States; examines cultures and practices while in Southeast Asia, the migration process, and the ways in the people and their cultural practices have changed in the United States.
Attribute/Distribution: SS

ASIA 191 Intermediate Asian Language and Culture Abroad 1-8 Credits
Intermediate language and culture abroad other than Chinese and Japanese.
Attribute/Distribution: SS

ASIA 192 (PHIL 192, REL 192) Lehigh in Japan: Kyoto I 3 Credits
This is one of two courses that will be part of an intensive international summer school course to take start Summer 2016 in Kyoto University. Students will study aspects of Western and Japanese philosophical thought in a small group led by local and international speakers. Participants in the class will also be local and international. Students will be expected to attend all classes for a number of hours over a period of two weeks.
Attribute/Distribution: HU

ASIA 193 (PHIL 193, REL 193) Lehigh in Japan: Kyoto II 3 Credits
A second component of the Philosophy summer school in Kyoto will involve a series of excursions to galleries, museums, temples, shrines, stores, and restaurants. Students can expect to develop their understanding of both Japanese aesthetics and the way in which the philosophical systems present in Japan have influenced the Japanese aesthetic sensibility. Students will be required to submit a series of shorter pieces of writing and a final project.
Attribute/Distribution: HU

ASIA 201 (GS 201, POLS 201) Democracy and Dictatorship in South Asia 4 Credits
Theories of democracy and democratization explored in the South Asian context. Relationship of democracy to economic development and identity considered. How do historical legacies and conflict shape contemporary outcomes.
Attribute/Distribution: SS
ASIA 220 (REL 220) Poet, Mediator, King: Classics of East Asian Religion 4 Credits
Classic texts of East Asia and an introduction to the traditions they represent. What do these texts teach about reality, humanity, divinity, virtue and society? How is the path of personal and social transformation presented?
Attribute/Distribution: HU

ASIA 221 (REL 221) Topics in Asian Religions 4 Credits
Selected thematic and comparative issues in different Asian religious traditions. May include Buddhism and Christianity, religion and martial arts, Asian religions in America, Taoist meditation, Zen and Japanese business, Buddhist ethics.
Repeat Status: Course may be repeated.

ASIA 240 (PHIL 240) Figures/Themes in Eastern Philosophy 4 Credits
This seminar course will involve in-depth focus upon a major figure in Eastern thought or upon the Eastern treatment of a particular theme or set of themes. Content varies. Must have completed one HU-designated course in Philosophy at 100-level or higher.
Repeat Status: Course may be repeated.

ASIA 247 (GS 247, REL 247) Islamic Mysticism 4 Credits
Sufism, the inner or ‘mystical’ dimension of Islam, has deep historical roots and diverse expressions throughout the Muslim world. Students examine Sufi doctrine and ritual, the master-disciple relationship, and the tradition’s impact on art and music, poetry and prose.
Attribute/Distribution: HU

ASIA 254 (ES 254, REL 254) Buddhism and Ecology 4 Credits
Buddhism's intellectual, ethical, and spiritual resources and reexamined in light of contemporary environmental problems. Is Buddhism the most green of the major world religions? What are the moral implications of actions that affect the environment?
Attribute/Distribution: HU

ASIA 291 Advanced Asian Language and Culture Abroad 3 Credits
Advanced language and culture abroad other than Chinese and Japanese.
Attribute/Distribution: HU

ASIA 337 (ANTH 337, REL 337) Buddhism and Society 4 Credits
In this course we explore ways in which Buddhism is localized to become lived religions in Thailand, Tibet, Japan, and the United States. We examine how Buddhist practices are integrated into local traditions and how religious practices become part of the larger social, political, and value systems. Students will develop a comparative framework that includes Theravada, Tibetan, and Zen Buddhism.
Attribute/Distribution: ND, SS

ASIA 339 (POLS 339) The Rise of the State in Modern East Asia 4 Credits
An examination of Asian nationalism in the construction of the modern state form in Asia.
Attribute/Distribution: SS

ASIA 340 (HIST 340) Japanese Industrialization 3-4 Credits
Explores economic growth in the traditional economy, the rise of an entrepreneurial class, the importation of western technology, and the social, political and economic institutions which support industrial society since the early 19th century.
Attribute/Distribution: SS

ASIA 343 (AAS 343, GS 343, POLS 343) Global Politics of Race: Asia and Africa 4 Credits
An examination of the concept of “race” and its impact on domestic and international politics.
Attribute/Distribution: SS

ASIA 361 Internship in Asian Studies 1-4 Credits
Internship in public or private agency involved in some aspect of Asian studies. Individual faculty mentor. Written report required. Program permission required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU, SS

ASIA 364 (IR 364) Chinese Foreign Policy 4 Credits
Research-oriented seminar focusing on the sources of Chinese foreign policy preferences and goals, foreign policy decision-making processes; international implications of the rise of China, and the pressing regional and global issues that China is facing now and in the future. Consent of department required.
Prerequisites: IR 010 or IR 061 or ASIA 061 or IR 062 or ASIA 062 or IR 063 or ASIA 063 or IR 161 or ASIA 161 or IR 163 or ASIA 163
Attribute/Distribution: SS

ASIA 371 Advanced Readings in Asian Studies 1-4 Credits
Directed course of reading and writing in advanced topic not covered in regular Asian Studies course offerings. Program permission required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU, SS

ASIA 381 Special Topics in Asian Studies 1-4 Credits
Advanced study of aspects of Asian studies not covered in regular course offerings. Individual faculty supervision. Research paper required. Program permission required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU, SS

ASIA 386 Chinese Culture in a Multinational Workplace 3 Credits
Students explore the interaction between Chinese and non-Chinese cultures at a variety of work sites in the city of Shanghai, a port city that has involved people of many nationalities since its birth in the 1840s. This project-based course involves a faculty mentored practicum at one or more specific sites related to the student’s own field or major, assigned readings, weekly electronic Course Site discussions, and a written summary of the experience.

ASIA 389 Honors Project 1-6 Credits

ASIA 391 Senior Seminar in Asian Studies 1-4 Credits
Advanced seminar focusing on discussion and research on specialized subjects in Asian studies. Variable subject matter. Offered by faculty on rotating basis. Program permission required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU, SS

ASIA 399 Senior Thesis in Asian Studies 1-4 Credits
Advanced, individual research project on topic agreed between faculty and student. Research paper and oral defense required. Open to Asian studies majors only. Program permission required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU, SS

Astronomy and Astrophysics

Astronomy and Astrophysics are offered in the department of Physics. Astrophysicists apply physics and mathematics to the study of planets, stars, galaxies, pulsars, black holes, quasars, and the universe, among many other fascinating objects in order to understand their origin, evolution and ultimate fate. Students who major in astronomy or astrophysics usually have very inquisitive minds and a good aptitude for physics and mathematics. The bachelor degree programs in astronomy and astrophysics provide the student with a solid background in laboratory and theoretical astrophysics as well as in the fundamentals of physics and mathematics. Research opportunities are available to supplement classroom instruction.

The bachelor of science degree in astrophysics is designed for students who wish to go on to graduate studies in astrophysics with the goal of becoming professional astronomers. Professional astronomers generally find positions at colleges, and universities, national labs, NASA, or its contractors and in various space industries. This degree also prepares you for many jobs in related fields such as computer science, mathematics or physics.

The bachelor of arts degree in astronomy is intended for students who desire a broad background in astronomy, mathematics and physics but do not plan to do graduate work in astrophysics. With this broad background, the student is well prepared in many fields of endeavor, including planetarium and museum work, teaching astronomy at colleges and universities, secondary education, science writing, or in many professions in which the ability to learn is critical.
Both of these degrees can be profitably combined with mathematics and other sciences producing excellent double majors or double degrees. A minor program in astronomy is also available for students who wish to enlarge their potential for a career choice or who may be eager to learn more about astrophysics than an introductory course can provide.

**ASTRONOMY AND ASTROPHYSICS DEGREE PROGRAMS**

**B.A. with Major in Astronomy Program Requirements**

**Mathematics**
- MATH 021: Calculus I 4
- MATH 022: Calculus II 4
- MATH 023: Calculus III 4
- MATH 205: Linear Methods 3

**Basic and Intermediate-Level Science**
- ASTR 007 & ASTR 008: Introduction to Astronomy and Introduction to Astronomy Laboratory 4
- PHY 010: General Physics I 4
- PHY 011: Introductory Physics I 4
- PHY 012: Introductory Physics Laboratory I 1
- PHY 022: Advanced Physics Laboratory 2
- CHM 030: Introduction to Chemical Principles 4
- EES 021: Introduction to Planet Earth 1
- EES 022: Exploring Earth 1

Select 2-4 EES credit hours at 100 level or above 2-4

**Intermediate - Advanced Astronomy/Astrophysics**
- ASTR/PHY/EES 105: Planetary Astronomy 3
- ASTR 110: Methods of Observational Astronomy 1

Select one of the following: 4
- ASTR/PHY 301: Modern Astrophysics I 3
- ASTR/PHY 302: Modern Astrophysics II 3

**Approved Electives**
Select two additional physics/astronomy courses at the 200 level or above 6
Select two additional science or mathematics courses at the 200 level or above 6

**Total Credits** 64-67

**B.A. Astronomy**

**First Year**

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**Second Year**

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**Total Credits: 59-64**

**B.S. in Astrophysics Program Requirements**

**Mathematics Courses**
- MATH 021: Calculus I 4
- MATH 022: Calculus II 4
- MATH 023: Calculus III 4
- MATH 205: Linear Methods 3
- MATH 208: Complex Variables 3-4
- or MATH 320: Ordinary Differential Equations
- or MATH 322: Methods of Applied Analysis I

**Basic Science Courses**
- PHY 011: Introductory Physics I 4
- or PHY 010: General Physics I
- PHY 021: Introductory Physics II 4
- or PHY 023: Introductory Physics II with Relativity
- PHY 012: Introductory Physics Laboratory I 1
- PHY 022: Introductory Physics Laboratory II 1
- PHY 031: Introduction to Quantum Mechanics 3
- CHM 030: Introduction to Chemical Principles 4
- ASTR 105: Planetary Astronomy 3

**Laboratory and Computing Courses**
- CSE 002: Fundamentals of Programming * 2
- PHY 220: Advanced Physics Laboratory I 3
- PHY 221: Advanced Physics Laboratory II 2

*Or an equivalent course in scientific computing.

**Intermediate and Advanced Courses**
- PHY 212: Electricity and Magnetism I 3
- PHY 213: Electricity and Magnetism II 3
- PHY 215: Classical Mechanics I 4
- PHY 340: Thermal Physics 3
- PHY 362: Atomic and Molecular Structure 3
- ASTR 301: Modern Astrophysics I 3
- ASTR 302: Modern Astrophysics II 3

**Approved Elective Courses**
Select three courses from among the following seven... 9
- ASTR/PHY 332: High-Energy Astrophysics 3
- ASTR/PHY 342: Relativity and Cosmology 3
- PHY 348: Plasma Physics 3
- PHY 352: Modern Optics 3
- PHY 364: Nuclear and Elementary Particle Physics 3
- PHY 369: Quantum Mechanics I 3
- PHY 380: Introduction to Computational Physics 3

... plus one additional course in an appropriate technical area in consultation with the adviser. Students planning graduate work in Astrophysics are advised to include ASTR 273 (Research) among their electives.

**Total Credits** 99-101

A total of 123 credit hours are required for the Bachelor of Science in Astrophysics.

**RECOMMENDED SEQUENCE OF COURSES FOR THE FIRST TWO YEARS**

**B.A. Astronomy**

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**Total Credits: 15-16**

**B.S. ASTROPhysics**

**First Year**

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**Total Credits: 15-16**

**B.S. ASTROPhysics**

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**Total Credits: 59-64**
CSE 002
Elective or Dist. Req.

3

Introduction to Quantum Mechanics
3-4

Modern Astrophysics I
4

Atomic and Molecular Structure
31

Complex Variables
CHM 030
3-4

Classical Mechanics I

2

Departmental Honors by satisfying the following requirements:

Students receiving a BA in Astronomy or a BS in Astrophysics may earn Departmental Honors by satisfying the following requirements:

1. Academic Performance: Minimum grade point average of 3.50 in astronomy and physics courses used to satisfy the major degree requirements.

2. Research or Project-Based/Creative Activity: completion of approved special topics courses in astronomy that include written reports, or completion of 6 credits of ASTR 273 (research) or equivalent, or completion of a summer research project with written report and oral presentation

3. Additional Course Work: Completion of at least one approved 300-level course in either physics or astronomy beyond those required in the student's degree program. This course may not be selected from special topics or research courses such as ASTR 372.

Specific approvals are granted by the Program Director.

The Minor Program in Astronomy

The minor program must be designed in consultation with the program director.

The requirements for a minor in astronomy are:

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<th>Course</th>
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</table>

Total Credits: 31

** Students may choose to select ASTR 007 by deferring a distribution requirement (though it is not required for the BS in Astrophysics).

** Or an equivalent course in scientific computing.

ASTR 007 Introduction to Astronomy 3 Credits
Introduction to planetary, stellar, galactic, and extragalactic astronomy. An examination of the surface characteristics, atmospheres, and motions of planets and other bodies in our solar system. Properties of the sun, stars, and galaxies, including the birth and death of stars, stellar explosions, and the formation of stellar remnants such as white dwarfs, neutron stars, pulsars, and black holes. Quasars, cosmology, and the evolution of the universe. May not be taken by students who have previously completed ASTR 105, PHY 105, ASTR 301, PHY 301, ASTR 302 OR PHY 302.

Attribute/Distribution: NS

ASTR 008 Introduction to Astronomy Laboratory 1 Credit
Laboratory to accompany ASTR 007. Must be enrolled concurrently in ASTR 007.

Corequisites: ASTR 007

ASTR 105 Planetary Astronomy 3 Credits

Attribute/Distribution: NS

ASTR 110 Methods of Observational Astronomy 1 Credit
Techniques of astronomical observation, data reduction, and analysis. Photometry, spectroscopy, CCD imaging, and interferometry. Computational analysis. Examination of ground-based and spacecraft instrumentation, and data transmission, reduction, and analysis.

Attribute/Distribution: NS

ASTR 272 Special Topics in Astronomy 1-4 Credits
Selected topics not sufficiently covered in other courses.

Repeat Status: Course may be repeated.

Attribute/Distribution: NS

ASTR 273 Research 2-3 Credits
Participation in current research projects being carried out within the department.

Repeat Status: Course may be repeated.

Attribute/Distribution: NS

ASTR 300 Apprentice Teaching 3 Credits

ASTR 301 Modern Astrophysics I 3 Credits

Prerequisites: (PHY 010 or PHY 011) and (PHY 013 or PHY 021 or PHY 023) and (MATH 022 or MATH 032 or MATH 052)

Attribute/Distribution: NS

ASTR 302 Modern Astrophysics II 3 Credits

Prerequisites: (PHY 010 or PHY 011) and (PHY 013 or PHY 021 or PHY 023) and (MATH 022 or MATH 032 or MATH 052)

Attribute/Distribution: NS

ASTR 332 (PHY 332) High-Energy Astrophysics 3 Credits
Observation and theory of X-ray and gamma-ray sources, quasars, pulsars, radio galaxies, neutron stars, black holes. Results from ultraviolet, X-ray and gamma-ray satellites. Generally offered in the spring of odd-numbered years.

Prerequisites: (PHY 021 or PHY 023) and (MATH 023 or MATH 033)

Can be taken Concurrently: MATH 023, MATH 033

Attribute/Distribution: NS
Biochemistry

An interdepartmental B.S. biochemistry major is offered in the College of Arts and Sciences. The B.S. in biochemistry degree is managed by an interdepartmental committee composed of biochemists, bioorganic chemists, and molecular/cellular biologists. The committee administers the degree, monitors the academic program, provides research possibilities, and advises student majors. The director of the program is currently Linda J. Lowe-Krentz. Faculty in both Biological Sciences and Chemistry serve as advisors.

BACHELOR OF SCIENCE DEGREE IN BIOCHEMISTRY

College and University Requirements

ENGL 001 Composition and Literature 3
ENGL 002 Composition and Literature II 3
First Year Seminar 3
Non-science Electives 1 16

Collateral Science Requirements

Select one of the following options: 9-10

Option A
PHY 010 General Physics I
& PHY 012 and Introductory Physics Laboratory I
PHY 013 General Physics II
& PHY 022 and Introductory Physics Laboratory II

Option B
PHY 011 Introductory Physics I
& PHY 012 and Introductory Physics Laboratory I
PHY 021 Introductory Physics II
& PHY 022 and Introductory Physics Laboratory II

Select one of the following options: 2 10-12

Option A
MATH 051 Survey of Calculus I
MATH 052 Survey of Calculus II
MATH 043 Survey of Linear Algebra

Option B
MATH 021 Calculus I
MATH 022 Calculus II
MATH 023 Calculus III
One statistics course 2 3
CSE 012 Survey of Computer Science
or ENGR 010 Applied Engineering Computer Methods

Required Chemistry Courses

CHM 040 Concepts, Models and Experiments I 3 4
CHM 041 Concepts, Models and Experiments II 3 4
CHM 110 Organic Chemistry I
& CHM 111 and Organic Chemistry Laboratory I
CHM 112 Organic Chemistry II
& CHM 113 and Organic Chemistry Laboratory II
CHM 194 Physical Chemistry for Biological Sciences 3

CHM 307 Advanced Inorganic Chemistry 3
CHM 332 Analytical Chemistry 3

Required Biological Science courses

BIOS 041 Biology Core I: Cellular and Molecular 4
& BIOS 042 and Biology Core I: Cellular and
Molecular Lab
BIOS 115 Biology Core II: Genetics 3
BIOS 371 Elements of Biochemistry I 3
BIOS 372 Elements of Biochemistry II 3
BIOS 377 Biochemistry Laboratory 3

Advanced Laboratory 4
Electives in Biological Sciences (3 hours minimum) 4 3
Technical Writing (2 hours minimum) 2

Total Credits 100-103

1 16 hours to be broadly distributed in fields of thought other than natural science and mathematics, including at least 8 hours each in humanities and social sciences.
2 Mathematics option and statistics course must be at least 12 hours combined.
3 The CHM 030 / CHM 031 sequence may be substituted.
4 The three credit hours of biological sciences electives are chosen with the approval of the adviser.

MODEL PATTERN ROSTER

First Year

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<td>CHM 041</td>
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<td>CHM 332</td>
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</table>
The mission of the Bioengineering Program is to prepare undergraduate students to be critical thinkers, problem solvers, innovators, leaders, and lifelong learners who can make a positive impact at the interfaces among the physical and life sciences, and engineering.

To achieve its educational mission, the Bioengineering Program has established the following set of Program Educational Objectives. Three to five years after graduation, we expect that

1. Graduates in professional practice function effectively as responsible and collaborative professionals in Bioengineering or in a related field.
2. Graduates pursue advanced degrees or engage in other forms of continuing education.

Bioengineering Program Faculty

**Professor** Anand Jagota, **Director**, Department of Chemical Engineering at 610-758-4396 or anj6@lehigh.edu

**Professor of Practice** Lori Herz, **Associate Director**, Department of Chemical Engineering at 610-758-6831 or loh208@lehigh.edu


**Professor of Practice**: Lori E. Herz, Ph.D. (Rutgers) Chemical Engineering; Susan F. Perry, Ph.D. (Pennsylvania State University) Biological Chemistry.

**UNDERGRADUATE PROGRAM**

The B.S. in Bioengineering degree provides a structured curriculum comprised of three tracks. Biopharmaceutical Engineering is for students whose interests lie in genomics, proteomics, bioinformatics, recombinant DNA, protein engineering, bioprocessing, drug synthesis and delivery. The Bioelectronics/photonics track covers education and research dealing with signal processing, biosensors, MEMs, biochips for DNA sequencing, laser and fiber based optical technology for biomedical applications. The Biomechanics and Biomaterials track encompasses applications of engineering principles to an understanding of biology and physiology, ranging from cells and tissues to organs and systems.

The B.S. in Bioengineering will prepare students for careers in established and emerging fields that require combining engineering principles with the life sciences. Potential paths open to students include the health care, biomedical, pharmaceutical, biomaterials, and other biotechnology related industries through careers in medicine or graduate studies.

The program strongly encourages experiential learning, including two summers of internships, required participation in Lehigh's Technical Entrepreneurship Capstone Design Projects, and opportunities for undergraduate research for credit.

A total of 132 credit hours are required for graduation with a degree of bachelor of science in bioengineering.

**BIOENGINEERING CORE REQUIREMENTS**

**General Requirements**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 001</td>
<td>Critical Reading and Composition</td>
</tr>
<tr>
<td>ENGL 002</td>
<td>Research and Argument</td>
</tr>
<tr>
<td>ECO 001</td>
<td>Principles of Economics</td>
</tr>
<tr>
<td>BIOE 226</td>
<td>Ethics in Bioengineering Practice</td>
</tr>
<tr>
<td>or PHIL 116</td>
<td>Bioethics</td>
</tr>
<tr>
<td>or PHIL 105</td>
<td>Ethics</td>
</tr>
<tr>
<td>ENGR 010</td>
<td>Applied Engineering Computer Methods</td>
</tr>
<tr>
<td>Electives to satisfy HSS depth and breadth requirements</td>
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</tr>
<tr>
<td>Free Electives (Number of general requirements and free elective credits are track-dependent.)</td>
<td>3-5</td>
</tr>
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</table>

**Mathematics**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MATH 021</td>
<td>Calculus I</td>
</tr>
<tr>
<td>MATH 022</td>
<td>Calculus II</td>
</tr>
<tr>
<td>MATH 023</td>
<td>Calculus III</td>
</tr>
<tr>
<td>MATH 205</td>
<td>Linear Methods</td>
</tr>
<tr>
<td>MATH 231</td>
<td>Probability and Statistics</td>
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**Chemistry**

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>CHM 030</td>
<td>Introduction to Chemical Principles</td>
</tr>
<tr>
<td>CHM 031</td>
<td>Chemical Equilibria in Aqueous Systems</td>
</tr>
<tr>
<td>CHM 110 &amp; CHM 111</td>
<td>Organic Chemistry I and Organic Chemistry Laboratory I</td>
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**Physics**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>PHY 011 &amp; PHY 012</td>
<td>Introductory Physics I and Introductory Physics Laboratory I</td>
</tr>
<tr>
<td>PHY 021 &amp; PHY 022</td>
<td>Introductory Physics II and Introductory Physics Laboratory II</td>
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**Biological Sciences**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOS 041 &amp; BIOS 042</td>
<td>Biology Core I: Cellular and Molecular Biology Core I: Cellular and Molecular Lab</td>
</tr>
<tr>
<td>BIOS 115 &amp; BIOS 116</td>
<td>Biology Core II: Genetics and Biology Core II: Genetics Laboratory</td>
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</tbody>
</table>

**Integrated Bioengineering**

Required by all Three Tracks

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>BIOE 001</td>
<td>Freshman Seminar 1, Introduction to Bioengineering 1: Philosophy to Practice (Pass/Fail)</td>
</tr>
<tr>
<td>BIOE 002</td>
<td>Freshman Seminar 2, Introduction to Bioengineering II: Current Topics (Pass/Fail)</td>
</tr>
<tr>
<td>BIOE 110</td>
<td>Elements of Bioengineering</td>
</tr>
<tr>
<td>BIOE 210</td>
<td>Introduction to Engineering Physiology</td>
</tr>
<tr>
<td>TE 211</td>
<td>Capstone Design Projects-1</td>
</tr>
<tr>
<td>TE 212</td>
<td>Capstone Design Projects-2</td>
</tr>
</tbody>
</table>
**Bioengineering Program**

**BIOE 225**  
GMP Good manufacturing practice and regulatory affairs for bioengineers

### Engineering Requirement by Track

Select one of the following tracks: 22-24

#### Biopharmaceutical Engineering Track
- CHM 112: Organic Chemistry II
- BIOE 343: Integrated Biotechnology Laboratory
- MAT 033: Engineering Materials and Processes
- CHE 031: Material and Energy Balances of Chemical Processes
- CHE 210: Chemical Engineering Thermodynamics
- CHE 211: Chemical Reactor Design
- BIOE 247: Biological Fluid Mechanics

#### Bioelectronics/Biophotonics Track
- ECE 108: Signals and Systems
- BIOE 331: Integrated Bioelectronics/Biophotonics Laboratory
- ECE 081: Principles of Electrical Engineering
- ECE 121: Electronic Circuits Laboratory
- ECE 123: Electronic Circuits
- ECE 202: Introduction to Electromagnetics
- MAT 033: Engineering Materials and Processes

#### Biomechanics and Biomaterials Track
- MECH 012: Strength of Materials
- MAT 033: Engineering Materials and Processes
- MAT 205: Thermodynamics of Macro/Nanoscale Materials
- or ME 104: Thermodynamics I
- BIOE 257: Biomechanics and Biomaterials
- BIOE 357: Integrated Biostructural Mechanics Laboratory
- BIOE 247: Biological Fluid Mechanics

#### Bioengineering Electives

Select one of the following: 3

- BIOE/ME 315: Bioengineering Statistics
- BIOE 341: Biotechnology I
- BIOE/PHY 321: Biomolecular & Cellular Mechanics
- BIOE 349: Metabolic Engineering
- BIOE/CHE 345: Quantitative Biology
- ECE 337: Introduction to Micro- and Nanofabrication

#### Technical Electives

Select one of the following: 9

- BIOE/ME 315: Bioengineering Statistics
- BIOE 341: Biotechnology I
- BIOE/PHY 321: Biomolecular & Cellular Mechanics
- BIOE 349: Metabolic Engineering
- BIOE/CHE 345: Quantitative Biology
- ECE 337: Introduction to Micro- and Nanofabrication

**Total Credits**: 127-131

---

**TYPICAL FOUR-YEAR COURSE SCHEDULE FOR BS IN BIOENGINEERING**

**Biopharmaceutical Engineering Track**

<table>
<thead>
<tr>
<th>First Year</th>
<th>CR</th>
<th>Second Semester</th>
<th>CR</th>
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<tbody>
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<td>BIOE 001 (Pass/Fail)</td>
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<td>BIOE 002 (Pass/Fail)</td>
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<tr>
<td>CHM 030</td>
<td>4</td>
<td>BIOS 041 &amp; BIOS 042</td>
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<tr>
<td>MATH 021</td>
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<td>MATH 022</td>
<td>4</td>
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<tr>
<td>ENGL 001</td>
<td>3</td>
<td>PHY 011 &amp; PHY 012</td>
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<td>ENGR 010</td>
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<th>Second Semester</th>
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<tr>
<td>BIOE 110</td>
<td>4</td>
<td>BIOE 210</td>
<td>4</td>
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<tr>
<td>MATH 023</td>
<td>4</td>
<td>BIOE 020</td>
<td>4</td>
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<td>PHY 021 &amp; PHY 022</td>
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<td>CHE 031</td>
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<th>Third Year</th>
<th>CR</th>
<th>Second Semester</th>
<th>CR</th>
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<tbody>
<tr>
<td>CHEM 110 &amp; CHEM 111</td>
<td>4</td>
<td>TE 211</td>
<td>3</td>
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<td>BIOS 115 &amp; BIOS 116</td>
<td>4</td>
<td>CHE 211</td>
<td>3</td>
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<td>BIOE 341</td>
<td>3</td>
<td>BIOE 247</td>
<td>4</td>
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<td>BIOE 225</td>
<td>1</td>
<td>CHM 112</td>
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<tr>
<td>MATH 231</td>
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<td>ECO 001</td>
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<td>Elective</td>
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<table>
<thead>
<tr>
<th>Fourth Year</th>
<th>CR</th>
<th>Second Semester</th>
<th>CR</th>
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<tbody>
<tr>
<td>TE 212</td>
<td>2</td>
<td>Electives</td>
<td>16</td>
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<tr>
<td>BIOE 343</td>
<td>3</td>
<td>BIOE 226</td>
<td>1</td>
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<tr>
<td>MAT 033</td>
<td>3</td>
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<tr>
<td>Electives</td>
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<td><strong>Total Credits</strong>: 17</td>
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<td><strong>Total Credits</strong>: 17</td>
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</table>

**Total Credits: 132**

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1. Students must achieve a minimum of a C- in both MATH 205 and MATH 231 for the B.S. in Bioengineering.
2. Note: BIOE 349 (Metabolic Engineering) may be taken in lieu of CHE 211. If BIOE 349 is taken instead of CHE 211, it may not count as an elective.
3. Students in the Biopharmaceutical Engineering track are required to take BIOE 341, since it is a prerequisite for BIOE 343.
4. Students must take nine (9) credits of technical electives, which include undergradate research, graphics for engineering design, engineering courses at the 200-level or higher, and BIOS/CHM PHY/MATH courses at the 200-level or higher. (Some 200-level courses are excluded from this list; the complete list of approved courses is available from the Bioengineering Program or the Registrar.) At least three (3) of the nine (9) credits must be a BIOE class at the 300-level or higher. No more than six (6) credits can be from CSE 002, CSE 017, ME 010, BIOE 020, BIOE 132, BIOE 142, BIOE 242, and BIOE 290.
Lehigh University 2016-2017

PHY 021 & PHY 022 4
   CHM 031 4
   ECE 123 & ECE 121 5

Third Year

First Semester CR   Second Semester CR
BIOS 115 4   MATH 231 3
   & BIOS 116
CHM 110 & CHM 111 4   TE 211 3
   MAT 033 3   BIOE 331 2
   ECE 108 4   MECH 003 3
   BIOE 225 1   ECO 001 4
   Elective 3

Total Credits: 17

Fourth Year

First Semester CR   Second Semester CR
TE 212 2   Electives 16
   ECO 001 4   BIOE 226 1
   Electives 12

Total Credits: 18

Total Credits: 136

GRADUATE PROGRAM

Bioengineering offers a graduate program leading to the doctor of philosophy degree. The graduate program will train students to solve problems that require the application of interdisciplinary knowledge, combining life sciences, physical sciences, and engineering. The program will emphasize cellular and biomolecular science and engineering, and aims to attract students with diverse academic backgrounds. Students who do not complete the doctor of philosophy have the option to earn a master of science.

Major Requirements

Doctor of Philosophy Degree
Candidates for the doctor of philosophy degree are required to complete a minimum of 72 credits.

ENGR 452 Mathematical Methods in Engineering 3
BIOS 411 Advanced Cell Biology 3
Two additional core courses from an approved list of courses 6
Twelve credits of adviser-approved technical electives at the 300-level or higher 12
Six credits of dissertation research 6
Additional 42 credits of electives and/or dissertation research 42

Total Credits: 72

Students must pass a qualification exam, typically taken after three semesters of study, a final written dissertation as well as an oral defense of the dissertation.

Master of Science Degree
An oral defense of thesis research is dependent upon the requirements of the student’s adviser.

Two options for the master of science degree are available: a thesis option and a non-thesis option. Candidates for both the thesis and non-thesis master of science degree are required to complete a minimum of 30 credits. Per university policy, graduate students may count no more than 12 credits at the 300-level toward the M.S. degree.

Thesis Option

ENGR 452 Mathematical Methods in Engineering 3
BIOS 411 Advanced Cell Biology 3
Two additional core courses from an approved list of courses 6
Twelve credits of adviser-approved technical electives at the 300-level or higher 12
Six credits of thesis research, culminating in a written thesis 6

Total Credits: 30

Non-Thesis Option

ENGR 452 Mathematical Methods in Engineering 3
BIOS 411 Advanced Cell Biology 3
Two additional core courses from an approved list of courses 6
Eighteen credits of adviser-approved technical electives at the 300-level or higher. No thesis research or written thesis is required 18

Total Credits: 30

Courses

BIOE 001 Freshman Seminar 1, Introduction to Bioengineering 1: Philosophy to Practice 1 Credit
Overview of the bioengineering field, the advancements of related topics in sciences, technology, engineering and applications for health care and medicine. Humanity and ethical issues. Pass/Fail.
BIOE 002 Freshman Seminar 2, Introduction to Bioengineering II: Current Topics 1 Credit
Overview of a broad spectrum of current topical areas in biotechnology and bioengineering and their applications in health care and medicine. Pass/Fail.

BIOE 020 Bioengineering Sophomore Research Seminar 1 Credit
Exposure to opportunities for on-campus research in bioengineering. Review of current literature on bioengineering topics through written reports and/or oral presentations. Preparation of written research proposal, including definition of topic, objectives, methodology, research plans, and expected impact.

BIOE 110 Elements of Bioengineering 4 Credits
An introduction to the fields of biotechnology and biomedical engineering. The areas include biomechanics, biomaterials, bioinstrumentation, molecular imaging, rehabilitation engineering, biosensors, biotechnology and tissue engineering.
Prerequisites: (BIO 041 and BIO 042)

BIOE 210 Introduction to Engineering Physiology 4 Credits
Mammalian physiology for bioengineering students, with an emphasis on control mechanisms and engineering principles. Basic cell function; biological control systems; muscle; neural; endocrine, circulatory, digestive, respiratory, renal, and reproductive systems; regulation of metabolism and defense mechanisms. Includes laboratory work.
Prerequisites: (BIO 041 and BIO 042) and (BIOE 110)

BIOE 225 GMP Good manufacturing practice and regulatory affairs for bioengineers 1 Credit
Review of the principles of the Food and Drug Administration including its history, mission and applied regulations. Understanding of how the FDA works with industry and is integral to the development of new products and technologies. Review and critique of case studies in various parts of the biomedical industry to see how FDA regulations are applied. Validation and analysis of products using failure mode analysis.
Prerequisites: BIOE 110

BIOE 226 Ethics in Bioengineering Practice 1 Credit
Introduction to ethical principles and role of critical thinking in ethical decision-making. Analysis of contemporary issues in bioengineering practice. Topics include biomedical device risk and failure, ethics of clinical trials, animal research, human enhancement, and research conduct.

BIOE 242 Bioengineering Research 1-4 Credits
Research on a topic chosen by students, with a faculty advisor typically from the three bioengineering tracks (biopharmaceutical engineering, bioelectronic/biophotonics or biomechanics and biomaterials). Independent meetings with advising professor will track progress. Includes written reports and/or oral presentations. Consent of instructor required.
Repeat Status: Course may be repeated.

BIOE 247 Biological Fluid Mechanics 4 Credits
Prerequisites: MATH 205

BIOE 257 Biomechanics and Biomaterials 3 Credits
Biomechanical analysis of tissues, microstructure of materials, force and mechanics in rigid and deformable bodies, analysis of biological response and biocompatibility, failure processes of implantable biomaterials/devices, strength of materials, and biomechanics of cells. Biomechanics and biomaterials concepts integrated (1) to examine the theoretical and practical implications of material properties and (2) to examine the biomechanical principles governing system behavior.
Prerequisites: MAT 033 and MECH 003 and MATH 205
Can be taken Concurrently: MATH 205

BIOE 290 Bioengineering Thesis 1-3 Credits
Thesis, guided by a faculty advisor, based on research and/or design projects. Independent meetings with advising professor to track progress. Consent of instructor required.
Prerequisites: BIOE 242 or TE 212

BIOE 307 (CSE 307) 3 Credits
Computational techniques and principles of structural biology used to examine molecular structure, function, and evolution. Topics include: protein structure alignment and prediction; molecular surface analysis; statistical modeling; QSAR; computational drug design; influences on binding specificity; protein-ligand, -protein, and -DNA interactions; molecular simulation, electrostatics. Tutorials on UNIX systems and research software support an interdisciplinary collaborative project in computational structural biology. Credit will not be given for both BIOE 307 and CSE 407. Must have junior standing or higher.
Prerequisites: BIOS 120 or CSE 109 or CHM 113 or MATH 231

BIOE 308 (CSE 308) Bioinformatics: Issues and Algorithms 3 Credits
Computational problems and their associated algorithms arising from the creation, analysis, and management of bioinformatics data. Genetic sequence comparison and alignment, physical mapping, genome sequencing and assembly, clustering of DNA microarray results in gene expression studies, computation of genomic rearrangements and evolutionary trees. Credit will not be given for both BIOE 308 (CSE 308) and BIE 408 (CSE 408). No prior background in biology is assumed.
Prerequisites: CSE 017 or CSE 018

BIOE 315 (ME 315) Bioengineering Statistics 3 Credits
Advanced methods in probability and statistics applied to bioengineering problems focusing on modeling and data analysis. Topics include the following: types of data, types of distributions, parametric and nonparametric analyses, goodness-of-fit, regression, power analysis, and multivariate analysis, life models, simulation, cluster analysis, and Bayesian statistics. Special emphasis is placed on projects and case studies.
Prerequisites: MATH 231

BIOE 320 (CSE 320) Biomedical Image Computing and Modeling 3 Credits
Biomedical image modalities, image computing techniques, and imaging informatics systems. Understanding, using, and developing algorithms and software to analyze biomedical image data and extract useful quantitative information: Biomedical image modalities and formats; image processing and analysis; geometric and statistical modeling; image informatics systems in biomedicine. Credit will not be given for both BioE 320 and BioE 420.
Prerequisites: (MATH 205 or MATH 043) and CSE 017

BIOE 321 (PHY 321) Biomolecular & Cellular Mechanics 3 Credits
Mechanics and physics of the components of the cell, ranging in length scale from fundamental biomolecules to the entire cell. The course covers the mechanics of proteins and other biopolymers in 1D, 2D, and 3D structures, cell membrane structure and dynamics, and the mechanics of the whole cell.
Prerequisites: MATH 205 and MATH 231 and PHY 022 and (PHY 013 or PHY 021 or PHY 023)
Attribute/Distribution: NS

BIOE 324 (MAT 324) Introduction to Organic Biomaterials 3 Credits
Property, characterization, fabrication and modification of organic materials for biomedical and biological applications; host responses to biomaterials on the molecular, cellular and system level; general introduction to biosensors, drug delivery devices and tissue engineering.
Prerequisites: BIOE 110

BIOE 325 (MAT 325) Inorganic Biomaterials 3 Credits
Fabrication methods for biomedical implants and devices. Selection of metals and ceramics with specific bulk and surface physical as well as chemical properties. The role of materials chemistry and microstructure. Biocompatibility. Case studies (dental and orthopedic implants, stents, nonporous ceramic filters for kidney dialysis).
Prerequisites: MAT 033
BIOE 326 (MAT 326) Biomimetic and Bio-enabled Materials 3 Credits
The structure, function, properties and use of biopolymers, biocomposites, and biomaterials. Biomimetic materials design, including colloids, interfaces, macromolecules, and applications of such materials. Environmental and ethical considerations, such as degradation products when using biomimetic materials. Closed to students who have taken MAT 426 (BioE 426).
Prerequisites: MAT 033 or BIOE 110

BIOE 331 (PHY 331) Integrated Bioelectronics/Biophotonics Laboratory 2 Credits
Experiments in design and analysis of bioelectronics circuits, micropatterning of biological cells, micromanipulation of biological cells using electric fields, analysis of pacemakers, instrumentation and computer interfaces, ultrasound, optic, laser tweezers and advanced imaging and optical microscopy techniques for biological applications.
Prerequisites: (ECE 081 or PHY 190) and (PHY 013 or PHY 021 or PHY 023) and PHY 022 and ECE 121 and ECE 123
Can be taken Concurrently: ECE 121, ECE 123
Attribute/Distribution: NS

BIOE 335 BioFluid Mechanics of Physiological Systems 3 Credits
Application of advanced fluid dynamic principles to physiological systems with emphasis on micron sized structures such as pulmonary airway/alveoli, small blood vessels and biological cells. Introduction to advanced topics relevant to the human body including a) oscillatory and transient flows in the cardiovascular and pulmonary systems by non-Newtonian flows, b) surface tension driven flows, d) fluid-structure interactions, and e) cellular fluid mechanics.
Prerequisites: (MATH 205 and ME 231 and MATH 231)

BIOE 339 Neuronal Modeling and Computation 3 Credits
Neuroscience in a computational, mathematical, and engineering framework. Literature surveys and case studies with simulations. Computational aspects of information processing within the nervous system by focusing on single neuron modeling. Single neurons and how their biological properties relate to neuronal coding. Biophysics of single neurons, signal detection and signal reconstruction, information theory, population coding and temporal coding.
Prerequisites: ENGR 001 and MATH 205

BIOE 341 (CHE 341) Biotechnology I 3 Credits
Applications of material and energy balances; heat, mass, and momentum transfer; enzyme and microbial kinetics; and mathematical modeling to the engineering design and scale up of bioreactor systems. Closed to students who have taken BioE 441 (CHE 441).
Prerequisites: (MATH 205 and CHE 031 and CHM 031)

BIOE 342 (CHE 342) Biotechnology II 3 Credits
Engineering design and analysis of the unit operations used in the recovery and purification of products manufactured by the biotechnology industries. Requirements for product finishing and waste handling will be addressed. Consent of instructor required. Closed to students who have taken BIOE 442 (CHE 442).
Prerequisites: CHE 031 and CHM 031

BIOE 343 Integrated Biotechnology Laboratory 3 Credits
Biosafety, sterilization, media formulation, biochemical and enzyme assays, recombinant DNA technique, protein and DNA isolation and purification, for microbial fermentation and animal cell culture. Integration of biotechnology techniques for biopharmaceutical production. Consent of instructor required.
Prerequisites: BIOE 110 and (CHE 341 or BIOE 341)

BIOE 344 (CHE 344) Molecular Bioengineering 3 Credits
Kinetics in small systems, stochastic simulation of biochemical processes, receptor-mediated adhesion, dynamics of ion-channels, ligand binding, biochemical transport, surface Plasmon resonance, DNA microarray design, and chemical approaches to systems biology. Senior standing in BIOE.
Prerequisites: (MATH 205 and MATH 231)

BIOE 345 (CHE 345) Quantitative Biology 3 Credits
Basic concepts in molecular and cellular biology as well as biochemistry. Connects these to engineering principles in order to (1) develop a quantitative understanding of biological systems and (2) understand how applications of methods and principles in biology are used in modern engineering. Topics include protein structure and function, enzymology, membrane transport and trafficking, transcription/translation, signal transduction and models for cellular processes. An important part of this course is also taking topics discussed in lecture and translating them into practice.
Prerequisites: MATH 205

BIOE 349 Metabolic Engineering 3 Credits
Prerequisites: MATH 205 and MATH 231

BIOE 350 Special Topics 1-4 Credits
Special topics in bioengineering. Permission of Instructor. Repeat Status: Course may be repeated.

BIOE 357 Integrated Biophysical Data Analysis 2 Credits
The structure, function, properties and use of biopolymers, mechanical properties of biological tissues, and analysis of specific tissues (i.e. bone, muscle, and soft connective tissues).
Prerequisites: MECH 003
Can be taken Concurrently: MECH 003

BIOE 359 Biomechanics 3 Credits
Applications of mechanics to study behavior of anatomical structures and biological tissues of the musculoskeletal system. Specific topics include structure and function of biological tissues, mechanical properties of biological tissues, and analysis of specific tissues (i.e. bone, muscle, and soft connective tissues).
Prerequisites: MECH 003 and BIOE 358
Can be taken Concurrently: MECH 003, BIOE 358

BIOE 366 (ECE 366) Neural Engineering 3 Credits
Neural system interfaces for scientific and health applications. Basic properties of neurons, signal detection and stimulation, instrumentation and microfabricated electrode arrays. Fundamentals of peripheral and central neural signals and EEG, and applications such as neural prostheses, implants and brain-computer interfaces. Closed to students who have taken BIOE 466, ECE 366, or ECE 468.
Prerequisites: ECE 081

BIOE 368 (ECE 368) Introduction to Biophotonics and Optical Biomedical Imaging 3 Credits
Optical principles, techniques, and instruments used in biomedical research and clinical medicine. Fundamental concepts of optical imaging and spectroscopy systems, and details of light-tissue interaction. Commercial devices and instruments, as well as novel optical imaging technologies in development. Closed to students who have taken BIOE 468, ECE 368, or ECE 468.
Prerequisites: ECE 202 or PHY 212
BIOE 380 (BIOS 380) Biomolecular & Cellular Biophysics 3-4 Credits
Physical principles of biomolecular and cellular organization. Biomolecular interactions and recognition, molecular motors, physical organization and functioning of cellular membranes, electrical signaling in live cells. Modern techniques in biophysics, molecular spectroscopy, molecular modeling, fluorescence imaging, electrophysiology, electron microscopy.
Prerequisites: (BIOS 115) and (PHY 013 or PHY 021)

BIOE 407 (CSE 407) 3 Credits
Computational techniques and principles of structural biology used to examine molecular structure, function, and evolution. Topics include: protein structure alignment and prediction; molecular surface analysis; statistical modeling; QSAR; computational drug design; influences on binding specificity; protein-ligand, -protein, and -DNA interactions; molecular simulation, electrostatics. This course, a version of 307 for graduate students, requires advanced assignments and a collaborative project. Credit will not be given for both BIOE 307 and 407. Consent of instructor required.

BIOE 408 (CSE 408) Bioinformatics: Issues and Algorithms 3 Credits
Computational problems and their associated algorithms arising from the creation, analysis, and management of bioinformatics data. Genetic sequence comparison and alignment, physical mapping, genome sequencing and assembly, clustering of DNA microarray results in gene expression studies, computation of genomic rearrangements and evolutionary trees. This course, a version of 308 for graduate students, requires advanced assignments. Credit will not be given for both BIOE 308 (CSE 308) and BIOE 408 (CSE 408). No prior background in biology is assumed.
Prerequisites: CSE 017 or CSE 018
Attribute/Distribution: ND

BIOE 420 (CSE 420) Biomedical Image Computing and Modeling 3 Credits
Biomedical image modalities, image computing techniques, and imaging informatics systems. Understanding, using, and developing algorithms and software to analyze biomedical image data and extract useful quantitative information: Biomedical image modalities and formats; image processing and analysis; geometric and statistical modeling; image informatics systems in biomedicine. This course, a graduate version of BioE 320, requires additional advanced assignments. Credit will not be given for both BioE 320 and BIOE 420.
Prerequisites: MATH 205 and CSE 109
Attribute/Distribution: ND

BIOE 421 (CHE 421) Biomolecular & Cellular Mechanics 3 Credits
Mechanics and physics of cell components, from fundamental biomolecules to the entire cell. The mechanics of proteins and other biopolymers in 1D, 2D, and 3D structures, cell membrane structure and dynamics, and the mechanics of the whole cell. This course is a graduate version of CHE 321 (BioE/Phy 321). The lecture content will be the same as in CHE 321 (BioE/Phy 321), but students enrolled in CHE 421 (BioE 421) will have more advanced assignments. Closed to students who have completed CHE 321 (BioE/Phy 321). Must have graduate standing.

BIOE 424 (MAT 424) Introduction to Organic Biomaterials 3 Credits
Property, characterization, fabrication, and modification of organic materials for biomedical and biological applications; host responses to biomaterials on the molecular, cellular, and system level; general introduction to biosensors, drug delivery, and tissue engineering. Graduate version of BioE 324 requiring additional assignments. Credit is not given for both BioE 324 (MAT 324) and BioE 424 (MAT 424).
Prerequisites: MAT 033

BIOE 425 (MAT 425) Inorganic Biomaterials 3 Credits
Fabrication methods for biomedical implant and devices. Selection of metals and ceramics with specific bulk and surface physical as well as chemical properties. The role of materials chemistry and microstructure. Biocompatibility. Case studies (dental and orthopedic implants, stents, nonporous ceramic filters for kidney dialysis). Graduate version of MAT 325; credit will not be given for both MAT 325 and MAT 425.
Prerequisites: MAT 033

BIOE 426 (MAT 426) Biomimetic and Bio-enabled Materials 3 Credits
This course is a graduate version of BIOE 326 (MAT 326). While the lecture content will be the same as the 300-level course, students enrolled in BIOE 426 (MAT 426) will have more advanced assignments. Closed to students who have taken BIOE 326 (MAT 326). Must have graduate standing in Bioengineering or Materials Science and Engineering.

Attribute/Distribution: ND

BIOE 439 (CHE 439) Neuronal Modeling and Computation 3 Credits
This course is a graduate version of BIOE 339 (CHE 339). While the lecture content will be the same as the 300-level course, students in the 400-level class will be expected to complete an independent term project. Closed to students who have completed BIOE 339 (CHE 339). Must have graduate standing in Bioengineering or Chemical Engineering.

BIOE 441 (CHE 441) Biotechnology I 3 Credits
See the course description listed for BioE 341. In order to receive 400-level credits, the student must do an additional, more advanced term project, as defined by the instructor at the beginning of the course. Closed to students who have taken BioE 341 (CHE 341).

BIOE 442 (CHE 442) Biotechnology II 3 Credits
See the course description listed for BIOE 342 (CHE 342). In order to receive 400-level credit, the student must do an additional, more advanced term project, as defined by the instructor at the beginning of the course. Closed to students who have taken BIOE 342 (CHE 342).

BIOE 447 (CHE 447) Molecular Bioengineering 3 Credits
This course is a graduate version of CHE 344 (BioE 344). While the lecture content will be the same as the 300-level course, students enrolled in CHE 447 will have more advanced assignments. Closed to students who have completed BioE 344 (CHE 344).

BIOE 449 (CHE 449) Metabolic Engineering 3 Credits
This course is a graduate version of BIOE 349. While the lecture content will be the same as the 300-level course, students enrolled in BIOE 449 (CHE 449) will have more advanced assignments. Closed to students who have completed BIOE 349. Must have graduate standing in Chemical Engineering or Bioengineering.

BIOE 450 Special Topics 1-3 Credits
Special topics of study in bioengineering. Permission of instructor.

BIOE 466 (ECE 466) Neural Engineering 3 Credits
Neural system interfaces for scientific and health applications. Basic properties of neurons, signal detection and stimulation, instrumentation and microfabricated electrode arrays. Fundamentals of peripheral and central neural signals and EEG, and applications such as neural prostheses, implants and brain-computer interfaces. Closed to students who have taken BIOE 366, ECE 366, or ECE 466. Students enrolled in the course at the 400-level must complete additional advanced assignments, as defined by the course instructor.

BIOE 468 (ECE 468) Introduction to Biophotonics and Optical Biomedical Imaging 3 Credits
Optical principles, techniques, and instruments used in biomedical research and clinical medicine. Fundamental concepts of optical imaging and spectroscopy systems, and details of light-tissue interaction. Commercial devices and instruments, as well as novel optical imaging technologies in development. Closed to students who have taken BIOE 368, ECE 368, or ECE 468. Students enrolled in the course at the 400-level must complete additional advanced assignments, as defined by the course instructor.

BIOE 490 Thesis 1-6 Credits
Repeat Status: Course may be repeated.

BIOE 499 Dissertation 1-12 Credits

Biological Sciences
The biological sciences include the study of living systems at levels ranging from the structure and function of molecules to the behavior and evolution of communities of organisms. The department offers four different routes to mastering skills and knowledge in this broad area. The B.A. and B.S. programs in biology provide a broad introduction to biology with opportunities for students to create a program of
study suited to their specific interests. Programs of study focused on particular aspects of biology are the B.A. and B.S. degree in the areas of behavioral neuroscience and molecular biology. For programs in biochemistry and bioengineering, see those separate sections in the catalog.

The Department of Biological Sciences strongly supports the positions of both the American Association for the Advancement of Science and the National Academy of Sciences that intelligent design is not scientific and should not be presented as science in science classes.

The requirements for the B.A. and B.S. in biology, behavioral neuroscience, and molecular biology are listed below. Research interests of the faculty and instrumentation are described in the section on graduate education.

**Professors.** Michael J. Behe, PhD (University of Pennsylvania); Lynne U. Cassimeris, PhD (University of North Carolina); David L. Cundall, PhD (University of Arkansas); Matthias M. Falk, PhD (Ruprecht Karl University of Heidelberg); Wonpil Im, PhD (Cornell University); Murray Itzkowitz, PhD (University of Maryland); Linda J. Lowe-Krentz, PhD (Northwestern University); Jill E. Schneider, PhD (Wesleyan University); Neal G. Simon, PhD (Rutgers University); Robert V. Skibbens, PhD (University of North Carolina Chapel Hill); Jennifer Swann, PhD (Northwestern University); Vassie C. Ware, PhD (Yale University)

**Associate Professors.** R. Michael Burger, PhD (University Texas, Austin); Mary Kathryn Iovine, PhD (Washington University); Michael R. Kuchka, PhD (Carnegie Mellon University)

**Assistant Professors.** Daniel Babcock, PhD (University Texas Houston); Julie Haas, PhD (Boston University); Gregory I. Lang, PhD (Harvard University); Michael J. Layden, PhD (University of Oregon); Julie M. Miwa, PhD (Rockefeller University); Amber M. Rice, PhD (University of North Carolina)

**Professor Of Practice.** Krystle McLaughlin, PhD (University of Rochester)

**Emeriti.** John H. Abel, Jr., SCD (Brown University); Steven Krawiec, PhD (Yale University); John G. Nyby, PhD (University Texas, Austin); Hayden N. Pritchard, PhD (Lehigh University); Jeffrey A. Sands, PhD (The Pennsylvania State University)

### B.A. WITH MAJOR IN BIOLOGY

**College and university requirements for all majors**

<table>
<thead>
<tr>
<th>Course</th>
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<td>ENGL 001</td>
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<td>ENGL 002</td>
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<td>First Year Seminar</td>
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<tr>
<td>Social Sciences</td>
<td>8</td>
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<td>Humanities</td>
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**Biology**

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<td>BIOS 115 &amp; BIOS 116</td>
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</tr>
<tr>
<td>BIOS 121 &amp; BIOS 122</td>
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<tr>
<td>Biology electives</td>
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**Mathematics**

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**Collateral Sciences**

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<th>Credits</th>
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</thead>
<tbody>
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<td>ENGL 001</td>
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**CHM 030 & CHM 041** Introduction to Chemical Principles and Honors General Chemistry II

**CHM 040 & CHM 041** Honors General Chemistry I and Honors General Chemistry II

**CHM 110 & CHM 111** Organic Chemistry I and Organic Chemistry Laboratory I

**CHM 112 & CHM 113** Organic Chemistry II and Organic Chemistry Laboratory II

**Total Credits** 74-75

1. Biology electives must include one course from list A (see below) and one course from list B (see below). These will be chosen in consultation with the major advisor. No more than 3 credits from the following courses: BIOS 161, BIOS 261, BIOS 262, BIOS 391, BIOS 393, College scholar project, not BIOS 130.

**Biology Electives List A**
Choose one of the following:

<table>
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<td>BIOS 385</td>
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**Biology Electives List B**
Choose one of the following:

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<td>BIOS 328</td>
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<td>BIOS 381</td>
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**THE B.S. IN BIOLOGY**

The Bachelor of Science in biology offers broad scientific preparation in biology to facilitate advanced work in the life sciences. Progression through the program is best served through early commitment.

**Requirements for the B.S. in Biology**

**College and university requirements for all majors**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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### Biology

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<td>&amp; BIOS 042</td>
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<tr>
<td>&amp; BIOS 116</td>
<td>&amp; Biology Core II: Genetics</td>
<td></td>
</tr>
<tr>
<td>BIOS 121</td>
<td>Biology Core III: Integrative &amp;</td>
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<td>&amp; BIOS 122</td>
<td>&amp; Comparative Biology</td>
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<tr>
<td>BIOS 317</td>
<td>Evolution</td>
<td>3</td>
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</table>

### Biology Electives List A

Choose two of the following:

- BIOS 234 Comparative Vertebrate Anatomy
- BIOS 235 Human Physiology
- BIOS 241 Vertebrate Natural History
- BIOS 276 Central Nervous System and Behavior
- BIOS 313 Vertebrate Histology
- BIOS 314 Vertebrate Development
- BIOS 315 Neuropharmacology
- BIOS 323 Evolution of Development
- BIOS 326 Coevolution
- BIOS 329 Herpetology
- BIOS 334 Species and Speciation
- BIOS 335 Animal Behavior
- BIOS 337 Behavioral Ecology
- BIOS 365 Neurobiology of Sensory Systems
- BIOS 366 Diseases of the Nervous System
- BIOS 369 Comparative Physiology of Vertebrate Systems
- BIOS 374 Sex Determination and Differentiation
- BIOS 382 Endocrinology of Behavior
- BIOS 385 Synapses, Plasticity and Learning
- BIOS 386 Genes and the Brain

### Mathematics

Select one of the following:

- MATH 021 Calculus I
- MATH 022 and Calculus II
- MATH 051 Survey of Calculus I
- MATH 052 and Survey of Calculus II

### Collateral Sciences

Select one of the following:

- CHM 030 Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems
- CHM 031 & CHM 032
- CHM 040 Honors General Chemistry I
- CHM 041 & CHM 042
- CHM 110 Organic Chemistry I
- CHM 111 & CHM 112
- CHM 112 Organic Chemistry II
- CHM 113 & CHM 114
- PHY 010 General Physics I
- or PHY 011 Introductory Physics I
- PHY 012 Introductory Physics Laboratory I
- PHY 013 General Physics II
- or PHY 021 Introductory Physics II
- PHY 022 Introductory Physics Laboratory II

### Total Credits

98-99

1 Biology electives must include two courses from list A (see below), two courses from list B (see below) and at least four credits of laboratory experience (e.g., two 2 credit laboratory courses). These will be chosen in consultation with the major advisor.

### Biology Electives List B

Choose two of the following:

- BIOS 323 Evolution of Development
- BIOS 324 Microbiology
- BIOS 327 Development and Disease
- BIOS 328 Immunology
- BIOS 340 Molecular Basis of Disease
- BIOS 342 Cellular Basis of Human Disease
- BIOS 345 Molecular Genetics
- BIOS 347 Advanced Topics in Genetics
- BIOS 367 Cell Biology
- BIOS 371 Elements of Biochemistry I
- BIOS 372 Elements of Biochemistry II
- BIOS 375 Developmental Biology
- BIOS 381 Physical Biochemistry
- BIOS 384 Eukaryotic Signal Transduction

### RECOMMENDED B.S. BIOLOGY SEQUENCE

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<th>Year</th>
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<td>MATH 051</td>
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<td>MATH 052</td>
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<td>4</td>
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<td>CHM 031</td>
<td>4</td>
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<td>Second Year</td>
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<td>4</td>
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<tr>
<td>AND/OR</td>
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<td>BIOS 121 &amp; BIOS 122</td>
<td>4</td>
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<tr>
<td>CHM 110 &amp; CHM 111</td>
<td>4</td>
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<td>CHM 112 &amp; CHM 113</td>
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<td>BIOS 130</td>
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<td>Third Year</td>
<td>CR</td>
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<td>BIOS 115 &amp; BIOS 116 AND/OR</td>
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<td>5</td>
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<td>PHY 010 &amp; PHY 012</td>
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<td>PHY 013 &amp; PHY 022</td>
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<tr>
<td>BIOS 317</td>
<td>3</td>
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### B.A. WITH MAJOR IN BEHAVIORAL NEUROSCIENCE

The B.A. in Behavioral Neuroscience is a natural science major for B.A. distribution purposes.

#### Required Major Courses

<table>
<thead>
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<th>Course Title</th>
<th>Credits</th>
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<tbody>
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<td>BIOS 041</td>
<td>Biology Core I: Cellular and Molecular</td>
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<tr>
<td>&amp; BIOS 042</td>
<td>and Biology Core I: Cellular and Molecular Lab</td>
<td>4</td>
</tr>
<tr>
<td>BIOS 115</td>
<td>Biology Core II: Genetics</td>
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<tr>
<td>&amp; BIOS 116</td>
<td>and Biology Core II: Genetics Laboratory</td>
<td>4</td>
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<tr>
<td>BIOS 121</td>
<td>Biology Core III: Integrative &amp; Comparative Biology</td>
<td>3</td>
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<td>CHM 110</td>
<td>Organic Chemistry I</td>
<td>3</td>
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<tr>
<td>BIOS 130</td>
<td>Biostatistics</td>
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<tr>
<td>BIOS 276</td>
<td>Central Nervous System and Behavior</td>
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</table>

Select one of the following:

- BIOS 277 Experimental Neuroscience Laboratory
- BIOS 278 Neurophysiology Laboratory
- BIOS 279 Experimental Molecular Neuroscience Laboratory
- BIOS 382 Endocrinology of Behavior

Select one of the following:

- BIOS 315 Neuropharmacology
- BIOS 323 Evolution of Development
- BIOS 365 Neurobiology of Sensory Systems
- BIOS 366 Diseases of the Nervous System
- BIOS 384 Eukaryotic Signal Transduction
- BIOS 385 Synapses, Plasticity and Learning
- BIOS 386 Genes and the Brain
- BIOS 395 Miscellaneous

#### Major Electives

Select two of the following: 6

- Any 300-level BIOS course not fulfilling another BNS requirement above
- CHM 031 Chemical Equilibria in Aqueous Systems
- or CHM 041 Honors General Chemistry II
- PSYC 117 Cognitive Psychology
- PSYC 153 Personality
- PSYC 176 Cognitive Neuroscience

### Math and Science Requirements for the B.A.

Select one of the following: 7-8

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<th>Course Code</th>
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<td>CHM 030</td>
<td>Introduction to Chemical Principles</td>
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<td>or CHM 040</td>
<td>Honors General Chemistry I</td>
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<td>PSYC 001</td>
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### Total Credits: 70-77

#### Other Options

The B.A. in Behavioral Neuroscience can be structured for a wide variety of possibilities (see listing of recommended elective courses). By using free electives to take additional science, the B.A. also can serve as a pre-professional degree for many graduate and professional schools. Students interested in a particular career based program should consult their advisor or the program director, Professor Michael Kuchka.

### B.S. IN BEHAVIORAL NEUROSCIENCE

An early commitment to the B.S. is desirable to meet all the requirements of this program.

#### Required Major Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<td>BIOS 121</td>
<td>Biology Core III: Integrative &amp; Comparative Biology</td>
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<td>BIOS 130</td>
<td>Biostatistics</td>
<td>4</td>
</tr>
<tr>
<td>BIOS 276</td>
<td>Central Nervous System and Behavior</td>
<td>3</td>
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</table>

Select one of the following:

- BIOS 277 Experimental Neuroscience Laboratory
- BIOS 278 Neurophysiology Laboratory
- BIOS 279 Experimental Molecular Neuroscience Laboratory
- BIOS 382 Endocrinology of Behavior

Select one of the following:

- BIOS 315 Neuropharmacology
- BIOS 323 Evolution of Development
- BIOS 365 Neurobiology of Sensory Systems
- BIOS 366 Diseases of the Nervous System
- BIOS 384 Eukaryotic Signal Transduction
- BIOS 385 Synapses, Plasticity and Learning
- BIOS 386 Genes and the Brain
- BIOS 395 Miscellaneous

### Additional Biological Sciences Requirements for the B.S.

<table>
<thead>
<tr>
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<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOS 371</td>
<td>Elements of Biochemistry I</td>
<td>3</td>
</tr>
<tr>
<td>BIOS 372</td>
<td>Elements of Biochemistry II</td>
<td>3</td>
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</tbody>
</table>

Select one of the following: 2-4

- BIOS 234 Comparative Vertebrate Anatomy
- BIOS 368 Cell Biology Laboratory
- BIOS 377 Biochemistry Laboratory
- BIOS 277 or BIOS 278 or BIOS 279 (must be different than course chosen for Required Major Courses)

### Advanced BIOS Course Requirement

Select two of the following: 3-4

<table>
<thead>
<tr>
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<tr>
<td>BIOS 315</td>
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<tr>
<td>BIOS 323</td>
<td>Evolution of Development</td>
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<tr>
<td>BIOS 365</td>
<td>Neurobiology of Sensory Systems</td>
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<tr>
<td>BIOS 366</td>
<td>Diseases of the Nervous System</td>
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<td>BIOS 384</td>
<td>Eukaryotic Signal Transduction</td>
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<tr>
<td>BIOS 385</td>
<td>Synapses, Plasticity and Learning</td>
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<tr>
<td>BIOS 386</td>
<td>Genes and the Brain</td>
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### Math and Science Requirements for the B.S.

Select one of the following: 7-8

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<th>Course Title</th>
<th>Credits</th>
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<tr>
<td>MATH 021</td>
<td>Calculus I</td>
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<tr>
<td>&amp; MATH 022</td>
<td>and Calculus II</td>
<td></td>
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<tr>
<td>MATH 051</td>
<td>Survey of Calculus I</td>
<td></td>
</tr>
<tr>
<td>&amp; MATH 052</td>
<td>and Survey of Calculus II</td>
<td></td>
</tr>
<tr>
<td>CHM 030</td>
<td>Introduction to Chemical Principles</td>
<td>4</td>
</tr>
<tr>
<td>or CHM 040</td>
<td>Honors General Chemistry I</td>
<td></td>
</tr>
<tr>
<td>CHM 110</td>
<td>Organic Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHM 111</td>
<td>and Organic Chemistry Laboratory I</td>
<td></td>
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<tr>
<td>CHM 112</td>
<td>Organic Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHM 113</td>
<td>and Organic Chemistry Laboratory II</td>
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<tr>
<td>PSYC 001</td>
<td>Introduction to Psychology</td>
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### Total Credits: 51-52

1. Except BIOS 320, BIOS 347, BIOS 383, BIOS 387, BIOS 388, BIOS 391, or BIOS 393.

### Total Credits: 17-18

### Biology electives including at least 4 credits of laboratory

### Total Credits: 13-17

### Math and Science Requirements for the B.A.

Select one of the following: 7-8
<table>
<thead>
<tr>
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<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOS 345</td>
<td>Molecular Genetics</td>
<td>5</td>
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<td>BIOS 346</td>
<td>and Molecular Genetics Laboratory</td>
<td></td>
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<tr>
<td>BIOS 367</td>
<td>Cell Biology</td>
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</tr>
<tr>
<td>BIOS approved electives</td>
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<tr>
<td>&amp; MATH 052</td>
<td>and Survey of Calculus II</td>
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### Chemistry

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<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHM 030</td>
<td>Introduction to Chemical Principles</td>
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<tr>
<td>CHM 040</td>
<td>Honors General Chemistry I</td>
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<th>Course Title</th>
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<tbody>
<tr>
<td>CHM 031</td>
<td>Chemical Equilibria in Aqueous Systems</td>
<td>4</td>
</tr>
<tr>
<td>CHM 041</td>
<td>Honors General Chemistry II</td>
<td></td>
</tr>
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<td>Organic Chemistry I</td>
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</tr>
<tr>
<td>&amp; CHM 111</td>
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</tr>
<tr>
<td>CHM 112</td>
<td>Organic Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHM 113</td>
<td>and Organic Chemistry Laboratory II</td>
<td></td>
</tr>
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Select one of the following:

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>PHY 101</td>
<td>General Physics I</td>
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<td>&amp; PHY 102</td>
<td>and Introductory Physics Laboratory I</td>
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<tr>
<td>PHY 103</td>
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### Total Credits

78-80

THE B.S. IN MOLECULAR BIOLOGY

Requirements for the B.S. in Molecular Biology

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</tr>
<tr>
<td>BIOS 367</td>
<td>Cell Biology</td>
<td>3</td>
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<tr>
<td>BIOS approved electives</td>
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<td>6</td>
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</tr>
<tr>
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<td>and Survey of Calculus II</td>
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### Total Credits

91-94

### B.A. WITH MAJOR IN MOLECULAR BIOLOGY

Requirements for the B.A. in Molecular Biology

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>BIOS 345</td>
<td>Molecular Genetics</td>
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<tr>
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</table>

### Total Credits

91-94
### Molecular Biology

<table>
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<tbody>
<tr>
<td>BIOS 041</td>
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<tr>
<td>&amp; BIOS 042</td>
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<tr>
<td>BIOS 115</td>
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<tr>
<td>&amp; BIOS 116</td>
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<tr>
<td>BIOS 121</td>
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<tr>
<td>&amp; BIOS 122</td>
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Select one of the following:

- BIOS 324 Microbiology
- BIOS 328 Immunology

Select one of the following:

- BIOS 325 Bacteriology Laboratory
- BIOS 368 Cell Biology Laboratory
- BIOS 377 Biochemistry Laboratory
- BIOS 345 Molecular Genetics
- & BIOS 346 Molecular Genetics Laboratory
- BIOS 367 Cell Biology
- BIOS 371 Elements of Biochemistry I
- BIOS 372 Elements of Biochemistry II
- BIOS 381 Physical Biochemistry
- BIOS Approved Molecular Biology Electives

**Total Credits:** 82-85

---

### RECOMMENDED SEQUENCE FOR THE B.S. IN MOLECULAR BIOLOGY

**First Year**

<table>
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<td>&amp; BIOS 042</td>
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<td>MATH 021</td>
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<td>MATH 022</td>
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<tr>
<td>CHM 030</td>
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<td>CHM 031</td>
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**Second Year**

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<td>&amp; BIOS 116</td>
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<td>CHM 110</td>
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**Third Year**

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<td>BIOS 324 or 328</td>
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<td>BIOS 325, 368, or 377</td>
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<td>BIOS 371</td>
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**Fourth Year**

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<td>BIOS 381</td>
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**Total Credits:** 79

### MOLECULAR BIOLOGY MINOR

**Minor Program**

<table>
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<td>&amp; BIOS 346</td>
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<td>BIOS coursework at the 200 or 300 level (minimum 4 additional credits)</td>
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**Collateral coursework**

- MATH 051 Survey of Calculus I 4
- or MATH 021 Calculus I
- CHM 030 Introduction to Chemical Principles 4
- CHM 110 Organic Chemistry I 3

**Total Credits** 28

### DEPARTMENTAL HONORS

A student may apply for admission to the departmental honors program through a potential thesis advisor. Requirements for Departmental Honors include a major GPA of 3.25 and at least 2 semesters of 300-level research for a minimum of 6 cr. The student must write a research proposal for their project and a thesis at the conclusion of their research. This work must be presented in a symposium at the end of the project. Students must meet regularly with their advisor and research group to discuss their research progress and also must complete the year-long, 2-course sequence for BIOS honors students (BIOS 387 and BIOS 388).

### SPECIAL HEALTH PROFESSIONS PROGRAMS

Students may apply for admission to an accelerated B.A.-Doctor of Medicine program and a B.A.-Doctor of Medical Dentistry program. A seven-year B.A.M.D. program is offered in conjunction with Drexel University College of Medicine, and a seven year B.A.D.M.D. program is offered in conjunction with the University of Pennsylvania School of Dental Medicine. Students in these programs receive a B.A. from Lehigh and a graduate degree from the designated professional school within a seven-year period. For details concerning admission to these programs, see Health Professions (p. 53).

### GRADUATE STUDY IN THE BIOLOGICAL SCIENCES

Rigorous, research-oriented graduate programs leading to a Doctor of Philosophy are offered in three divisions of the Department of Biological Sciences: biochemistry, integrative biology and neuroscience, and cell and molecular biology. To complete the program students must successfully complete core courses, pass a qualifying exam, prepare, submit, and successfully defend a written research proposal, complete the research described in the proposal, and submit a written dissertation and defend the completed research to the department.

Once students enter the department, their progress is monitored by the graduate committee until they are admitted to candidacy. Members of the committee meet with the student each semester to assess the student's progress towards the degree and to assist students in choosing the appropriate courses to provide a solid scientific foundation and an up-to-date understanding of the discipline. This will be assessed by the qualifying exam.

The qualifying exam generally should be taken after the third semester and no later than the fourth semester of course work. It will be prepared, administered and graded by the faculty associated with the specific graduate program in which the student is enrolled. It consists of a two-day written exam and an oral examination. The exam can be repeated.
once. Admission to candidacy is granted after successful completion of the qualifying exam and the thesis proposal. The proposal is a written description of an original research project developed under the guidance of a faculty member chosen by the student to be his/her advisor. The proposal will be presented orally to the thesis committee, typically after the fifth semester. Following the presentation of the proposal, an oral examination will take place in which the thesis committee will question the student about general science related to the project. This will constitute the general examination.

Core requirements for each division are listed below. The graduate school requires students to register for at least 72-credit baccalaureate credits to earn the Ph.D. In addition, all students must take BIOS 408 (0 credits) Responsible Conduct of Science within their first year of graduate study. All students must also attend departmental seminars and enroll in BIOS 406 (1 credit) Biological Sciences Seminar at least twice in the first four semesters. A minimum of 24 course credits may be chosen from upper level courses in biochemistry, molecular biology, cell biology, behavioral biology and evolutionary biology, and neuroscience. At least 12 of these credits must be at the 400 level.

Biochemistry
In the biochemistry program, research areas include DNA structure and function, regulation of protein synthesis, and signal transduction. Students admitted to graduate study in biochemistry will typically have an undergraduate degree in chemistry or biochemistry. Students with an undergraduate degree in a related discipline will be expected to have the following undergraduate preparation for graduate study:

- an introductory course in organic chemistry and at least one semester of analytical chemistry and one semester of physical chemistry thermodynamics and kinetics, with appropriate math. Students without that background will be expected to take courses to fulfill those requirements as part of their graduate study.

Required courses
- BIOS 371 Elements of Biochemistry I 3
- BIOS 372 Elements of Biochemistry II 3
- CHM 423 Bio-Organic Chemistry 3
- BIOS 345 Molecular Genetics 3

Seminar course
- BIOS 406 Biological Sciences Seminar 1
  or CHM 400 First Year Graduate Student Seminar 1

Integrative Biology and Neuroscience
The graduate program in integrative biology and neuroscience is designed to train students in advanced organismal biology with the emphasis on behavioral ecology, evolution, functional morphology, endocrinology, and neurobiology of animals. The mission of the program is to create students who are broadly trained and uniquely capable of asking questions and solving problems at the interface of these traditionally defined fields. Students admitted to the program should have a basic knowledge of evolution, anatomy, physiology, behavioral neuroscience, and/or behavioral ecology. Students will begin by taking core courses providing a broad foundation in integrative biology at the graduate level and work toward a Ph.D. with a concentration in either behavioral neuroscience or behavioral and evolutionary biology. Regardless of concentration, all students in the program develop an appreciation for the fact that all aspects of biology, whether cellular, physiological, anatomical, behavioral, evolutionary, or social, are inextricably linked and cannot be fully understood as separate, parallel systems of knowledge. The integrative program consists of two tracks: (I) Animal Behavior and Evolution, and (II) Neuroscience.

Track 1: Animal Behavior and Evolution

Required Courses
- Take three (3) of the following:
  - BIOS 426 Speciation
  - BIOS 428 Molecular Evolution
  - BIOS 434 Coevolution
  - BIOS 439 Advanced Behavioral Ecology

Take one (1) course from EITHER the 400-level Cell and Molecular offerings (see Catalog entry) OR the 400-level Neuroscience offerings (see below)

Additional Requirements
- BIOS 401 Professional Skills for Biological Sciences Graduate Students (strongly recommended to be taken in first two years)
- BIOS 406 Biological Sciences Seminar (2 semesters)
- BIOS 408 Responsible Conduct of Science

Track 2: Neuroscience
Depending on the student’s background, additional courses may be required.

Required Courses
- Take one (1) of the following:
  - BIOS 453 General Neuroanatomy
  - BIOS 457 Advanced Behavioral Neuroendocrinology

Take one (1) of the following:
- BIOS 415 Synapses, Plasticity and Learning
- BIOS 424 Advanced Neurobiology of Sensory Systems

Take one (1) of the following:
- BIOS 471 Eukaryotic Signal Transduction
- BIOS 486 Genes and the Brain

Take one (1) course from EITHER the 400-level Cell and Molecular offerings (see Catalog entry) OR the 400-level Animal Behavior and Evolution offerings (see above)

Cell and Molecular Biology
In the cell and molecular biology program, research areas include microbial evolution and genetics, plant and animal molecular genetics, eukaryotic cell biology, and regulation of gene expression.

- BIOS 345 Molecular Genetics 3
- BIOS 371 Elements of Biochemistry I 3
- BIOS 372 Elements of Biochemistry II 3
- BIOS 411 Advanced Cell Biology 3
- BIOS 421 Molecular Cell Biology I 3
- BIOS 422 Molecular Cell Biology II 3

Additional Requirements
- BIOS 406 Biological Sciences Seminar (2 semesters)

Upper level electives in molecular biology, cell biology, and biochemistry

Total Credits 25

Additional Facilities available for research in the biological sciences include core facilities with equipment (for example, for DNA synthesis, confocal microscopy, digital imaging, chromatography, cell culture, centrifugation, controlled environments, gamma and scintillation counting, flow cytometry, and rodent surgery). Individual research laboratories and advanced teaching laboratories contain a variety of additional equipment. Ongoing interactions with a variety of private companies contribute additional opportunities for student experiences.

Courses
- BIOS 010 Bioscience in the 21st Century 4 Credits
  A multidisciplinary survey of advances in bioscience. Exploration of themebased topics (e.g., infectious diseases, cancer, genomebase medicine, engineered biomedical systems) coupled with social/ethical considerations. Three lectures per week. Participation in online multidisciplinary discussion, writing assignments, field trips, and/or other activities.

Attribute/Distribution: NS
BIOS 041 Biology Core I: Cellular and Molecular 3 Credits
Basic building blocks and higherorder structures required for cellular processes. Topics include the character of membranes, the molecular/ cellular basis of energy production, cell cycle progression, DNA replication, gene expression, signal transduction, and cell division. 
Prerequisites: CHM 075 or CHM 025 or CHM 030 or CHM 040
Can be taken Concurrently: CHM 075, CHM 025, CHM 030, CHM 040
Attribute/Distribution: NS

BIOS 042 Biology Core I: Cellular and Molecular Lab 1 Credit
Techniques and experiments related to the principal topics covered in BIOS 041; emphasis on experimental design and scientific communication. 
Prerequisites: BIOS 041
Can be taken Concurrently: BIOS 041
Attribute/Distribution: NS

BIOS 043 Phage Hunting Laboratory 2 Credits
The first laboratory research course in a two-semester series (as part of the Howard Hughes Medical Institute’s SEA-PHAGES Program) that focuses on the isolation (from local soil), as well as the physical and genomic characterization of novel bacteriophages that infect mycobacteria. Course will substitute for BIOS 42. Application and acceptance into Lehigh's SEA program required (see www.lehigh.edu/~isea); freshman status in the spring semester or permission of the instructor. Co-requisite: BIOS 41 or instructor permission.
Prerequisites: BIOS 041
Can be taken Concurrently: BIOS 041
Attribute/Distribution: NS

BIOS 115 Biology Core II: Genetics 3 Credits
Prerequisites: BIOS 041
Attribute/Distribution: NS

BIOS 116 Biology Core II: Genetics Laboratory 1 Credit
Introduction to model organisms; techniques used in molecular genetics; experimental design and scientific communication. 
Prerequisites: BIOS 115
Can be taken Concurrently: BIOS 115
Attribute/Distribution: NS

BIOS 118 Phage Genetics Laboratory 2 Credits
Part of a 2-semester series focusing on genetic analysis of novel bacteriophage genomes to determine gene function using recombineering strategies. Phage genome annotation using bioinformatics for previously sequenced phage genomes. Additional genetics, molecular biology, and/or biochemical research on previously isolated bacteriophages may also be included. 
Prerequisites: BIOS 115
Can be taken Concurrently: BIOS 115
Corequisites: BIOS 115
Attribute/Distribution: NS

BIOS 121 Biology Core III: Integrative & Comparative Biology 3 Credits
Experimental and historical approaches to the analysis of structural and functional properties in organisms. Use of scientific method to study species diversity. Introduction to the analysis of organismal attributes that explain behavioral repertoire and ecological relationships. 
Prerequisites: BIOS 41 and BIOS 42
Attribute/Distribution: NS

BIOS 122 Biology Core III: Integrative and Comparative Lab 1 Credit
Experiments and discussions related to the topics covered in BIOS 121; emphasis on experimental design and scientific communication. 
Prerequisites: BIOS 121
Can be taken Concurrently: BIOS 121
Attribute/Distribution: NS

BIOS 130 (MATH 130) Biostatistics 4 Credits
Elements of statistics and probability theory with emphasis on biological applications. Statistical analysis of experimental and observational data. 
Prerequisites: BIOS 041 and MATH 052 or MATH 022
Attribute/Distribution: ND

BIOS 161 Supervised Research 1-3 Credits
Apprenticeship in ongoing faculty research program. Literature review, experimental design, data collection and analysis, and professional writing under faculty sponsor supervision. Only 3 credits can be counted toward any life science major. Consent of instructor required. 
Repeat Status: Course may be repeated.
Prerequisites: BIOS 041
Attribute/Distribution: ND

BIOS 202 Biomedical Externship 1-3 Credits
Analysis of individualized experiences at external biomedical clinical or research sites. Limited enrollment. May not be taken for pass/fail grading. May not be used to satisfy any life science major or minor requirement. Consent of department chair required. 
Attribute/Distribution: NS

BIOS 234 Comparative Vertebrate Anatomy 4 Credits
A course in vertebrate zoology with emphasis on the study of homologous body structures in the various vertebrate classes and their relationship to the functional demands of habit and environment in each class. Detailed dissections of representative vertebrates are made in the laboratory. Two lectures and two laboratory periods. 
Prerequisites: BIOS 121 or BIOS 122
Attribute/Distribution: NS

BIOS 235 Human Physiology 4 Credits
Movement, digestion, respiration, circulation and excretion. Sensory systems, hormonal and electrical signal transduction, reproduction. 
Prerequisites: BIOS 121 and BIOS 122
Attribute/Distribution: NS

BIOS 241 Vertebrate Natural History 4 Credits
An introduction to the ecology, behavior, distribution and evolution of vertebrates, with emphasis on the North American fauna. Two lectures, one tutorial and one laboratory and field trip. This course may be used to fulfill junior writing requirements with the permission of the instructor. 
Prerequisites: BIOS 115 or BIOS 116 or BIOS 121 or BIOS 122
Attribute/Distribution: NS

BIOS 251 Writing and Biological Sciences 3 Credits
A course designed to acquaint students with some of the intellectual foundations of science, with attention to the distinctiveness of the biological sciences. Format includes readings, intensive writing, extemporaneous speaking, and discussion. May not be used to fulfill Biology B.A. elective requirements. 
Attribute/Distribution: NS

BIOS 261 Special Topics in Biological Sciences 1-3 Credits
Research, conferences and reports on selected topics not covered in the general undergraduate offerings. Consent of instructor required. 
Repeat Status: Course may be repeated.
Attribute/Distribution: NS

BIOS 262 Research Proposal 3 Credits
Literature and methods of research in area of department faculty expertise. Requires development of detailed proposal for research to be performed in senior year. Must have major in any biological sciences degree program, junior standing, GPA of 3.0 in major, and consent of department. 
Attribute/Distribution: NS

BIOS 276 Central Nervous System and Behavior 3 Credits
Neuronanatomy and neurophysiology of animal and human behavior. Feeding, thirst, sleep, emotions, learning, and psychopathology. 
Prerequisites: BIOS 121 and BIOS 122
Attribute/Distribution: NS

BIOS 277 Experimental Neuroscience Laboratory 2 Credits
Structure and function of the mammalian brain with special attention to cellular morphology and organization. Widely used histological and behavioral techniques to determine how the shape and function of the nervous system regulates behavior. Experimental design, hypothesis testing, statistical analysis, reading and writing of scientific papers, basic histology and imaging. 
Prerequisites: BIOS 276
Can be taken Concurrently: BIOS 276
Attribute/Distribution: NS
BIOS 278 Neurophysiology Laboratory 2 Credits
The functional electrical underpinnings of the nervous system explored through direct recordings and thorough data analyses. Experimental design, hypothesis testing, numerical analysis, reading and writing of primary science.
Prerequisites: BIOS 276
Can be taken Concurrently: BIOS 276
Attribute/Distribution: NS

BIOS 279 Experimental Molecular Neuroscience Laboratory 2 Credits
Inquiry-based lab course emphasizing molecular and cellular neuroscience approaches to understanding the nervous system. Opportunity for making real research discoveries on the genetic and cellular underpinnings of brain function. Molecular genetic, bioinformatic, and neurochemical techniques. Can be taken more than once with instructor approval.
Repeat Status: Course may be repeated.
Prerequisites: BIOS 276
Can be taken Concurrently: BIOS 276
Attribute/Distribution: NS

BIOS 300 Apprentice Teaching 1-4 Credits
Repeat Status: Course may be repeated.

BIOS 313 Vertebrate Histology 4 Credits
Microstructural and ultrastructural properties of vertebrate cells and tissues. Techniques of tissue preparation. Two lectures and two labs.
Prerequisites: BIOS 115 and BIOS 116 and BIOS 121 and BIOS 122
Attribute/Distribution: ND, NS

BIOS 314 Vertebrate Development 4 Credits
Germ cell formation, fertilization, early development, and the origin of the principal organ systems. Location, structure, and regulation of information from molecular to organismal levels of organization.
Prerequisites: BIOS 115 and BIOS 116 and (BIOS 120 or (BIOS 121 and BIOS 122),)
Attribute/Distribution: NS

BIOS 315 Neuropharmacology 3 Credits
Prerequisites: BIOS 276
Attribute/Distribution: NS

BIOS 317 Evolution 3 Credits
Prerequisites: BIOS 121 and BIOS 122
Attribute/Distribution: NS

BIOS 320 (ENTP 320) The Business of Life Science 3 Credits
An examination of business process in startup, early stage and developing biotechnology companies. Technology assessment, business plan and proposal preparation, financial strategies, resource management, intellectual property, and legal as well as regulatory issues. Cannot be used to fulfill major or minor requirements in Biological Sciences.
Prerequisites: BIOS 121
Attribute/Distribution: NS

BIOS 323 Evolution of Development 3 Credits
This course examines how changes in the blueprint that describes the development of a multicellular animal from a single fertilized egg lead to the evolution of new species or new forms within a species.
Prerequisites: BIOS 317 or BIOS 376 or BIOS 327
Can be taken Concurrently: BIOS 317, BIOS 376, BIOS 327

BIOS 324 Microbiology 3 Credits
An examination of microbial life, including archaea, bacteria, fungi, protists and viruses. Emphasis on microbial molecular genetics and its relationship to the origin of life, human health/medicine, and the environment.
Prerequisites: CHM 110 and BIOS 115
Attribute/Distribution: NS

BIOS 325 Bacteriology Laboratory 2 Credits
Laboratory studies of microbes. Experiments on environmental microbiology, bacterial molecular genetics, bacteriophages, and/or other topics covered in BIOS 324 using modern and classical microbiology techniques.
Prerequisites: BIOS 324
Can be taken Concurrently: BIOS 324
Attribute/Distribution: NS

BIOS 326 Coevolution 3 Credits
Discussion-based seminar course covering readings from the primary literature. Course will examine evolutionary consequences of species interactions, interactions between the sexes, and genetic interactions. Topics will include predator-prey interactions, host-parasite interactions, sexual conflict, genic conflict, mutualism, and more. Consequences of coevolution for biodiversity and human health will also be examined.
Prerequisites: BIOS 317
Attribute/Distribution: NS

BIOS 327 Development and Disease 3 Credits
Development of organs from precursor cells; diseases that impact organ function. Focus on understanding how mutations or other causes influence organ development and function. Combination lecture and primary literature. Course cannot be taken for credit if BIOS 376 is taken.
Prerequisites: BIOS 345
Can be taken Concurrently: BIOS 345
Attribute/Distribution: NS

BIOS 328 Immunology 3 Credits
Distinction of "self" and "nonsself" through humoral and cellular mechanisms. Antigens; biochemical structures, cellular mechanisms, genetic control and processing, phylogenetic distribution, diseased states.
Prerequisites: BIOS 115
Attribute/Distribution: NS

BIOS 329 Herpetology 3 Credits
Biology of amphibians and reptiles. Two lectures, one laboratory or field trip per week.
Prerequisites: BIOS 115 and BIOS 116 and (BIOS 120 or (BIOS 121 and BIOS 122),)
Attribute/Distribution: ND

BIOS 334 Species and Speciation 3 Credits
Consideration of the origin of species. Discussion of a variety of "species" definitions and exploration of the evolutionary mechanisms by which new species arise. Alternation between lecture and discussion, drawing on the textbook and on current and classical literature.
Prerequisites: BIOS 317

BIOS 335 (PSYC 335) Animal Behavior 3 Credits
Discussion of the behavior of invertebrates and vertebrates and analysis of the physiological mechanisms responsible for behavioral stimuli, and adaptive value of specific behavior patterns.
Prerequisites: BIOS 121 and BIOS 122
Attribute/Distribution: NS

BIOS 336 Animal Behavior Laboratory 2 Credits
Experiments and field observations illustrating principles discussed in BIOS 335. Emphasis on observing animals, performing experiments, collecting and analyzing data, and individual research. Six hours of laboratory per week.
Prerequisites: BIOS 335 or BIOS 337
Can be taken Concurrently: BIOS 335, BIOS 337
Attribute/Distribution: NS

BIOS 337 Behavioral Ecology 3 Credits
Social systems of vertebrate and invertebrate groups. Emphasis on ecological and evolutionary factors that influence social behavior.
Prerequisites: BIOS 121 and BIOS 122
Attribute/Distribution: NS
BIOS 340 Molecular Basis of Disease 3 Credits
Lectures and student projects on molecular mechanisms of human disease. Physiology of disease, molecular mechanisms, therapeutic approaches, ongoing research. Topics include: neurodegenerative diseases, cancer, autoimmune diseases, infectious diseases.
Prerequisites: BIOS 115
Attribute/Distribution: NS

BIOS 342 Cellular Basis of Human Disease 3 Credits
Cell and molecular biological advanced topics relevant to human disease and/or health. Critical reading of the primary literature, discussion and student discussion required.
Prerequisites: BIOS 367 or BIOS 411
Attribute/Distribution: NS

BIOS 345 Molecular Genetics 3 Credits
The organization and replication of genetic material; mutagenesis; mechanisms of regulation; mechanisms of gene transmission involving prokaryotes and eukaryotes and their viruses; techniques for intervention into genetic organization and expression.
Prerequisites: BIOS 115
Attribute/Distribution: NS

BIOS 346 Molecular Genetics Laboratory 2 Credits
Laboratory experiments related to the topics covered in BIOS 345. Emphasis is on molecular characterization of DNA and the principles of gene isolation and transfer.
Prerequisites: BIOS 345
Can be taken Concurrently: BIOS 345
Attribute/Distribution: NS

BIOS 347 Advanced Topics in Genetics 3 Credits
Lectures and student projects on selected aspects of genetics such as the genetics and evolution of particular organisms, regulation of gene expression and transmission, human genetics, gene therapy, etc. Consent of department chair.
Prerequisites: BIOS 115 and BIOS 116
Attribute/Distribution: NS

BIOS 356 Neurobiology of Sensory Systems 3 Credits
The fundamental features of sensory systems in a diverse array of animals. Focus on how nervous systems detect, compute, and internally represent aspects of the environment from the single cell to whole system level. Special attention to the way sensory processing influences how we think about the biological basis of perception and possible mechanisms for consciousness. Instructor permission required.
Prerequisites: BIOS 276
Attribute/Distribution: NS

BIOS 365 Diseases of the Nervous System 3 Credits
Neurobiological basis of CNS disorders, including affective, neurological and psychotic conditions. Emphasis on primary literature covering causes, diagnostic and treatment issues.
Prerequisites: BIOS 276 or BIOS 382
Attribute/Distribution: NS

BIOS 367 Cell Biology 3 Credits
Molecular aspects of cell biology. Emphasis on membrane structure and function, organelle biogenesis, cell motility, the cytoskeleton, and extracellular matrix.
Prerequisites: BIOS 115
Attribute/Distribution: NS

BIOS 368 Cell Biology Laboratory 2 Credits
Basic methods used in cell biology laboratories around the world and the opportunity to carry out an independent research project. Techniques include histology and microscopy (both white and fluorescent light), tissue culture and sterile procedures, cellular fractionation, nuclear import assays, and immunological probing. Consent of department required.
Prerequisites: BIOS 367
Can be taken Concurrently: BIOS 367
Attribute/Distribution: NS

BIOS 369 Comparative Physiology of Vertebrate Systems 3-4 Credits
Functional analysis of energy balance in vertebrate animal models. Digestion, respiration, circulation, and excretion, across aquatic and terrestrial vertebrates. Homeostatic mechanisms of salt, water, and gas exchange. Ionotropic and metabotropic signal transduction. Hormonal and electrical cellular communication among muscles, glands, and neurons. Sensory systems, movement and reproduction. Physiological adaptations to extreme environments. When offered for 4 credits, the course includes one laboratory meeting per week.
Prerequisites: BIOS 121 and BIOS 122
Attribute/Distribution: NS

BIOS 371 (CHM 371) Elements of Biochemistry I 3 Credits
A general study of carbohydrates, proteins, lipids, nucleic acids and other biological substances and their importance in life processes. Protein and enzyme chemistry are emphasized. Must have completed one year of organic chemistry.
Prerequisites: CHM 031 or CHM 112
Attribute/Distribution: NS

BIOS 372 (CHM 372) Elements of Biochemistry II 3 Credits
Dynamic aspects of biochemistry; enzyme reactions including energetics, kinetics and mechanisms; metabolism of carbohydrates, lipids, proteins and nucleic acids; photosynthesis, electron transport mechanisms, coupled reactions, phosphorylations, and the synthesis of biological macromolecules.
Prerequisites: (BIOS 371 or CHM 371) and (BIOS 041)
Attribute/Distribution: NS

BIOS 374 Sex Determination and Differentiation 3 Credits
An examination of the primary scientific literature on how sex is conferred to a zygote. Hormonal and non-hormonal mechanisms of sexual differentiation. Neural correlates of sex, gender, and sexual orientation.
Prerequisites: BIOS 367 or BIOS 371 or BIOS 382
Attribute/Distribution: NS

BIOS 375 Methods in Developmental Biology Lab 2 Credits
Detection of gene expression and protein expression in vivo or in vitro. Mutants and/or transgenics examined. Students address research questions of instructor.
Prerequisites: BIOS 115 and BIOS 116
Attribute/Distribution: NS

BIOS 376 Developmental Biology 3 Credits
Differentiation of multicellular organisms from a single cell. Axis determination; gradients; induction and pattern formation viewed through modern analysis of regulated gene expression. Lecture topics on organ formation paired with discussions on birth defects and human diseases.
Prerequisites: BIOS 115 and BIOS 116
Attribute/Distribution: NS

BIOS 377 (CHM 377) Biochemistry Laboratory 3 Credits
Laboratory studies of the properties of chemicals of biological origin and the influence of chemical and physical factors on these properties. Laboratory techniques used for the isolation and identification of biochemicals.
Prerequisites: (BIOS 371 or CHM 371) and (BIOS 041)
Can be taken Concurrently: BIOS 371, CHM 371
Attribute/Distribution: ND

BIOS 378 Biochemical Preparations 1-3 Credits
A laboratory course involving the preparation or isolation, purification and identification of chemicals of biological origin.
Prerequisites: (BIOS 377 or CHM 377) and (BIOS 372 or CHM 372)
Attribute/Distribution: ND

BIOS 380 (BIOE 380) Molecular and Cellular Biophysics 3-4 Credits
Prerequisites: (BIOS 115) and (PHY 013 or PHY 021)
BIOS 381 Physical Biochemistry 3 Credits
Topics include: thermodynamics of biological systems; Forces acting on and between biological molecules; Principles of macromolecular structure; Physical methods used to characterize biomolecules; and other topics to be determined.
Prerequisites: (BIOS 371 or CHM 371) and (BIOS 041)
Attribute/Distribution: NS

BIOS 382 (PSYC 382) Endocrinology of Behavior 3 Credits
Hormonal effects upon animal and human behavior. Emphasis on neuroendocrinology of steroid hormone involvement in reproductive behaviors.
Prerequisites: BIOS 121
Attribute/Distribution: NS

BIOS 383 Biological Sciences Colloquia 1 Credit
Analysis of weekly colloquia in the biological sciences.
Repeat Status: Course may be repeated.
Prerequisites: BIOS 121
Attribute/Distribution: NS

BIOS 385 Synapses, Plasticity and Learning 3 Credits
Communication between neurons. Physiology of synaptic transmission; varying forms of neuronal plasticity; acquisition, encoding, and retrieval of memory.
Prerequisites: BIOS 276
Attribute/Distribution: NS

BIOS 386 Genes and the Brain 3 Credits
Modern molecular genetics techniques applied to complex brain processes. Emphasis on DNA and RNA manipulation strategies to elucidate mechanisms of complex behaviors. Animal models of learning, behavioral plasticity, and neuropsychiatric diseases.
Prerequisites: BIOS 276
Attribute/Distribution: NS

BIOS 387 Biological Sciences Honors Seminar 1 Credit
Development, presentation and implementation of research proposals, and discussions of research. Required for senior biology, molecular biology, biochemistry, and behavioral neuroscience majors pursuing departmental honors. Departmental permission required.
Attribute/Distribution: ND

BIOS 388 Biological Sciences Honors Seminar 1 Credit
Continuation and extension of BIOS 387. Departmental permission required.
Attribute/Distribution: ND

BIOS 389 Honors Project 1-6 Credits
Repeat Status: Course may be repeated.

BIOS 391 Undergraduate Research 1-3 Credits
Laboratory research under tutorial with a faculty member. Must have junior standing. Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

BIOS 393 Thesis 3 Credits
Literature review and design of project in selected area, execution of the project, final report and presentation. Consent of department required. Intended for senior majors in BIOS only. Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

BIOS 401 Professional Skills for Biological Sciences Graduate Students 3 Credits
Students learn expectations and fundamental skills related to success in the biological sciences. The course is designed to help students make the most out of their graduate education. Students learn the principles underlying fundable, publishable research, and how these general principles can be applied to their specific research area. They learn to write and review manuscripts and grant proposals by serving on a mock editorial board and scientific review panel. They gain experience in giving oral presentations. Readings are from texts on scientific writing and research styles, and from original journal articles and grant proposals written by the faculty. Required of all Integrative Biology graduate students.

BIOS 404 (PSYC 404) Behavioral Neuroscience 3 Credits
Theoretical and empirical issues in biopsychology. Must have graduate standing.

BIOS 405 Special Topics in Molecular Biology 1-3 Credits
Research, conferences, and reports on selected topics not covered in the general graduate offerings.
Repeat Status: Course may be repeated.

BIOS 406 Biological Sciences Seminar 1 Credit
An advanced seminar in current developments including departmental research. Required for candidates for graduate degrees in molecular biology.
Repeat Status: Course may be repeated.

BIOS 407 Research in Biological Science 1-9 Credits
Laboratory investigations in one of the department's research areas.

BIOS 408 Responsible Conduct of Science 0 Credits
Responsible practice in research. Training in general laboratory methods; human subjects concerns; radiation safety; chemical hazards; aseptic technique; physical, mechanical, biological, and fire hazards; animal welfare. Occupational and workplace considerations. Recombinant DNA guidelines; patent and proprietary rights; controversies over applications of science. Appropriate aspects required of investigators in all departmental research projects.

BIOS 409 Evolutionary and Functional Morphology 3 Credits
Readings in the current literature, demonstrations and laboratory exercises exploring the applications of comparative methods to the analysis of evolutionary patterns at a range of morphological levels (molecular and macroscopic). Students will also learn experimental approaches to testing relationships between form and function in vertebrates. Emphasis will be on the musculoskeletal and nervous systems.

BIOS 410 Special Topics in Behavioral and Evolutionary Bioscience 1-3 Credits
Readings and discussions on selected topics not covered in the general graduate offerings.

BIOS 411 Advanced Cell Biology 3 Credits
Cell structure and biochemistry, as related to specialized cell functions.

BIOS 412 Metabolic Influences on Behavior 3 Credits
Sensory systems that detect metabolic energy availability and affect the behavior of humans and other animals: food intake and body weight regulation, sexual and parental behavior, aggression, learning, and body temperature regulation.

BIOS 414 Sexual Differentiation 3 Credits
Genetic and hormonal events mediating the development and expression of sexual dimorphisms in physiology and behavior. Current theoretical models; emphasis on biochemical, neuroanatomical and molecular biological considerations.

BIOS 415 Synapses, Plasticity and Learning 3 Credits
Communication between neurons. Physiology of synaptic transmission; varying forms of neuronal plasticity; acquisition, encoding and retrieval of memory.

BIOS 420 Pheromonal Communication 3 Credits
Mechanisms of pheromone synthesis, biochemistry, sensory transduction, neuroanatomy/ neuroendocrinology, and adaptive significance.
BIOS 421 Molecular Cell Biology I 3 Credits
Molecular aspects of cell structure, cell motility, intracellular transport; and biomembrane dynamics.
Prerequisites: BIOS 411

BIOS 422 Molecular Cell Biology II 3 Credits
Molecular aspects of gene expression, including genome structure and replication, RNA synthesis/processing, and protein synthesis.
Prerequisites: BIOS 421

BIOS 423 Evolution of Development 3 Credits
This course examines how changes in the blueprint that describes the development of a multicellular animal from a single fertilized egg lead to the evolution of new species or new forms within a species.
Prerequisites: BIOS 317 or BIOS 376 or BIOS 327
Can be taken Concurrently: BIOS 317, BIOS 376, BIOS 327

BIOS 424 Advanced Neurobiology of Sensory Systems 3 Credits
This course is designed to provide an overview of core principles of neuroscience through exploration of sensory systems. The course will provide an intensive review of fundamental neural signaling followed by a broad introduction to the major sensory pathways. Focus will be on major organizing principles of neural systems, and information processing. Student discussions and presentations will incorporate current literature and concepts.

BIOS 426 Coevolution 3 Credits
Discussion-based seminar course covering readings from the primary literature. Course will examine evolutionary consequences of species interactions, interactions between the sexes, and genetic interactions. Topics will include predator-prey interactions, host-parasite interactions, sexual conflict, genomic conflict, mutualism, and more. Consequences of coevolution for biodiversity and human health will also be examined.

BIOS 427 Techniques in Cell and Molecular Biology 1-3 Credits
Laboratory experiences in three or more cell and molecular biological techniques: gel electrophoresis of nucleic acids/proteins; polymerase chain reaction; DNA/RNA sequencing; molecular hybridization techniques; fluorescence microscopy; confocal microscopy; flow cytometry; electron microscopy tissue preparation; immunological detection methods; molecular cloning techniques; oocyte microinjection techniques; tissue culture methods; and autoradiography.

BIOS 428 Molecular Evolution 3 Credits
Evolution at the level of individual genes, proteins, and genomes. Lectures and discussion of papers from the recent primary literature. Topics include pathways for adaptive evolution, directionality in evolution, epistasis, evolvability, genome rearrangements and speciation, gene duplication, and evolutionary dynamics. Examples of molecular evolution in nature, laboratory model systems, and human pathogens.
Prerequisites: BIOS 317 or BIOS 345
Can be taken Concurrently: BIOS 317, BIOS 345

BIOS 429 Advances in Herpetology 3 Credits
Lectures and readings from the primary literature on current research in amphibian and reptilian biology. Two lectures, one discussion session and one laboratory or field trip. Not open to students who have received credit for BIOS 329.

BIOS 431 Advanced Topics in Cell Biology 3 Credits
Current research problems in cell biology.
Repeat Status: Course may be repeated.
Prerequisites: BIOS 367 or BIOS 367 or BIOS 411

BIOS 432 Advanced Topics in Molecular Genetics 3 Credits
Current research in molecular genetics.
Repeat Status: Course may be repeated.

BIOS 433 Advanced Topics in Developmental Biology 3 Credits
Current research problems in developmental biology.
Repeat Status: Course may be repeated.
Prerequisites: BIOS 345 or BIOS 345

BIOS 434 Speciation 3 Credits
Discussion-based seminar course covering readings from classical and current literature, including both theoretical and empirical contributions. Topics will be included species concepts, reproductive isolation, mechanisms and modes of speciation, and current approaches to studying speciation.

BIOS 437 (CHM 437) Pathophysiological Chemistry 3 Credits
Biochemical basis of human diseases involving abnormal metabolism of proteins, nucleic acids, carbohydrates, and lipids. Emphasis on the correlation of the clinical presentation of disease processes seen as physiological dysfunctions with clinical laboratory methods. Lectures, student presentations, and clinical case discussions. Consent of department required.

BIOS 439 Advanced Behavioral Ecology 3 Credits
Critical evaluation of the theoretical foundation in sociobiology. Emphasis placed on kinship, altruism, mate choice, parental investment, parent-offspring conflict, etc. Lectures and seminars. Not open to students who have taken BIOS 337.
Prerequisites: BIOS 317 or BIOS 317

BIOS 442 Cellular Basis of Human Disease 3 Credits
Cell and molecular biological advanced topics relevant to human disease and/or health. Critical reading of the primary literature, discussion and student discussion required.
Prerequisites: BIOS 367 or BIOS 411

BIOS 445 Systematics and Evolution 3 Credits
Theoretical, philosophical and methodological foundations of the classification of eukaryotic organisms and the manner in which systematic theory and method relate to evolutionary theory. Two lectures and one lab/recitation/discussion session.

BIOS 450 Developmental Neurobiology 3 Credits
Fundamental mechanisms underlying neural development. Early events leading to the induction of the neuroectoderm and the reorganization of the vertebrate central nervous system during adulthood and aging. Major developmental events such as phenotype commitment, cell migration, differentiation and growth cone guidance. Emphasis on the interplay between concepts emerging from organismal and molecular levels of analyses.

BIOS 453 General Neuroanatomy 3 Credits
Graduate level study of the neuroanatomy and neurochemistry of systems that underlie behavior in vertebrates. Emphasis will be on the traditional and novel methodologies used to reveal neuroanatomical pathways as well as the function of these pathways. Consent of department required.

BIOS 457 Advanced Behavioral Neuroendocrinology 3 Credits
A seminar course that covers current primary literature on the hormone-nervous system interactions that underlie physiology and behavior. The course covers the neuroendocrinology of reproduction, sex behavior, parental behavior, social behavior, agonistic and territorial behavior, learning and memory, homeostasis (caloric, nutritional, water and salt balance, temperature regulation), circadian rhythms and seasonality in a variety of vertebrates.

BIOS 464 Molecular Biology of Eukaryotic Organisms 3 Credits
Comparative analysis of several eukaryotes as model systems in cell biology, developmental biology, genetics, and molecular biology.

BIOS 466 Structure and Function of RNAs and Ribonucleoprotein Complexes 3 Credits
Biochemistry and function of small nuclear RNP's, RNase P, ribosomes, self-splicing introns, signal recognition particles, RNA viruses. Functions of RNA in DNA replication, in regulation, as an enzyme, and as a repressor.

BIOS 467 (CHM 467) Principles of Nucleic Acid Structure 3 Credits
An examination of the principles underlying nucleic acid structure including stereochemistry, electrostatics, hydration, torsional constraints, sequence specific effects, and interaction with nuclear proteins. Special emphasis will be placed on DNA structure. Must have completed one year of biochemistry and one year of physical chemistry or consent of department required.
BIOS 468 (CHM 468) Principles of Protein Structure 3 Credits
An examination of the principles underlying protein structure including stereochemistry, preferred tertiary structures, protein homology, excluded volume effects, time dependent structural fluctuations, and prediction of protein structure from sequence information. Must have completed one year of biochemistry and one year of physical chemistry or consent of department required.

BIOS 469 (CHM 469) Biochemical Problem Solving I 1 Credit
Applications of material covered in BIOS 371 or CHM 371 including techniques used in research.

BIOS 470 (CHM 470) Biochemical Problem Solving II 1 Credit
Applications of concepts covered in BIOS 372 or CHM 372 including techniques used in research.

BIOS 471 Eukaryotic Signal Transduction 3 Credits
Signal transduction between and within cells of multicellular organisms examined in the context of specialized functions that include: nutrition, hormones and neurotransmitters, vision, muscle contraction, adhesion and the immune system. The evolution of cancer based on mutations in these signaling systems. Lecture, discussion, and student presentations.
Prerequisites: (BIOS 372 or CHM 372 or BIOS 411)

BIOS 472 (CHM 472) Lipids and Membranes 3 Credits
Structure, physical properties and functions of lipids and their biological aggregates. Techniques for studying lipid assemblies, enzymes which act on lipids, membrane proteins and lipoproteins will also be discussed.
Prerequisites: BIOS 372 or CHM 372.

BIOS 477 (CHM 477) Topics in Biochemistry 1-3 Credits
Selected areas of biochemistry, such as mechanisms of enzyme action, new developments in the chemistry of lipids, nucleic acids, carbohydrates and proteins.
Repeat Status: Course may be repeated.

BIOS 479 (CHM 479) Biochemical Techniques 3 Credits
Laboratory studies of the techniques and principles involved in the isolation, identification, and biochemical transformation of carbohydrates, lipids, nucleic acids and proteins.
Prerequisites: (BIOS 371)
Can be taken Concurrently: BIOS 371

BIOS 480 (CHM 480) Advanced Biochemical Preparations 1-3 Credits
An advanced laboratory course in the preparation, isolation, purification, and identification of biochemically produced materials. Emphasis is placed on materials and procedures of current interest in biochemistry. Consent of department required.

BIOS 483 Special Topics in Behavioral Neuroscience 3 Credits
Examination of the biological substrates of behavior. Topics may include animal communication, sociobiology, behavioral endocrinology, or behavior genetics.
Repeat Status: Course may be repeated.

BIOS 486 Genes and the Brain 3 Credits
Modern molecular genetics techniques applied to complex brain processes. Emphasis on DNA and RNA manipulation strategies to elucidate mechanisms of complex behaviors. Animal models of learning, behavioral plasticity, and neuropsychiatric diseases.
Attribute/Distribution: NS

BIOS 488 Seminar in Neuroscience, Behavior, and Evolution 1 Credit
Advanced seminar in current research developments.

BIOS 490 Thesis 1-6 Credits
Repeat Status: Course may be repeated.

BIOS 499 Dissertation 1-15 Credits

Biology

Biology, life science, and related courses at Lehigh University are offered in a variety of settings that reflect the various levels of organization in life science and different orientations relating to areas of application. The College of Arts and Sciences offers degree programs in Behavioral Neuroscience, Biochemistry, Biology, Earth and Environmental Science, and Molecular Biology. The P. C. Rossin College of Engineering and Applied Science offers a degree program in Bioengineering. Refer to the catalog entries below for complete descriptions.

Major and Minor Programs | Catalog Entry
--- | ---
Behavioral Neuroscience (BA or BS) | Biological Sciences
Biochemistry | Biochemistry (BS only)
Bioengineering | Bioengineering
Biology (BA or BS) | Biological Sciences
Earth and Environmental Science | Earth and Environmental Sciences
Molecular Biology (BA or BS) | Biological Sciences

Courses related to life science interest can be found under the catalog entries above as well as in other departments, including Chemical Engineering, Chemistry, Mathematics, Physics, Psychology, and Sociology and Anthropology.

Professors. Michael J. Behe, PhD (University of Pennsylvania); Lynne U. Cassimeris, PhD (University of North Carolina); David L. Cundall, PhD (University of Arkansas); Matthias M. Falk, PhD (Ruprecht Karl University of Heidelberg); Woonpl Im, PhD (Cornell University); Murray Itzkowitz, PhD (University of Maryland); Linda J. Lowe-Krentz, PhD (Northwestern University); Jill E. Schneider, PhD (Wesleyan University); Neal G. Simon, PhD (Rutgers University); Robert V. Skibbens, PhD (University of North Carolina Chapel Hill); Jennifer Swann, PhD (Northwestern University); Vassie C. Ware, PhD (Yale University)

Associate Professors. Daniel Babcock, PhD (University Texas Houston); Julie Haas, PhD (Boston University); Gregory L. Lang, PhD (Harvard University); Michael J. Layden, PhD (University of Oregon); Julie M. Miwa, PhD (Rockefeller University); Amber M. Rice, PhD (University of North Carolina)

Professor Of Practice. Krystle McLaughlin, PhD (University of Rochester)

Emeriti. John H. Abel, Jr., SCD (Brown University); Steven Krawiec, PhD (Yale University); John G. Nyby, PhD (University Texas, Austin); Hayden N. Pritchard, PhD (Lehigh University); Jeffrey A. Sands, PhD (The Pennsylvania State University)

Business

The designation of “business” refers to general business courses.

Business Minor
Program Admission Requirements: Each spring, approximately 100 students will be accepted into the Business Minor Program for the following fall. Applications to the program will be made by students and submitted to the program director by the last Friday in January. An admissions committee comprised of the Business Minor Program director and the Business Minor curriculum committee will make admission decisions based on G.P.A., experience, and interest in pursuing business opportunities upon graduation from Lehigh (to be evaluated on the basis of a written essay). Students will be notified of admissions decisions prior to registration for the fall semester. Entrance into business minor classes will be controlled by restricted overrides by the Director of the Business Minor Program, Robert Kuchta, Professor of Practice, rok8@lehigh.edu, RBC 330.

Business Courses
BUS 001 Introduction to Business in a Global Environment 3 Credits
An introduction to business, emphasizing critical issues impacting the business world, such as globalization, technology, ethics, and diversity. Provides an overview of the various functional areas of business and how they fit together. Stressses experiential learning and develops team-building skills. Strengthens written and oral communications skills. Provides an introduction to career opportunities and curriculum choices in business and economics. is offered only in the fall and is open only to College of Business and Economics students.
BUS 002 Introduction to Business In a Global Environment (for Non First-Year Students) 3 Credits
An introduction to business, emphasizing critical issues impacting the business world, such as globalization, technology, ethics, and diversity. Bridges the functional depth students bring from various introductory business courses to provide an overview of the various functional areas of business and how they fit together and can be applied to address real business issues and challenges. Stresses experiential learning (e.g., case studies) and develops team-building skills. Strengthens written and oral communication skills.
Prerequisites: ECO 001 and (MKT 111 or ACCT 151 or FIN 125 or MGT 143 or ECO 146 or BUS 111 or SCM 186)

BUS 005 Values Based Decision Making for Business 1 Credit
An introduction to the foundations of business integrity. The role of individual decisions and ethics in business is explored. Students evaluate cases and ethical issues they are likely to face in business. Covers fundamentals of corporate governance and cases in governance failures such as WorldCom and Enron. Social responsibility, ethical business leaders, and current topics in business ethics are addressed. Class dialog is emphasized along with reflective writing. Open only to CBE students.

BUS 125 Behavioral Skills Workshop 1 Credit
BUS 125 is a aimed to equip students to work with others in a business setting in making business decisions. The focus of the class is on effective decision making and includes such topics as group and team decision making, conflict resolution and negotiation, ethical decision making, and creative problem solving. This course is offered as a series of intensive workshops in the fall semester and is heavily focused on experiential learning.
Prerequisites: ECO 001

BUS 126 Information Analysis and Financial Decision Making I 3 Credits
An integrated introduction to business, accounting and finance. Students are introduced to the goals, people and activities of business, before focusing on the fundamental elements of accounting and finance, including financial statement construction and analysis, time value of money, financing and investing with equity and debt, and the impact of various operating decisions on business. Experiential learning and development of team/communication skills are encouraged through portfolio simulation and financial analysis projects.
Prerequisites: BUS 125
Can be taken Concurrently: BUS 125

BUS 127 Information Analysis and Financial Decision Making II 3 Credits
This course builds upon the foundational teachings of BUS 126 through examination of topics in portfolio management, capital investment decision making, business planning, analysis and reporting, and various specialized topics such as entrepreneurship, business law, ethics, internal control systems, and E-business. Experiential learning, and development of team/communication skills are encouraged through group projects and guest speakers.
Prerequisites: BUS 126

BUS 173 Non-Major Summer Internship 1-4 Credits
CBE internships expose students to the business world, enriching their understanding of ideas and problems encountered in their business courses. This course is available summers and open to students in the College of Business & Economics and those in the following programs: CSB, IBE, and Business Minor. Students are evaluated on a directed writing assignment and on a detailed evaluation provided by the work supervisor. A minimum of 150 hours of work must be completed in the internship, and verified by work supervisor. Course registration and related arrangements must be made in advance of the work experience. This course does not satisfy any major requirements. Must have completion of a minimum of 24 college credits.

BUS 212 (DES 212, ENGR 212) Integrated Product Development (IPD) II 2 Credits
Business, engineering, and design arts students work in cross disciplinary teams of 4-6 students on the detailed design including fabrication and testing of a prototype of the new product designed in IPD course 1. Additional deliverables include a detailed production plan, marketing plan, detailed base case financial models, project and product portfolio. Teams work on projects with external sponsors, from students start-ups to global industries, mentored by faculty or graduate student advisers. Oral presentations and written reports.
Prerequisites: BUS 211 or ENGR 211

BUS 225 Developing, Producing, and Marketing Products and Services I 3 Credits
Introduction to the key elements in the marketing framework of a corporation. Focus on defining marketing, analyzing the market and competitors, developing effective marketing strategies, segmenting the market, creating customer value, satisfaction, and loyalty, analyzing consumer and business markets, creating brand equity, and managing an effective marketing program to deliver the right products and services to the right audience at the right place at the right price and the right time. Emphasis on business writing skills. Experiential learning through the development of a product or service marketing plan.
Prerequisites: BUS 127

BUS 226 Developing, Producing, and Marketing Products and Services II 3 Credits
This course extends the marketing management principles initiated in BUS 225 with the creation, development, and delivery of new product ideas to the marketplace. Comprehensive overview of the new product development process, including how to develop an effective development strategy, manage cross-functional teams across the organization, generate and evaluate concepts, manage the technical development of a product, develop the marketing plan, and manage the financial aspects of a project. As product innovation is a multi-disciplinary field, this course, while focusing on marketing’s role in product innovation, relies heavily on techniques that encompass engineering, research and development, management, production, and design. Emphasis on business writing skills and creativity. Experiential learning through the implementation of a new product idea and the performance assessment of both the supporting marketing and business plan.
Prerequisites: BUS 127

BUS 300 Apprentice Teaching 1-3 Credits

BUS 326 Business Strategy 1 Credit
Business Strategy is a capstone covering total enterprise problems in determination, execution, and control within a global setting. The course integrates the theories of production, marketing, finance, and organization and provides an opportunity to study the function of higher level management as related to the total business environment through a team-based business simulation. Students will develop a business strategy and make decisions that impact performance metrics of the firm.
Prerequisites: BUS 226
Can be taken Concurrently: BUS 226

BUS 347 Practicum in Real Estate I 2 Credits
This course is an interdisciplinary study of the creation of value in commercial real estate. Organized into groups, with each group assigned a different subject commercial real property, the class engages in the study of the physical and locational characteristics of commercial real estate as they relate to value including: property history; architecture; physical attributes that add to or detract from value; tenant mix; the immediate neighborhood environment; and, the specific market in which the real property competes for tenants. Each group submits a written report of their findings and produces a 10-minute video documentary on their subject property. Permission of the instructor. Students enrolling in this course must also commit to enrolling in the follow-on course - Bus 348 - Practicum in Real Estate II.
Prerequisites: (ECO 145 or ECO 045 or ECO 146) and ACCT 151 and FIN 225
BUS 348 Practicum II in Real Estate 2 Credits
This course is a continuation if the interdisciplinary study of the creation of value in commercial real estate begun in Bus 347 - Practicum in Real Estate I. Organized into groups, with each group continuing with the subject commercial real property assigned to them in Bus 347, the class engages in the study of the market and financial characteristics of commercial real estate. Students relate to value through: a financial analysis of the market in which their property is located to include market rents, market vacancy rates and market absorption rates; and, financial analysis of the subject property to include both historical results, and pro forma estimates of revenues, expenses, cash flow and residual value.
Prerequisites: BUS 347

BUS 490 Thesis (Moc) 1 Credit

BUS 499 Dissertation (Moc) 1 Credit

Integrated Program Real Estate Courses

IPRE 001 Introductory Seminar in Real Estate 3 Credits
Required of all entering ire@l students, this seminar explores a variety of issues related to real estate, entrepreneurship and leadership. Topics include: the relationship of real estate to finance, architecture, environmental issues, government, engineering, urban planning and economic development; the role of the entrepreneur in real estate and real estate development; ethical considerations in real estate; and, models of leadership. The seminar will consist of lectures and presentations by a variety of Lehigh faculty, entrepreneurs, and real estate professionals. Must have freshman OR sophomore standing. Consent of instructor required.
Prerequisites: IPRE 001

IPRE 002 Field Laboratory 2 Credits
An introduction to the real estate development process. Using an actual, planned commercial real estate development, the class will engage in an extensive inquiry into the breadth and depth of the real estate development process. Topics include: the sequence of events in the development process; parallel and sequential activities; impediments to highest and best use; strategies for overcoming impediments; managing relationships with various constituents; sources of capital; and, market analysis. Each class member will submit a final report detailing his or her findings with respect to these topics. Consent of instructor required.
Prerequisites: IPRE 001

IPRE 101 Real Estate Practicum Clerkship I 1 Credit
Just as medical school and law school students serve clerkships as a key part of their academic preparation, ire@l students may serve clerkships in the Real Estate Practicum. Clerkship students will rotate among all of the groups engaged in the Real Estate Practicum - accompanying Practicum groups on site visits, observing those groups’ interactions with various faculty and real estate professionals, and assisting those groups in the completion of numerous tasks. During the fall semester, the focus of these rotations be on the physical characteristics of the Practicum properties including design considerations, structural integrity, floor plans, building systems and tenant improvements. Students will also develop an understanding of the property’s location, and how that location affects the use(s) of the property. Finally, students will gauge the area in which the property is located. Concurrent with these rotations, these students will reference their Field Laboratory property that is in an earlier stage of development, drawing a contrast between a completed property and a property under development. Consent of instructor required.
Prerequisites: (IPRE 001 and IPRE 002)

IPRE 102 Real Estate Practicum Clerkship II 1 Credit
A continuation of the fall semester, the spring semester rotations focus on the real estate markets in which the Practicum properties are located, and on the financial analysis (valuation) of the Practicum properties. Clerkship students will reference their Field Laboratory property to contrast the difference between the demonstrated value created (in a completed property) and the value that is expected to be created (in a property under development).
Prerequisites: IPRE 001 or IPRE 002

IPRE 300 Apprentice Teaching 1-4 Credits
Repeat Status: Course may be repeated.

IPRE 301 Case Studies in Real Estate Value Creation 3 Credits
An investigation into ways in which the entrepreneur is able to create value through the development or redevelopment of real estate. Issues: establishing a real property’s highest and best use; the entrepreneurial thought process; zoning, planning and land use regulations and their effects on real estate development; real and potential environmental effects on real estate development; the role of government in stimulating (or destimulating) real estate development; overcoming barriers to real estate development; negotiation techniques; and, application of alternative strategies in the development process. The course is taught using the case method with the majority of the cases from previous Real Estate Practica. The course is a combination of lectures, presentations by entrepreneurs, and site visits to (re)developed properties as well as properties in the planning phase. Consent of instructor required.

IPRE 302 IPRE Internship 0-1 Credits
Open to students in the Integrated Real Estate At Lehigh (ire@l) Program. The student will be evaluated on a directed writing assignment of no fewer than 9 pages and on a detailed evaluation provided by his or her work supervisor. A minimum of 150 hours of work must be completed in the internship, and verified by work supervisor. It should be noted that the internship experience itself is not the basis for academic credit. Course registration and related arrangements must be made in advance of the work experience. This course cannot be used to satisfy any major requirements. Consent of program director required. In extraordinary circumstances and with the consent of the program director this requirement can be altered according to the director’s stipulations.
Prerequisites: (IPRE 001 and IPRE 002)

IPRE 347 Practicum in Real Estate I 2 Credits
Organized into teams, with each team assigned a different subject commercial real property, the class engages in the study of the physical and locational characteristics of commercial real estate as they relate to value including: property history; architecture; physical attributes that add to or detract from value; tenant mix; the immediate neighborhood environment; and, the specific market in which the real property competes for tenants. Each team meets with the property owner and conducts a thorough review of the property’s development process including, where applicable, previous attempts to develop the property, prior uses for the property, and significant phase points in the development process (for example, “deal killing” impediments that were overcome). Each team submits a written report of their findings and produces a 10-minute video documentary on their subject property. Permission of the instructor required.

IPRE 348 Practicum in Real Estate II 2 Credits
A continuation of the study of the creation of value in commercial real estate begun in the Practicum in Real Estate I. Each student team continues with the subject commercial real property assigned to them in Practicum I. The class engages in the study of the market and financial characteristics of commercial real estate as they relate to value through: a financial analysis of the market in which their property is located to include market rents, market vacancy rates and market absorption rates; and, financial analysis of the subject property to include both historical results, and pro forma estimates of revenues, expenses, cash flow and residual value. Each team also studies the financial characteristics of comparable properties. The grand finale of the Real Estate Practicum (and the IPRE curriculum) is the Collins Family Scholarship Competition. Held at the conclusion of the spring semester, this competition is the public vehicle for the Practicum teams to present the results of their property studies. Consent of instructor required.
Prerequisites: IPRE 347

Business and Economics Graduate Programs and Courses

Graduate degree programs offered by the college include the Master of Business Administration, the Master of Science in Accounting and Information Analysis, the Master of Science in Economics, the Master of Science in Management, and the Ph.D. in Business and Economics. Graduate certificate programs offered include Corporate Entrepreneurship and Supply Chain Management. Interdisciplinary degree programs (p. 64) are offered through partnerships with other
Introductory Text:

- P.C. Rossin College of Engineering and Applied Science
- Master of Business Administration and Engineering
- P.C. Rossin College of Engineering and Applied Science and the College of Arts and Sciences-Master of Science in Analytical Finance
- College of Education-Master of Business Administration and Educational Leadership

Courses for the programs are taught by faculty from the Accounting (p. 64), Economics (p. 193), Finance (p. 237), Management (p. 300), and Marketing (p. 303) departments.

**GRADUATE DEGREES IN BUSINESS ADMINISTRATION AND ECONOMICS**

Candidates for admission to graduate study in the College of Business and Economics must provide the results obtained in the Graduate Management Admissions Test (GMAT) for the degree in accounting and information analysis. The GMAT or the Graduate Record Examination general test (GRE) must be submitted for degrees in business administration, analytical finance, economics and management. International applicants are required to take the Test of English as a Foreign Language (TOEFL) for admission to the program.

**MASTER OF BUSINESS ADMINISTRATION**

The Lehigh MBA program is accredited by AACSB International—the Association to Advance Collegiate Schools of Business. The Lehigh MBA program provides a rich learning experience for students. The College of Business and Economics offers two MBA programs: the One Year Full-Time MBA program (1-MBA) and the Flex MBA program.

**ONE YEAR FULL-TIME MBA PROGRAM**

The One Year Full-Time MBA Program (henceforth 1-MBA) is designed for individuals who already have at least three years’ work experience and wish to either pivot their careers into a business-related area which may not be in their previous field of employment, or accelerate their career within their chosen field. This MBA program is designed to accommodate those from non-business related fields, as well as students whose undergraduate major is in business but who may want to change their focus, such as from finance to marketing.

The 1-MBA program, which starts each January, is a cohort-based, lockstep program initially to develop core knowledge of functional areas and team building. These courses emphasize a stakeholder perspectives approach. Following this, students are required to embark on an internship/equivalent experience. The final part of the program emphasizes building domain expertise via electives and a focus on data analytics and project management. Another feature is a dedicated coaching team consisting of a professional staff member, an alumnus, and a faculty member.

**1-MBA Mission Statement**

The One Year Full-Time MBA Program (henceforth 1-MBA) develops and positions students for organizational and career success as strategic thinkers in an environment that seeks solutions beneficial to business and society. In a 12-month program format, it provides not only a rigorous and comprehensive coverage of fundamental business principles but also helps students use an integrated framework for addressing large, multi-stakeholder organizational challenges. Students in the 1-MBA program will apply their learning with an in-depth summer internship experience and also will have opportunities of extensive networking with peers, alumni, experienced executives, faculty, and coaching professionals.

**Program Admission Requirements**

Admission to the 1-MBA program will be based on standardized scores on the GMAT or GRE, college transcripts with undergraduate degree conferred, 3 recommendation letters, candidate essays, and interviews. Three (3) years of professional work experience is required. International students must show English proficiency as measured by the TOEFL.

**Program Requirements**

The following are pre-requisites for students prior to arrival on campus to begin the program:

1. Calculus knowledge as evidenced by an acceptable grade in a college-level calculus class
2. English proficiency (for international students) as evidenced by a high TOEFL score and via interviews by the admissions committee
3. Economics knowledge as evidenced by an acceptable grade in a college-level elementary economics course
4. Acceptable grades in Approved Online Tests as determined by program faculty, such as (a) Quantitative Methods, (b) Statistics, (c) Excel

**Curriculum Overview**

- Pre-Program Session (2 weeks) 5.0 credits
- Functional Area Core Knowledge (7 weeks) 7.5 credits
- Stakeholder Perspectives Session (7 weeks) 7.5 credits
- Integrating Societal Shifts Session (4 weeks) 12.0 credits
- Internship/Equivalent Experience (8 weeks) 3.0 credits
- Fall Semester – Electives (14 weeks) 15.0 credits
- Total 50.0 credits

Further information about the 1-MBA Program may be obtained by contacting the Graduate Programs Office of the College of Business and Economics, Lehigh University, College of Business and Economics, 621 Taylor Street, Bethlehem PA 18015

phone: (610) 758-3418
email: mba.admissions@lehigh.edu (mbd.admissions@lehigh.edu)

www.lehigh.edu/mba

**FLEX MBA PROGRAM**

Lehigh’s Flex MBA curriculum is a fully integrated model which simulates the business environment in the classroom. Business issues are viewed and taught from the perspective of the firm as a whole rather than along departmental lines. Flex MBA students acquire skills in leadership, managerial communication, and resource allocation coupled with a comprehensive understanding of complex domestic and global business issues.

Due to the compact and integrated core, students have increased flexibility to tailor the program to their individual needs. Students may select a concentration in corporate entrepreneurship, finance, international business, marketing, project management, or supply chain management or pursue a broader experience by selecting courses from a variety of disciplines. Students may only have one concentration.

The Flex MBA program is available both on campus and online. Students may opt to attend class through both methods of delivery. Flex MBA concentrations in finance, international business, marketing, and supply chain management are currently available through online study.

**Flex MBA Mission Statement**

The Flex MBA program will further the development of organizational leaders and managers. This is accomplished by honing students’ knowledge, skills and abilities through a comprehensive and integrated core curriculum and customized concentrations designed to meet individual needs. The Flex MBA program will also foster life-long learning through continuing professional education programs.

**Innovative Structure**

The Flex MBA Program requires 36 credit hours. Full-time students can fulfill that requirement in 12 to 16 months. Part-time students average three years to complete the degree.

**Core Courses**

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tr>
<td>MBA 401</td>
<td>Introduction to the Organization and its</td>
<td>2</td>
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<td></td>
<td>Environment</td>
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<tr>
<td>MBA 402</td>
<td>Managing Financial and Physical Resources</td>
<td>4</td>
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<td>MBA 403</td>
<td>Managing Information</td>
<td>4</td>
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<td>MBA 404</td>
<td>Managing Products and Services</td>
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<td>MBA 405</td>
<td>Managing People</td>
<td>4</td>
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<tr>
<td>MBA 406</td>
<td>Integrative Experience</td>
<td>3</td>
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**Electives**

Select 15 credit hours of elective course work

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<tr>
<th>Credits</th>
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<tr>
<th>Total Credits</th>
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<tr>
<td>36</td>
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Further Information:

Email: mba.admissions@lehigh.edu (mbd.admissions@lehigh.edu)

Website: www.lehigh.edu/mba

Contact: MBA Program Office, Lehigh University, College of Business and Economics, 621 Taylor Street, Bethlehem, PA 18015

Phone: (610) 758-3418

Email: mba.admissions@lehigh.edu (mbd.admissions@lehigh.edu)

Website: www.lehigh.edu/mba
Students are permitted to design an area of study in consultation with their adviser to best suit their career goals or they may choose to complete an area of concentration. Concentrations in international business and supply chain management require nine credit hours of approved electives. Concentrations in corporate entrepreneurship, finance, marketing, and project management require twelve credit hours of approved electives. Students may also complete a maximum of six credit hours of electives outside of the College of Business and Economics (but within Lehigh University). All elective courses must be at the 400 level.

Prerequisites
Students should have completed undergraduate courses in computer literacy, and principles of microeconomics and macroeconomics. The prerequisites of financial accounting and statistics may be completed after acceptance into the Flex MBA program.

The statistics prerequisite may be fulfilled by having taken a class within the past 5 years and receiving a "B" or better, by taking a proficiency exam administered through the College, or by enrolling in Basic Statistics for Business and Industry or equivalent. The Accounting prerequisite may be waived by enrolling in Financial Accounting for Managers and Investors at Lehigh or by taking a proficiency exam administered by the College.

If a student has no previous background in financial accounting or statistics, he/she is encouraged to take a course in the subject area. If a student has previously taken coursework but has not achieved a grade of "B" or the course has exceeded the time limit, self-directed learning and a proficiency exam may be appropriate.

The prerequisites of financial accounting and statistics must be completed before enrolling in MBA 402 Managing Financial and Physical Resources and/or MBA 403 Managing Information.

Electives
Students will take 15 credit hours of elective course work. Students are permitted to design an area of study in consultation with their adviser to best suit their career goals or they may choose to complete an area of concentration. Concentrations in international business and supply chain management require nine credit hours of approved electives. Concentrations in corporate entrepreneurship, finance, marketing, and project management require twelve credit hours of approved electives. Students may also complete a maximum of six credit hours of electives outside of the College of Business and Economics (but within Lehigh University). All elective courses must be at the 400 level.

Waiver Policy
There are no waivers for courses in the Flex MBA Program.

GMAT or GRE Scores
All applicants are required to take the Graduate Management Admissions Test (GMAT) administered by Pearson Vue or the Graduate Record Exam (GRE) administered by the Educational Testing Service (ETS). Only GRE scores from the revised version taken after August 1, 2011 will be accepted.

Work Experience
Students are required to have a minimum of 2 years of full-time, professional work experience.

International Students/TOEFL
International students must have 16 years of formal education, including four years at the university level, to be considered for admission to Lehigh’s graduate programs. Applicants whose native language is not English are required to take the Test of English as a Foreign Language (TOEFL). For information, write or call the TOEFL Registration Office, P.O. Box 6154, Princeton, N.J., 08541-6154 or at www.toefl.org (http://www.toefl.org).

Flexible Class Scheduling
Classes are scheduled Monday through Thursday evenings, with seminars offered on Fridays and Saturdays. Part-time students may complete the entire program with evening classes. Many students accelerate completion of the program by taking courses during the two six-week summer sessions.

Further information about the Flex MBA Program may be obtained by contacting the Graduate Programs Office of the College of Business and Economics, Lehigh University, College of Business and Economics, 621 Taylor Street, Bethlehem PA 18015

phone: (610) 758-3418
email: mba.admissions@lehigh.edu (mbd.admissions@lehigh.edu)
www.lehigh.edu/mba

MASTER OF BUSINESS ADMINISTRATION AND EDUCATIONAL LEADERSHIP

The MBA & Educational Leadership joint degree program offers students the opportunity to acquire a solid foundation in both business and education. Designed to develop the administrative skills required in today’s educational systems, the MBA/Ed. Leadership provides a framework where excellent education and sound business practices can flourish. The MBA/Ed. Leadership will provide an additional option for business students in educational leadership. The program will enhance the students’ marketability in private and public sector education while providing students with an understanding of the cultures of both business and education. Core courses from both colleges will ensure that recipients of the joint degree will bring to their future positions an extraordinary medley of skills to manage human and financial resources efficiently while employing expertise in instructional supervision and training in both education and corporate settings. This program of study will enhance training and skills for those currently in the area of business and financial management in the field of education. The Lehigh MBA/Ed. Leadership is a 45-credit joint degree program.

ADMISSION REQUIREMENTS

Applications need to be approved through both the MBA Program and the Educational Leadership program. Students are required to take the GMAT. Students must have at least 2 years of professional post graduate work experience to apply for this joint degree program.

Further information about the program may be obtained by contacting Dr. Floyd D. Beachum, Associate Professor, College of Education, 610-758-5955 or fdb209@lehigh.edu.

MBA Core Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBA 401</td>
<td>Introduction to the Organization and its Environment</td>
</tr>
<tr>
<td>MBA 402</td>
<td>Managing Financial and Physical Resources</td>
</tr>
<tr>
<td>MBA 403</td>
<td>Managing Information</td>
</tr>
</tbody>
</table>
MBA 404  Managing Products and Services  4
MBA 405  Managing People  4

ENGINEERING CORE COURSES
Each engineering program has its own set of core courses. Course choices are intended to be as flexible as possible, and are tailored to meet the needs of individual students. Further information can be obtained from the appropriate departmental graduate coordinator, or from the Office of Graduate Studies (610-758-6310) in the P.C. Rossin College of Engineering and Applied Science.

ELECTIVES
Engineering electives are chosen from courses in the appropriate P.C. Rossin College of Engineering and Applied Science (RCEAS) engineering program and the business electives are selected from course offerings in CBE. Electives can also be chosen from joint courses that are being developed by RCEAS & CBE.

PROJECT
A short interdisciplinary project is required of all students. Project topics, based on the specific interests of each student, will be developed by CBE and RCEAS faculty.

ADMISSIONS
Applications must be accepted by the MBA program and by the relevant department in the P.C. Rossin College of Engineering and Applied Science. When required by the engineering program, students must take the GRE. If this is not required, then the GMAT or GRE examination must be taken. Students will not be required to take both tests. Further information can be obtained from:
Office of Graduate Studies
P.C. Rossin College of Engineering & Applied Science
610-758-6310
www.lehigh.edu/engineering

or
The Graduate Programs Office
College of Business & Economics
610-758-3418
www.lehigh.edu/mba

MASTER OF SCIENCE IN ACCOUNTING AND INFORMATION ANALYSIS
The Lehigh Master of Science in Accounting and Information Analysis (MSIA) degree program offers an outstanding opportunity to prepare for a career in today’s demanding field of accounting. Accounting professionals are engaged in a variety of services, including assurance (auditing), business valuation, information resources, and consulting. The program focuses on using information and technology to improve business processes and forge business solutions. Accredited by AACSB International, the Association to Advance Collegiate Schools of Business, Lehigh’s M.S. in Accounting and Information Analysis program satisfies the 150-hour CPA educational requirement adopted by almost all states. The program serves as an excellent foundation for professional careers as CPAs, CMAs and related fields. It provides the broad business education employers value so highly.

The Master of Science in Accounting and Information Analysis curriculum is designed to be flexible so that students may choose to concentrate their electives in a specific field, such as finance, or use them for breadth.

Students are encouraged to obtain an internship during the summer prior to beginning the program. The internship will complement the chosen concentration and provide an excellent practical framework to enrich the academic coursework experience.

Non-Accounting Majors
The M.S. in Accounting and Information Analysis program seeks applicants from a variety of academic backgrounds. Those with undergraduate business degrees in fields other than accounting often lack eighteen credits of background requirements in intermediate accounting, cost accounting, accounting information systems, fundamentals of federal income taxation and auditing. To the extent possible, applicants should take those courses during their undergraduate programs.

Applicants who do not have an undergraduate business degree will likely require two years to complete the program. The first year is devoted to background courses and the second to the graduate program itself.

Mission Statement
Lehigh University’s Master of Science in Accounting and Information Analysis provides a broad business education and the specialized coursework for a professional career in accounting. Graduates aspire to leadership positions at top-tier organizations in fields that include public accounting, corporate accounting, financial services, consulting, and information systems. Through this program, Lehigh continues a long tradition of providing accounting majors with the necessary educational requisites for licensure as certified public accountants within the United States and its territories. The program seeks only the best and the brightest applicants: motivated, dedicated to their studies, not afraid of challenges, possessing confidence, self-discipline, and the ability to articulate their ideas orally and in writing. The program continually pursues the excellence necessary to meet the standards of only the highest-quality educational institutions.

Core Program
The MSIA core consists of fifteen credits in the courses shown below and thirty credits overall. Designed specifically for this program, and dedicated to it, these innovative courses seek to develop a set of skills and experiences not available in undergraduate programs that will enhance MSIA students’ ability to perform throughout their chosen careers. Core courses are offered each academic year.

MACC 412  IT Auditing  3
MACC 413  The Corporate Financial Reporting Environment  3
MACC 424  Governance, Risk and Control  3
MACC 420  Forensic Accounting and Auditing  3
MACC 427  Reporting and Auditing Fair Value Estimates  3

ELECTIVES
Select 15 hours in electives, 3 of which must be in accounting

Total Credits  30

Electives
The MSIA curriculum provides for fifteen elective credits that students may use to specialize in an area of interest or to augment one’s general business education. Frequently-taken electives include graduate-level courses in taxation and business decisions, financial statement analysis, corporate financial management, investments, strategic supply management, managerial economics, and strategic marketing management. Three of the elective credits must be in Accounting.

Waiver Policy
There are no waivers for courses in the M.S. in Accounting and Information Analysis Program.

GMAT Scores
All applicants are required to take the Graduate Management Admissions Test (GMAT) administered by Pearson Education, Inc. GMAT scores have been averaging 670. A score of at least 600 and 50th percentile in the quantitative sections will improve the prospects for admission. Undergraduate students should take the exam in the senior year. To make an appointment to take the GMAT exam call 1-800-717-GMAT (4628) or by registering online at www.mba.com (http://www.mba.com). The GMAT is waived for Lehigh accounting majors.

Presidential Scholars
Presidential Scholars must meet normal admission standards.

International Students/TOEFL®
International students must have 16 years of formal education, including four years at the university level, to be considered for admission to Lehigh’s graduate programs. Applicants whose native language is not English are required to take the Test of English as a Foreign Language (TOEFL®). For information, contact www.ets.org/toefl (http://www.ets.org/toefl). The MSIA program features considerable student/faculty interaction in class. Very good English language skills are therefore highly important to success in the program. An internet-based
TOEFL (IBT) of 105 will improve the prospects for admission. Admitted applicants typically are required to complete the English as a Second Language American Business English (ABE) program before beginning their graduate program.

Further information about the MSAIA program may be obtained by contacting the Graduate Programs Office of the College of Business and Economics, Lehigh University, 621 Taylor Street, Bethlehem PA 18015; phone: (610) 758-3418 email: business@lehigh.edu.; or Professor David Hinrichs, Director, M.S. in Accounting and Information Analysis Program, phone: (610) 758-4674 email: dhj404@lehigh.edu.

http://cbe.lehigh.edu/msaia

MASTER OF SCIENCE IN ECONOMICS
A minimum of 30 semester hours of course work is required.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECO 402</td>
<td>Managerial Economics</td>
<td>3</td>
</tr>
<tr>
<td>ECO 412</td>
<td>Mathematical Economics</td>
<td>3</td>
</tr>
<tr>
<td>ECO 415</td>
<td>Econometrics I</td>
<td>3</td>
</tr>
<tr>
<td>ECO 417</td>
<td>Advanced Macroeconomic Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ECO 447</td>
<td>Economic Analysis of Market Competition</td>
<td>3</td>
</tr>
</tbody>
</table>

Select 15 credit hours of electives 15 Credits

Total Credits 30

Students may also elect to write an M.S thesis. The thesis is worth six hours of credit toward the degree and is particularly encouraged for those who may be considering the Ph.D. program.

The M.S. in Economics Director must approve all elective course work.

Further information about the M.S. in Economics Program may be obtained by contacting the Graduate Programs Office of the College of Business and Economics or Dr. Robert Thornton, Director M.S. in Economics Program, Lehigh University, College of Business and Economics, 621 Taylor Street, Bethlehem PA 18015, email: rjt1@lehigh.edu

phone: (610) 758-3460
email: business@lehigh.edu

http://cbe.lehigh.edu/mseco

MASTER OF SCIENCE IN MANAGEMENT
The Master of Science in Management (M²) is a nine month program designed to build core business education onto the foundation of a liberal arts or scientific degree (such as engineering or history). M² is ideal for students who want to enter the work force and ready to hit the ground running from day one. Eligible applicants are college seniors or recent (one year out) graduates without undergraduate business degrees or majors. Economics majors are welcome. College calculus is helpful but not mandatory for admission.

Students will have classes that include accounting, finance, statistics, management, economics and marketing. The program is structured to provide classroom instruction in the fall and spring semesters. In addition the program will include career exploration, trips, and professional development focused on job acquisition and job acclimation. During the January intersession students have the opportunity for optional experiential learning through focused corporate engagements, consulting projects, Lehigh Silicon Valley, and/or international immersion experiences.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCT 442</td>
<td>Financial Reporting and Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ACCT 444</td>
<td>Accounting for Decision Making</td>
<td>2</td>
</tr>
<tr>
<td>BIS 423</td>
<td>Management Information Systems</td>
<td>2</td>
</tr>
<tr>
<td>ECO 409</td>
<td>Money, Banking and Macroeconomic Analysis</td>
<td>2</td>
</tr>
<tr>
<td>ECO 427</td>
<td>Statistical Analysis for Management</td>
<td>2</td>
</tr>
<tr>
<td>ECO 448</td>
<td>Business Economics</td>
<td>3</td>
</tr>
<tr>
<td>FIN 418</td>
<td>Principles of Corporate Finance and Investments</td>
<td>3</td>
</tr>
<tr>
<td>LAW 417</td>
<td>Regulatory Environment of Business</td>
<td>2</td>
</tr>
<tr>
<td>MGT 416</td>
<td>Managing Talent</td>
<td>3</td>
</tr>
<tr>
<td>MGT 461</td>
<td>Strategic Management</td>
<td>1</td>
</tr>
</tbody>
</table>

MKT 415 Marketing Foundations 3
MKT 425 Brand Strategy 2
SCM 423 Supply Chain Operations Management 2

All courses required

Total Credits 30

Further information about the Master of Science in Management (M²) program may be obtained by contacting the Graduate Programs Office of the College of Business and Economics, Lehigh University, 621 Taylor Street, Bethlehem PA 18015; email: incbem2@lehigh.edu.; or Mary Theresa Taglang, Director, M.S. in Management Program, phone: (610) 758-4386 email: mtt4@lehigh.edu.

www.lehigh.edu/m2

DOCTOR OF PHILOSOPHY
Program Requirements
The Ph.D. program requires a minimum of 48 credits (including dissertation) beyond the master’s degree or 72 credits beyond the bachelor’s degree. Each student is expected to choose one primary and two secondary fields of specialized study. Students must take core courses in microeconomics, macroeconomics, econometrics, and mathematical economics. Students must also take written, qualifying examinations in microeconomic theory and econometrics as well as an examination in their primary field of study. As a condition for advancement to candidacy, a student must write an original third-year paper (the pre-dissertation research project) suitable for submission to a scholarly journal. The fields of specialization normally available include, but are not necessarily limited to, health economics, labor economics, industrial organization, applied macroeconomics and applied econometrics.

Under the guidance of a dissertation chairperson and committee, the candidate undertakes research culminating in a dissertation. The Ph.D. is awarded upon the successful completion of the doctoral dissertation and its oral defense.

Further information about the Ph.D. in Business and Economics Program may be obtained by contacting the Graduate Programs Office of the College of Business and Economics or Dr. Muzhe Yang, Director of the Ph.D. in Business and Economics Program, Lehigh University, College of Business and Economics, 621 Taylor Street, Bethlehem PA 18015

phone: (610) 758-4962
email: business@lehigh.edu

http://cbe.lehigh.edu/phd

CERTIFICATE PROGRAMS
Certificate in Corporate Entrepreneurship
Businesses often nurture the entrepreneurial spirit by forming new venture groups within their organizations. The members of these groups require a special blend of education to develop the skills of discovery, innovation and leadership that starting a new enterprise requires. This certificate program prepares students to successfully evaluate business opportunities within a corporate environment.

Requirements
The certificate requires 12 credit hours of coursework with six credit hours of directed electives plus an additional six credits.

Directed Electives

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>GBEN 403</td>
<td>Anatomy of Entrepreneurship: Startups and Established Companies</td>
<td>1</td>
</tr>
<tr>
<td>GBEN 404</td>
<td>Market Opportunity: Targeting Strategies and Selling Tactics</td>
<td>1</td>
</tr>
<tr>
<td>GBEN 406</td>
<td>Performing a Business Enterprise Audit: Developing an Industry Perspective</td>
<td>1</td>
</tr>
<tr>
<td>GBEN 408</td>
<td>The New Venture Organization: Management, Design, and Governance</td>
<td>1</td>
</tr>
<tr>
<td>GBEN 409</td>
<td>Financial Forecasting: Developing Pro Forma Financial Statements</td>
<td>1</td>
</tr>
</tbody>
</table>
GBEN 410  Financing StartUps: Seeking Outside Venture Capital  1

Elective Courses
Select 6 credit hours from the following:  6

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>GBEN 401</td>
<td>The Business Plan I: Strategic Considerations (2)</td>
<td></td>
</tr>
<tr>
<td>GBEN 402</td>
<td>The Business Plan II: Operating Strategies and Implementation (2)</td>
<td></td>
</tr>
<tr>
<td>GBEN 405</td>
<td>Intellectual Property: Management and Valuation (1)</td>
<td></td>
</tr>
<tr>
<td>GBEN 407</td>
<td>Processes and Infrastructure: Creating Production and Delivery (1)</td>
<td></td>
</tr>
<tr>
<td>GBEN 411</td>
<td>Establishing Credit Facilities: Asset-Based and Cash Flow Financing (1)</td>
<td></td>
</tr>
<tr>
<td>GBEN 412</td>
<td>Developing Exit Strategies: Concepts and Approaches (1)</td>
<td></td>
</tr>
<tr>
<td>GBEN 413</td>
<td>Integrative Experience/New Venture Internship (1-4)</td>
<td></td>
</tr>
</tbody>
</table>

Total Credits 12

Admission Requirements
Students admitted to the certificate program in entrepreneurship will enter as non-degree students. Applicants are required to have a 3.0 undergraduate GPA and to have earned a 4 year baccalaureate degree from an accredited college or university. Two years of full time professional work experience is also required.

Further information about certificate programs may be obtained by contacting the Graduate Programs Office of the College of Business and Economics, Lehigh University, College of Business and Economics, 621 Taylor Street, Bethlehem PA 18015

phone: (610) 758-3418
email: business@lehigh.edu

http://cbe.lehigh.edu/mba/certificates

CERTIFICATE IN SUPPLY CHAIN MANAGEMENT

Increasingly sophisticated information technology applications and the shift toward global economic activity have shaped a competitive environment that rewards creating value for customers while reducing cost and cycle time. Through in depth study of the organizations' value chain -logistics, operations, marketing, sales and service- the certificate in supply chain management demonstrates how these activities are linked both internally and externally.

Required Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>GBUS 432</td>
<td>Demand and Supply Chain Planning</td>
<td>3</td>
</tr>
<tr>
<td>GBUS 450</td>
<td>Strategic Supply Management</td>
<td>3</td>
</tr>
<tr>
<td>GBUS 453</td>
<td>Transportation and Logistics Management</td>
<td>3</td>
</tr>
<tr>
<td>GBUS 456</td>
<td>Applied Supply Chain Models</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Credits 12

Admission Requirements

Students admitted to the certificate program will enter as non-degree students. Applicants are required to have a 3.0 undergraduate GPA and to have earned a 4 year baccalaureate degree from an accredited college or university.

Further information about certificate programs may be obtained by contacting the Graduate Programs Office of the College of Business and Economics, Lehigh University, College of Business and Economics, 621 Taylor Street, Bethlehem PA 18015

phone: (610) 758-3418
email: business@lehigh.edu

http://cbe.lehigh.edu/mba/certificates

Professors. Paul Brockman, PhD (Louisiana State University); Stephen G. Buell, PhD (Lehigh University); Shin-Yi Chou, PhD (Duke University); James A. Dearden, PhD (The Pennsylvania State University); Mary E. Deily, PhD (Harvard University); David A. Griffith, PhD (Kent State University); Frank R. Gunter, PhD (Johns Hopkins University); Kathleen W. Hanley, PhD (University of Florida); Thomas J. Hycolak, PhD (University of Notre Dame); Richard J. Kish, PhD (University of Florida); Judith A. McDonald, PhD (Princeton University); Matthew A. Melone, JD (University of Pennsylvania); Vincent G. Munley, PhD (State University of NY, Binghamton University); George A. Nation, III, JD (Villanova University); Nandkumar Nayar, PhD (University of Iowa); Georgette C. Phillips, JD (Harvard Law School); Michael D. Santoro, PhD (Rutgers University); Susan A. Sherer, PhD (University of Pennsylvania); K. Shivakumar, PhD (Syracuse University); Larry W Taylor, PhD (University of North Carolina Chapel Hill); Robert J. Thornton, PhD (University of Illinois Upper Chicago); Robert J. Trent, PhD (Michigan State University); Todd A. Watkins, PhD (Harvard University); Yuliang Yao, PhD (University of Maryland College Park)

Associate Professors. Anne-Marie Anderson, PhD (University of Arizona); Liuba Y. Belkin, PhD (Rutgers University); Ravindra Chitturi, PhD (University Texas, Austin); Beibei Dong, PhD (University of Minnesota); W. Wampler, Columba; William Forster, PhD (University of Pennsylvania); Nevena Taneva Koukouva, PhD (University of Maryland); Douglas M. Mahony, PhD (Rutgers University); James M. Maskulka, DBA (Kent State University); Chad Meyerhoefer, PhD (Cornell University); Oleksandr Nikolsko Rzhesvskyy, PhD (University of Houston Park); Corinne A. Post, PhD (Rutgers University Newark); Steven McKay Price, PhD (Florida State University); Catherine M. Ridings, PhD (Drexel University); Jesus M. Salas, PhD (University of Oklahoma); Stephen F. Thode, DBA (Indiana University Bloomington); Andrew John Ward, PhD (University of Pennsylvania); Muzhe Yang, PhD (University of California Berkeley); Ke Yang, PhD (University of Iowa); Zach G. Zacharia, PhD (University of Tennessee Knoxville)

Assistant Professors. Keith A. Botner, PhD (University of Utah); Weijia Dai, PhD (University of Maryland); Michael B Imerman, PhD (Rutgers University); Taewan Kim, PhD (Syracuse University); Ernest Kong-Wah Lai, PhD (University of Pittsburgh); Alberto Lamadrid, PhD (Cornell University); Ju-Yeon Lee, PhD (University of Washington); Yung-Yu Ma, PhD University of Utah); Ozias A. Moore, MSE (University of Pittsburgh); Irina Panovska, PhD (Washington University); Marina Puzzakova, PhD (Drexel University); Seth Richards-Shubik, PhD (University of Pennsylvania); Naomi B. Rothman, PhD (New York University); Charles E. Stevens, PhD (Ohio State University); Rebecca Jen-Hui Wang, MSEM (Dartmouth College); Dawei Zhang, PhD (University of Calgary); Haibei Zhao, PhD (Georgia State University)

Lecturer. Chitra S. Nayar, MBA (University of Iowa)

Professors Of Practice. Marija Baltrusaitiene, MA (University of Iowa); Michael R Catalano, MBA (Cornell University); Joshua Walter Ehrgart, MA (Lehigh University); Dale F. Falcinelli, MS (Lehigh University); Robert Kuchta, MS (New Jersey Institute of Technology); David H. Myers, PhD (University of Pennsylvania); Paul Myerson, MBA (Temple University); Steven L. Savino, MBA (Wake Forest University); Samuel C. Weaver, PhD (Lehigh University)

Emeriti. J. Richard Aronson, PhD (Clark University); Nicholas W. Balabkins, PhD (Rutgers University); Richard W Barsness, PhD (University of Minnesota); Alden S. Bean, PhD (Northwestern University); Carl R. Beidleman, PhD (University of Pennsylvania); John W. Bonge, PhD (Northwestern University); James Edward Hansz, PhD (University of Cincinnati); Jon T. Innes, PhD (University of Oregon); Arthur E. King, PhD (Ohio State University); Michael G. Kolchin, DBA (Indiana State University); John R. Mc Namara, PhD (Rensselaer Polytechnic Institute); Anthony Patrick O'Brien, PhD (University of California Berkeley); Warren A. Pillsbury, PhD (University of Virginia); Peter P. Poole, PhD (The Pennsylvania State University); Theodore W. Schlie, PhD (Northwestern University); Bruce M. Smackey, PhD (Rensselaer Polytechnic Institute); John E. Stevens, PhD (University of Cincinnati)
Business Information Systems Courses
BIS 423 Management Information Systems 2 Credits
This course examines the role of information systems (IS) and information technology (IT) in the organization. The focus of the course is the organizational uses of IS and IT to compete effectively. Both technical and managerial aspects of information systems are explored. The course includes technical infrastructure, management decision-making, trends and innovations in IS, and business process issues critical to the understanding of operational and strategic information systems.
Prerequisites: Must have Excel competency
BIS 448 Predictive Analytics in Business 3 Credits
The course covers theories and practices in predictive analytics in business. Students will have hands-on experience on analyzing business data for business intelligence and improved business decision making. Includes: key theories, concepts, and models of predictive analytics; and data mining tools to formulate and solve business problems. The course uses data analytics software and real data. Topics include prediction, forecasting, classification, clustering, data visualization, and data reduction techniques. Credits will not be given for both BIS 348 and BIS 448.

Economics Courses
ECO 401 Basic Statistics for Business and Economics 3 Credits
Descriptive statistics, probability and probability distributions, estimation, hypothesis testing, correlation and regression, chi-square analysis, and analysis of variance. Computer applications.

ECO 402 Managerial Economics 3 Credits
Prerequisites: MATH 021 and (MATH 022 or MATH 096) and ECO 401

ECO 403 Econometric Software 1 Credit
An opportunity to become proficient in the powerful statistical package, Stata, which which has been widely and heavily used by economic consulting firms and economists from academia and the private and public sectors. Students will learn how to utilize Stata to bridge the gap between source data and final analysis. Working with World Bank data will provide hands-on, practical experience. Upon completion of this course students will be able to manage data to boost their research and analysis skills.
Repeat Status: Course may be repeated.

ECO 404 Applied Microeconometrics 3 Credits
The purpose of this course is to expose students to econometric techniques frequently used in applied microeconomic research. The course features critical reading of empirical research papers and the implementation of econometric methods on actual data sets.

ECO 409 Money, Banking and Macroeconomic Analysis 2 Credits
The role of financial intermediation in the U.S. economy, the process of money creation, impacts of fiscal and/or monetary policy on the goals of macroeconomic policy, inflation and unemployment.

ECO 412 Mathematical Economics 3 Credits
Applications of various mathematical techniques in the formation and development of economic concepts and theories. Consent of instructor required.

ECO 413 Advanced Microeconomics Analysis 3 Credits
A survey of methods of decision-making at the microeconomic level; price theory and econometric applications.
Prerequisites: ECO 402

ECO 414 Advanced Topics in Microeconomics 3 Credits
Resource allocation and price determination. Theories of choice of consumers, firms, and resource owners under various market forms.
Prerequisites: ECO 413

ECO 415 Econometrics I 3 Credits
Prerequisites: ECO 401

ECO 416 Econometrics II 3 Credits
Mathematical and statistical specification of economic models. Statistical estimation and tests of parameters in single and multiple equation models. Prediction and tests of structural change.
Prerequisites: ECO 415

ECO 417 Advanced Macroeconomic Analysis 3 Credits
Macroeconomic theory and policy. Emphasis on theoretical models and policy implications.

ECO 418 Advanced Topics in Macroeconomics 3 Credits
Prerequisites: ECO 417

ECO 423 Real Options 3 Credits
This is an introductory graduate level course in financial economics. It is intended for students with strong technical backgrounds who are comfortable with mathematical arguments. The course is divided into three major parts: deterministic finance, single-period uncertainty finance, and options theory and its applications.
Prerequisites: GBUS 420

ECO 425 Cost-Benefit Analysis 3 Credits
Theory and methods of cost-benefit analysis; efficiency and equity as criteria in program evaluation; proper measurement of market and non-market costs and benefits; consideration of risk, uncertainty, appropriate discounting techniques, and distributional consequences; applications to the evaluation of health care policies and therapies.
Prerequisites: ECO 402 and (ECO 357 or ECO 415)

ECO 427 Statistical Analysis for Management 2 Credits
Descriptive statistical measures, probability and probability distributions, statistical inference (estimation and hypothesis testing), correlation and regression. EXCEL will be used for statistical computing.

ECO 429 Monetary Theory 3 Credits
The role of money in the economy from theoretical and empirical perspectives. The influence of money and prices, interest rates, output, and employment.

ECO 430 Public Finance 3 Credits
The economics of public spending and taxation; principles of government debt management; theories of budgeting and cost-benefit analysis and public choice.

ECO 440 Labor Economics I 3 Credits
The economics of labor markets and various labor-market institutions with emphasis on current theoretical and empirical research. Topics include labor supply and demand, human capital, the structure of labor markets, labor market regulation, information and job search, labor mobility, unionism, and labor market discrimination.
Prerequisites: ECO 401 and ECO 402

ECO 441 Labor Economics II 3 Credits
An examination of empirical research in labor economics, focusing on topics such as human resource management and internal labor market outcomes, wage and income inequality and poverty, unemployment, and other issues current in the literature.
Prerequisites: ECO 402 and ECO 415

ECO 447 Economic Analysis of Market Competition 3 Credits
Mathematical models based on game theory and industrial organization. Cases are used to analyze the strategic interaction of firms and governments as competitors and partners.
Prerequisites: ECO 402
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Course Description</th>
<th>Prerequisites</th>
<th>Repeat Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECO 448</td>
<td>Business Economics 3 Credits</td>
<td>3</td>
<td>Applications of economic analysis to business decision-making; technology in economic systems; resource allocation and pricing strategies in various market structures; decisions under risk and uncertainty; and government regulation and support of business and innovation.</td>
<td>ECO 402</td>
<td>Course may be repeated</td>
</tr>
<tr>
<td>ECO 454</td>
<td>Economics of Environmental Management 3 Credits</td>
<td>3</td>
<td>Economic theory of natural resources. Optimal policies for the development of renewable and nonrenewable resources and environmental quality.</td>
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<tr>
<td>ECO 455</td>
<td>Health Economics I 3 Credits</td>
<td>3</td>
<td>Economic theory and empirical analysis of health production, the demand for health services, and health insurance. Implications for the current institutional structure of health care and health delivery systems will also be discussed. Additional topics and extensions will be selected based on developments in the literature.</td>
<td>ECO 402 and ECO 415</td>
<td>Course may be repeated</td>
</tr>
<tr>
<td>ECO 456</td>
<td>Industrial Organization 3 Credits</td>
<td>3</td>
<td>The goal of the course is to review theoretical and empirical attempts by economists to understand market structures lying between the extremes of perfect competition and monopoly. The course will focus first on describing the current U.S. industrial structure and reviewing models of imperfect competition. The course then shifts to a closer study of individual firm behavior. The final segment of the course is an overview of two significant relationships between government and industry caused by the existence of imperfect.</td>
<td>ECO 415 and ECO 447</td>
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<tr>
<td>ECO 457</td>
<td>Bio-Pharmaceutical Economics 3 Credits</td>
<td>3</td>
<td>Characteristics of the market for pharmaceuticals; barriers to entry, competition and innovation; pricing and regulation; physician prescribing behavior; commercialization and financing of biotech startups; international comparisons of public policy.</td>
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<tr>
<td>ECO 460</td>
<td>Time Series Analysis 3 Credits</td>
<td>3</td>
<td>Classical decomposition of time series, trend analysis, exponential smoothing, spectral analysis and Box-Jenkins autoregressive and moving average methods.</td>
<td>ECO 401 and ECO 402</td>
<td>Course may be repeated</td>
</tr>
<tr>
<td>ECO 461</td>
<td>Forecasting 3 Credits</td>
<td>3</td>
<td>Methods of economic and business forecasting.</td>
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<tr>
<td>ECO 463</td>
<td>Topics in Game Theory 3 Credits</td>
<td>3</td>
<td>A mathematical analysis of how people interact in strategic situations. Topics include normal-form and extensive-form representations of games, various types of equilibrium requirements, the existence and characterization of equilibria, and mechanism design. The analysis is applied to micro-economic problems including industrial organization, inter-national trade, and finance. Must have completed two semesters of calculus.</td>
<td>ECO 412 and ECO 413</td>
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<tr>
<td>ECO 464</td>
<td>Applied Econometrics I 3 Credits</td>
<td>3</td>
<td>This course focuses on the identification of causal relationships using cross-sectional and panel data. The objectives are to 1) familiarize students with identification assumptions for causal inference; and 2) enable students to select appropriate econometric tools for empirical economic problems and policy evaluation. Topics include robust inference and bootstrap; instrumental variables and generalized method of moments (GMM); quantile and nonparametric regression methods; treatment effect analysis, and models for discrete choices, panel data, and social interactions.</td>
<td>ECO 416</td>
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<tr>
<td>ECO 465</td>
<td>Applied Econometrics II 3 Credits</td>
<td>3</td>
<td>Econometric analysis of skewed and truncated distributions, discrete outcomes, and missing or incomplete data. The first part of this course will involve the functional specification and testing of appropriate estimators in these situations, while the second part of the course will focus on conducting causal inference using nonlinear models in the presence of unobserved heterogeneity. Emphasis will be given to common applications in health and labor economics.</td>
<td>ECO 416</td>
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<tr>
<td>ECO 466</td>
<td>Health Economics II 3 Credits</td>
<td>3</td>
<td>Selected topics in the literature on health economics with an emphasis on the application and evaluation of econometric techniques and identification strategies. Both demand and supply side issues will be addressed. Examples of the former include the demand for health, health insurance and health care services, while examples of the latter include the regulation of supplier behavior and industrial organization issues.</td>
<td>ECO 402 and ECO 416</td>
<td></td>
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<tr>
<td>ECO 472</td>
<td>International Trade Theory 3 Credits</td>
<td>3</td>
<td>Theories of comparative advantage, factor price equalization, trade and welfare, tariffs, trade and factor movements.</td>
<td>ECO 413</td>
<td></td>
</tr>
<tr>
<td>ECO 473</td>
<td>International Monetary Economics 3 Credits</td>
<td>3</td>
<td>Theory of the balance of payments, the microeconomics of international finance, various approaches to balance-of-payments adjustments, theories of foreign exchange-rate determination, and macroeconomic policy under fixed and flexible exchange rates.</td>
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<tr>
<td>ECO 490</td>
<td>ENGL 490 Master’s Thesis 0-6 Credits</td>
<td>0-6</td>
<td>Extended study of an approved topic not covered in scheduled courses.</td>
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<tr>
<td>ECO 492</td>
<td>Special Topics in Economics 1-3 Credits</td>
<td>1-3</td>
<td>Independent study on a topic that is being pursued to fulfill the third year paper requirement, and has been approved by the student’s interim advisor.</td>
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<tr>
<td>ECO 493</td>
<td>Doctoral Pre-Dissertation Research Project - Independent Study 1-9 Credits</td>
<td>1-9</td>
<td>Independent study on a topic that is being pursued to fulfill the third year paper requirement, and has been approved by the student’s interim advisor.</td>
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<tr>
<td>ECO 499</td>
<td>Dissertation 1-15 Credits</td>
<td>1-15</td>
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**Finance Courses**

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Course Description</th>
<th>Prerequisites</th>
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</thead>
<tbody>
<tr>
<td>FIN 418</td>
<td>Principles of Corporate Finance and Investments 3 Credits</td>
<td>3</td>
<td>This course provides students with a basic foundational knowledge of finance principles, working knowledge of various aspects of corporate finance, and the principles of investments. Short-term financial decisions will be discussed. Long-term capital investment will be explored starting with the basics of time value of money and capital investment techniques. Topics include the determination of the appropriate investment discount rate, the organization’s cost of capital and hurdle rates, the risk-reward tradeoff, and specific financial instruments.</td>
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<td>Course may be repeated</td>
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</table>

**Grad Business Entrepreneurship Courses**

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Course Description</th>
<th>Prerequisites</th>
<th>Repeat Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>GBEN 401</td>
<td>The Business Plan I: Strategic Considerations 2 Credits</td>
<td></td>
<td>This course is first of a two-part sequence that focuses on the initial steps necessary to design and build a high-impact business plan for the startup company or new enterprise within an existing firm. The development process is integrative, complex, and time-consuming for the entrepreneur. Foundation or strategic-level issues that impact the formation and growth of the new enterprise are addressed. The goal in this first phase is to complete various sections of the business plan that deal with market opportunity, industry trends and developments, company positioning, competitive advantage, and core competencies. This course is project-oriented and makes extensive use of one-on-one instruction between class meetings. Students identify a market opportunity, develop the product/service offering, target potential customers and users, assess market demand, analyze market penetration, and determine the revenue potential of the new venture.</td>
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</table>
GBEN 402 The Business Plan II: Operating Strategies and Implementation 2 Credits

This course is the second of a two-part sequence that focuses on the final steps necessary to complete the business plan. This phase concentrates on designing the appropriate operational framework and business processes, including technology and infrastructure, which are required to successfully launch the new enterprise. The business plan must also demonstrate that the venture will have strong leadership and a capable management team to deal with uncertainty and drive results. Finally, the business plan must incorporate detailed financial forecasts and financing methods, and should address equity valuation and investor exit strategies. Like its predecessor, this course is project-oriented and makes extensive use of one-on-one instruction between class meetings. Additional emphasis is placed on developing an effective format and packaging of the written document.

Prerequisites: GBEN 401

GBEN 403 Anatomy of Entrepreneurship: Startups and Established Companies 1 Credit

This interactive seminar focuses on understanding the true meaning of entrepreneurship. The new venture opportunity is profiled from the perspective of the individual entrepreneur who is starting a business and embarking on a new career path involving high risk and reward. Different entrepreneurial management styles are analyzed and highlighted. Emphasis is also placed on managing innovation and creativity in a corporate environment. Successful implementation of entrepreneurial activities for the large company makes special demands on management to promote discovery and create internal stakeholders. Both startups and established companies are placed under the microscope through guest speakers, panel discussions, selected readings, and case analysis.

GBEN 404 Market Opportunity: Targeting Strategies and Selling Tactics 1 Credit

The focal point of any business plan is identifying and understanding the target customer that will be served. The product/service offering must have strong buyer appeal and capture immediate attention in the marketplace. The need to rapidly penetrate a market demands that a marketing mix be designed, built, and implemented in a manner that leads to differentiation and superior positioning. Maximizing marketing firepower with severely limited financial and organizational resources is a major challenge that confronts today’s entrepreneurs. Market segmentation strategies, the target marketing process, forming market alliances, and managing the selling process are viewed from the perspective of seed and early stage ventures.

GBEN 405 Intellectual Property: Management and Valuation 1 Credit

New technologies create new markets and new venture possibilities. Their discovery and success rate, along with the ability of an enterprise to leverage these assets in markets, depends on how the firm views and manages its investment in intellectual property. Obtaining the necessary legal protection of intellectual property can also serve as an effective management tool to leverage these assets in markets, depends on how the firm views and manages these assets in markets. The need to address equity valuation and investor exit strategies is also critical. This course is project-oriented and makes extensive use of one-on-one instruction between class meetings. Additional emphasis is placed on developing an effective format and packaging of the written document.

GBEN 406 Performing a Business Enterprise Audit: Developing an Industry Perspective 1 Credit

New ventures must position themselves for long-term growth and market development. Entrepreneurs create enterprises, define their organizations, and build business models based on changes in technology, government regulation, demographics, and shifts in other exogenous variables. A strategy must be crafted that is sustainable over the long run. Success or failure is often predicated on market cycles, market saturation, supply/demand imbalances and other forces that are not controllable. This seminar places emphasis on assessing the market potential and valuation of startups from an industry or macro-perspective, particularly from the view of an outside investor. It also focuses on how to gather and make effective use of competitive intelligence.

GBEN 407 Processes and Infrastructure: Creating Production and Delivery 1 Credit

This course provides an overview of the internal capabilities and the process and technology platform required to fully operationalize the business plan. Critical business activities and functions are dissected, such as establishing needed backend procurement, production, and distribution systems and capabilities and focus on supply chain dynamics and management; determining the scope of frontend call center and e-commerce activities; managing logistics; and utilizing information systems and web-based solutions that effectively link customers, elements of the supply chain, and employees. These topics are explored from the perspective of the startup and emerging company as well as the large corporation engaged in new venture creation.

GBEN 408 The New Venture Organization: Management, Design, and Governance 1 Credit

Managing a new enterprise presents unique and difficult challenges for its leadership. Expanding workloads and the increased complexity of tasks resulting from the rapid and sustained growth of the business create the need for a smooth transition from entrepreneurial-style management to professional management. Timing is critical, and for many startups it is not an easy bridge to cross. This dissects the design and characteristics of small organizations, and the need to correctly align structure with strategy. It also considers how entrepreneurial activities should be seeded, managed, organized, and executed within the context of an established company. Under scrutiny are the heavy demands placed upon entrepreneurs and corporate managers to effectively lead and manage under highly uncertain conditions where change is a constant. Additional emphasis is placed on comprehending the critical role that boards of directors play for startup companies.

GBEN 409 Financial Forecasting: Developing Pro Forma Financial Statements 1 Credit

No business plan would be complete without providing detailed financial projections and identifying the key assumptions that help shape the numbers. The financial translation of business models is expressed through pro forma income statements, balance sheets, and sources and uses of funds. Having this information allows management, investors, and lenders to measure and evaluate future financial performance. This exercise also establishes the capitalization required to launch the venture, support operations, and meet interim goals as the enterprise progresses through the beginning stages of its development. Emphasis is placed on the use of forecasting methods and break-even analysis, working capital and cash flow management, and identification of accounting and financial issues that impact on profit measurement and financial risk.

GBEN 410 Financing Startups: Seeking Outside Venture Capital 1 Credit

This course provides an overview of the venture capital market, examines the nature and role of the venture capitalist, and analyzes whether and how venture capital financing may be the preferred approach in raising outside capital. Venture deals are closely examined in terms of types of equity instrument, methods of valuation, milestones and staged release of funds, special provisions that may include anti-dilution measures and other protective arrangements, and developing term sheets. Emphasis is also given to dissecting the process and criteria used to seek and attract venture capitalists, including angel investors. Various scenarios and tradeoffs are covered in this intensive .

GBEN 411 Establishing Credit Facilities: Asset-Based and Cash Flow Financing 1 Credit

Borrowing from a commercial bank or a credit intermediary can provide outside funding for working capital and equipment purchases in many situations. For seed and early stage firms, attention is often given to asset-based lending programs that make use of first liens on accounts receivable and inventory or fixed assets to provide added legal protection to creditors. For later stage firms, traditional line-of-credit financing may be feasible and desirable from a cash flow standpoint. Various borrowing alternatives, including leasing, are covered in this course along with covenants and restrictions that often apply. Government loan programs, especially those of the Small Business Administration, are also given emphasis.
GBEN 412 Developing Exit Strategies: Concepts and Approaches 1 Credit
Sophisticated equity investors require that an exit or harvest plan be developed and that it be viable and capable of being executed within the foreseeable future. Venture capitalists and angel investors anticipate their future departure and a positive financial outcome at the very point the deal is struck in the present. Various planned and unplanned exit strategies are analyzed in this course which include: an initial public offering, offering the business for sale, merging with another company, franchising, acquisition of shares by some investors, or liquidation of the business. Valuation methods, financial and tax implications, and due diligence are also examined.

GBEN 413 Integrative Experience/New Venture Internship 1-4 Credits
Only students enrolled in the Entrepreneurial concentration may elect one of these hands-on, project-oriented s. Integrative Experience must meet the requirements of formal independent study and involve a new venture situation with a startup or existing company. Students employed in a New Venture Internship may also qualify for credit if the same requirements are satisfied.

GBEN 415 LehighSiliconValley 1-3 Credits
Immersion study-abroad-like program focused on venture capital-backed companies and the paths taken to start, build, and exit an enterprise. Offered in the hub of entrepreneurship, Silicon Valley, live cases draw on seasoned practitioners from all reaches of the venture community. Students strategically analyze and evaluate startups, lead discussion, and assess team performance in recommending go-forward strategies. Emphasis on real companies, real players, and real situations in real time create a highly charged learning environment. Winter term. Includes pre-trip sessions. Competitive admission. Program fees.

GBEN 424 Entrepreneurship & Innovation: From Idea to Opportunity 3 Credits
Thought about starting a business but wonder where to begin? focuses on the idea stage of new venture creation where discovery plants seeds of future enterprises. Student projects, case studies and speakers introduce personal, interpersonal, financial, and legal challenges startups encounter. Drawing on research on entrepreneurial decision-making, students learn to think and behave entrepreneurially. Participants "kick the tires" on their own and others' just-emerging ideas and improve them. For those interested in starting a business sometime in their lives.

GBEN 492 Special Topics 1-3 Credits
Graduate Business Courses

GBUS 401 Financial Reporting for Managers and Investors 3 Credits

GBUS 408 Advanced Business Speaking and Pragmatics 2 Credits
Designed to assist international business students become capable communicators within the U.S. and the global marketplace. Students will increase their oral communicative competence and socio-cultural communication awareness through assignments designed to help them learn successful behaviors and customs that are essential elements of oral communication in U.S. graduate business courses, job searching, networking, business presentations, and career development. Students are assessed through their successful use of advanced language functions during the application of face-to-face business settings including business-style negotiations, interviews, presentations, and panel discussions.

GBUS 409 Advanced Business Writing and Reading 2 Credits
Designed to introduce international business students to the types of rhetoric and written structures required in an American university graduate business program, as well as in most business environments; and to provide them with the skills and strategies that are necessary to produce cogent academic essays and papers, as well as business summaries and briefs for the global marketplace. Using a process writing approach, students model expository, chronological order/ process, compare and contrast, cause and effect, argumentative, and problem-solution styles, as well as formal and informal business written communication styles. Students are assessed through their successful use of these rhetorical models in writing, their advanced level of academic vocabulary and grammatical structures, as well as through summaries and analyses of research-level articles that include appropriate academic publication conventions.

GBUS 413 Advanced Management Accounting 3 Credits

Prerequisites: MBA 403

GBUS 414 Financial Statement Analysis and Interpretation 3 Credits
This course focuses on analysis of financial statements. It develops the skills necessary to interpret and use financial statement information effectively to assess profitability and risk and is intended for individuals likely to become intensive users of financial accounting information. Requirements include readings, case studies, presentations, and written analysis of actual financial statements.

Prerequisites: (MBA 402) or (ACCT 151 and FIN 125 or FIN 225)

GBUS 419 Financial Management 3 Credits
An intermediate level course in corporate finance. Coverage includes capital budgeting techniques including real options, decision tree analysis, risk analysis, advanced cost of capital theories, capital structure theory, dividend policy, working capital management, mergers and acquisitions, restructuring, and bankruptcies. The course emphasizes both theory and practice through lectures, cases, and financial modeling exercises. Students not possessing the relevant prerequisites must obtain waivers from the designated finance faculty representative.

Prerequisites: (MBA 402) or (ACCT 151 and FIN 125)

GBUS 420 Investments 3 Credits
A survey course in investments. Overview of financial institutions and markets involved in the issuance and trading of securities. Emphasis on valuation/security analysis, risk analysis, advanced cost of capital theories, capital structure theory, dividend policy, working capital management, mergers and acquisitions, restructuring, and bankruptcies. The course emphasizes both theory and practice through lectures, cases, and financial modeling exercises. Students not possessing the relevant prerequisites must obtain waivers from the designated finance faculty representative.

Prerequisites: (MBA 402) or (ACCT 151 and FIN 125)

GBUS 421 Advanced Investments 3 Credits
Advanced topics relating to specific areas within investment finance such as valuation/security analysis; portfolio/risk management; fixed investment securities; mutual funds; hedge funds; microstructure; and trading. Consent of designated finance faculty representative required.

Repeat Status: Course may be repeated.

Prerequisites: GBUS 420

GBUS 422 Derivatives and Risk Management 3 Credits
The theory and application of a variety of derivative instruments (options, futures contracts, etc.) used in corporation finance and the financial services industry. The focus is on the risk management application vs. a rigorous development of option pricing theory and similar topics. Consent of designated finance faculty representative required.

Prerequisites: GBUS 420
GBUS 424 Advanced Topics in Financial Management 3 Credits
Advanced topics relating to specific areas of corporate finance such as: theoretical and empirical examination of recent developments in financial management, asset valuation and capital budgeting including the role of uncertainty, imprecise forecasts, risk preferences, inflation, market conditions, and the global marketplace, working capital management, leasing, mergers, and financing. The course content may vary between instructors or each time the course is offered. Consent of designated finance representative.
Repeat Status: Course may be repeated.
Prerequisites: GBUS 419

GBUS 425 Real Estate Financing and Investing 3 Credits
An upper-level course in modern real estate financing techniques from the perspectives of both the borrower and the lender. Subject matter encompasses the following areas: The principles of financing decisions; financing methods and techniques; institutional sources of funds for real estate; and real estate financing decisions. Consent of designated finance faculty representative required.
Prerequisites: (MBA 402 and GBUS 420)

GBUS 426 Financial Markets and Institutions 3 Credits
Functions and portfolios of financial intermediaries. Sectional demand and supply of funds, nature and role of interest rates, term structure and forecasting, impact of inflation and regulations on financial intermediaries and markets, and current developments in the financial system. Management of assets and liabilities within the U.S. financial institution's legal and economic constraints. Consent of designated finance faculty representative.
Prerequisites: (GBUS 420)

GBUS 431 Quantitative Finance 3 Credits
Relationship of quantitative models to financial theory and applications. Capital budgeting, portfolio selection, security evaluation, cash management, inventory policy and credit analysis. Consent of designated finance faculty.
Prerequisites: MBA 402

GBUS 432 Demand and Supply Chain Planning 3 Credits
Students will learn how businesses work together to build relationships and integrate demand and supply planning activities across the supply chain to deliver superior value to customers. They will also learn about tools and technologies that enable integration as well as the critical drivers and the key metrics that support supply chain performance. Current readings and case studies, simulations and written assignments will be used.

GBUS 437 Federal Taxation and Business Decisions 3 Credits
Impact of federal taxation on the structure and timing of business decisions. Problem-solving methods and research techniques from a managerial perspective.
Prerequisites: ACCT 307

GBUS 440 Human Resource Management 3 Credits
A survey of personnel management activities in organizations. Topics include human resource planning, recruitment, selection, equal employment opportunity, performance appraisal, compensation, career planning, safety and health, and quality of work life issues. consists of lectures, discussion, and case analysis.

GBUS 442 Seminar in Management Consulting 3 Credits
A study of consulting practices in general and their application to small business. Processes include a field study/counseling service to a local business. Emphasis is on the identification and analysis of multidisciplinary problems and opportunities and the implementation of recommendations. Must have completion of MBA background courses (or equivalent). Consent of instructor required.

GBUS 444 Managerial Communication Skills 3 Credits
Organization, style and strategy of language to inform, direct and persuade. Application of writing, reading, speaking and listening skills to managerial problems. Case studies.

GBUS 445 Labor-Management Administration 3 Credits
A study of the U.S. system of industrial relations, including the evolution and present status of labor law; union organizing efforts; the strategy of negotiations; the substantive provisions of collective bargaining and the administration of collective agreements. Also considered is the role of unions in the implementation of programs for employee self-management and other workplace innovations.

GBUS 446 Commercial Potential Assessment 3 Credits
A study of the process of bringing an invention to market with emphasis on commercial potential. Industrial analysis, competitor intelligence and strategic issues will be emphasized along with the development of market strategy and an overall business plan. Extensive research including data base searches will be included. Instructor permission required.

GBUS 447 Negotiation 3 Credits
The class examines the behavioral foundations of the negotiation process. Topics include: The negotiation process, negotiation planning, power in negotiations, communications in negotiations, tactics, concepts of win-win and win-lose, social styles, individual and team negotiations, ethical considerations, cultural differences, negotiating in sole source (customer) situations, using third parties. The concepts will be exposed through both lectures and simulations.

GBUS 448 Leadership 3 Credits
This course is an examination of leadership at the organization and group/team levels, and aims to develop a student's leadership skills and the ability to diagnose leadership needs in different situations. In identifying and building these leadership skills, the course will focus on the decisions leaders need to make, and the appropriate leadership decision-making processes required in various contexts and at different stages of an organization's existence. Cases and developmental exercises including in-depth decision-making exercises are utilized and cover diverse situations and cross-cultural dimensions including specific situations such as a crisis or ethically difficult decisions.

GBUS 450 Strategic Supply Management 3 Credits
A survey course designed to introduce the MBA/MSE student to the vital role played by supply management in achieving overall effectiveness for the firm in today's global economy. The course starts by examining the traditional purchasing process and then moves on to an examination of the evolution of purchasing into supply management and, finally, to the role purchasing plays in improving effectiveness of the entire value chain. consists of lectures, discussion and case analysis.

GBUS 453 Transportation and Logistics Management 3 Credits
The control of physical distribution and inventories; the flow of information, products and cash through the integrated supply chain.

GBUS 455 E-Business Enterprise Applications 3 Credits
Implications of key information technologies used within and across businesses to conduct e-business, including customer relationship management, enterprise resource planning, online ordering and inventory management, supply chain management, and e-procurement systems, data warehousing, data mining, intra-extranets, and knowledge management.

GBUS 456 Applied Supply Chain Models 3 Credits
This course will present applied and analytic approaches for developing inventory and forecasting models, supplier selection, supply chain quality management, and production planning and supply chain network design.

GBUS 458 Strategic Information Systems 3 Credits
Understanding the various types of computer based information systems and developing an ability to identify and exploit information technologies to gain competitive advantage, at the individual, group and organizational levels.
Prerequisites: MBA 403
GBUS 460 Strategic Marketing Management 3 Credits
The course studies the management of contemporary organizations from the perspective of a marketing manager. While the course content addresses the activities required to maintain a strategic fit between an organization's environment and its particular set of objectives and resources, the central focus is on designing strategic marketing actions for various types of organizations. The course pedagogy emphasizes the application of marketing and other business principles through seminars, simulations, or case discussion.
Prerequisites: MBA 404

GBUS 462 Pharmaceutical Marketing 3 Credits
The course provides an introduction and overview of the various healthcare system components as they relate to the pharmaceutical industry. This course will (1) focus on product decisions of the firm, requiring an occasional shift in focus from that of corporate management to that of operating managers of new product activities or established brands; (2) recognize the importance of marketing research as input to product decisions; (3) take a managerial orientation; (4) recognize the need to tailor product policy approaches to the characteristics of the decision-maker and the firm. The course will be a mixture of lectures, discussions, case analyses, and group exercises. Graduate students only.
Prerequisites: MBA 404

GBUS 464 Business-to-Business Marketing 3 Credits
This course focuses on marketing strategies and tactics in firms whose customers are other institutions, not individuals. Topics covered include organizational buying behavior, managing strategic buyer-seller relationships, sales force deployment, communication strategies, and so on. Specific attention is given to the impact of information technology and globalization in the business to business context.

GBUS 465 Creating Breakthrough Innovations 3 Credits
Most products and services either fail or do average business, but some are phenomenally successful. Such products and services that provide phenomenal financial returns and become market leaders can be called “Breakthrough Products and Services”. The main objective of the course is to improve our understanding of the process of creating breakthrough products and services. It is accomplished by in-class discussions of cases, assignments, and the state-of-the-art research work in academia and industry. The course concludes with a term paper that integrates the concepts learned from class discussions, reference books, and research papers and applies them to a real product. Must have graduate student status plus two years of postgraduate work experience.

GBUS 466 Marketing Research and Analysis 3 Credits
This course focuses on procedures for collecting and analyzing relevant information for informed decision making by managers. The process of identifying research questions, developing instruments for collecting information, appropriate interpretation of information, and appropriateness of research methods are some of the topics discussed in this course. The course focuses on the process of doing marketing research as well as the techniques for analyzing information. Discussion of concepts and cases, developing data collection instruments, and doing actual marketing research projects will form the key elements of this course.
Prerequisites: (ECO 401 or BUEC)

GBUS 467 Sales Management 3 Credits
This course takes an integrated approach to the study of sales management, including formulation of strategically sound programs and the implementation of selling initiatives and the evaluation and control of the organization’s sales activities. Topics include the role of the sales manager in the divergent demands of multiple constituencies; the development of effective sales organizations; lead generation and quota setting; territory management; and motivation and reward systems. Learning methods include case studies where students’ diagnose problems and develop viable alternatives.

GBUS 470 Strategic Marketing Communications Strategies 3 Credits
This course focuses on how various elements of communications are integrated to achieve various organizational objectives. In addition to the traditional communication media such as advertising and point of purchase media, emphasis will also be placed on new media and strategies made possible due to the advances in technology. The course will involve discussion of concepts, case analysis and discussion, insights from practitioners, and group projects.

GBUS 471 Strategic Brand Management 3 Credits
This course approaches the study of brand management by illustrating the formulation of strategically sound brand management programs and the evaluation and control of the implementation of key brand initiatives (new products, advertising support, etc.). Focus is on theories and models to develop and manage brand equity. Specific learning modules include customer development, brand strategy development, brand extension development and annual brand planning. Specific attention is focused on case studies and team projects in building, measuring and managing brand equity.

GBUS 472 Strategies for Services Marketing 3 Credits
The course focuses on the challenges of marketing and managing services (whether in a manufacturing or service business) and discusses the development of strategies for addressing these challenges. The need for cross-functional integration to provide effective service is stressed. Illustrative topics include service quality gap analysis, relationship between superior service and profitability, service encounter analysis, customer lifetime value analysis, services guarantees, and service demand and capacity management.

GBUS 473 International Finance 3 Credits
Consideration of problems arising from the risks associated with international investing and multinational corporation finance (currency, political, etc.). Focus is on (a) investing in international market given the institutional constraints and differences between domestic markets, and (b) managerial issues relating to corporations, investors, and financial institutions. Consent of designated finance faculty representative.
Prerequisites: GBUS 419

GBUS 474 Legal Aspects of International Business 3 Credits
Various legal problems of engaging in business abroad, including contracts, technology transfer, property ownership, business organizations and labor, using a case and problem-solving approach.

GBUS 475 Global Marketing Strategies 3 Credits
The course is designed to provide a framework within which global marketing operation can be analyzed, understood, and undertaken. The course focuses on issues that are being faced by firms in today’s global marketplace, particularly those that are related to strategy formulation and implementation. The learning experience in this course is placed on global business decision-making, through the use of case studies, projects, exercises, and lectures.

GBUS 481 (MSE 481) Technology, Operations and Competitive Strategy 3 Credits
Develops an understanding and appreciation of the interrelationships among technology, operations and the competitive strategy of the firm. Industry analysis and competitiveness; competitive strategy formulation and implementation; value chain analysis; operations strategy and technology strategy; operation’s contributions to competitive advantages in cost, quality and variety and new product introduction.

GBUS 486 Qualitative Research Methodology 3 Credits
Study of techniques that describe, decode and translate social phenomena. Explores how interpretive researchers plan and conduct studies and present findings. Studies investigators’ roles, data sources, observation methods, data analysis methods and trustworthiness of findings. A field research project is required.

GBUS 490 Thesis 0-6 Credits
Repeat Status: Course may be repeated.

GBUS 492 Special Topics 1-4 Credits
GBUS 494 Field Projects 1-4 Credits
The field projects course will provide MBA students with an opportunity to apply MBA concepts with an employer, corporate partner or other suitable organization. Students will work with a supervising professor and a corporate representative on a project designed by the student. Students must prepare a written proposal for the project including the expected outcomes and an estimate of the hours required for completion. Students will present their proposal to a faculty member of their choice for approval. The academic rigor and time required to complete the project will determine the number of credits earned.

GBUS 499 Dissertation 1-12 Credits
Graduate MBA Core Courses
MBA 401 Introduction to the Organization and its Environment 2 Credits
An MBA core course designed to provide a thorough understanding of business organizations by examining strategies middle and senior managers use to create and sustain organizational competitive advantage. The course examines the organization from an overall perspective within the context of the firm's internal and external environment. The second aspect of this course deals with the ability to communicate effectively in today's business and professional environment. Students will examine and practice the written and verbal communications strategies and skills that are essential to their success in business.

MBA 402 Managing Financial and Physical Resources 4 Credits
An MBA core course designed to integrate financial and managerial concepts into operations decisions. Disciplines of accounting, finance and economics are combined to provide substantive foundations for discussing and analyzing data. Implications of analysis are applied to facilitate decision-making in other areas such as marketing, operations (manufacturing, logistics and engineering), human resources, information technology and general management. The major learning objectives will be applied through a series of "living" cases that are centered on analyzing historical financial performance, preparing a business plan, and valuing a business.

Prerequisites: (MBA 401 and GBUS 401 or BUAC)
Can be taken Concurrently: MBA 401

MBA 403 Managing Information 4 Credits
An MBA core course dealing with concepts and methods involved in the collection, organization and dissemination of information that helps managers make operational and strategic decisions. The course also deals with attributes of information and examines enterprise-wide impacts of local decisions. Revenue, cost, time and quality-based information are accorded equal emphasis, while students are exposed to alternative evaluation methods for decisions related to different parts of the value chain. Topics include: activity-based costing; activity-based management; transaction analysis; operational and strategic decisions such as outsourcing, design partnerships, etc; investment analysis for short lifecycle investments; evaluation of uncertainty, risk and ambiguity; metrics development; compensation policies; segment evaluation methods; target costing and functional analysis; quality function deployment; total cost of ownership; and transfer pricing. In addition, the course deals with: information technology enablers which allow firms to improve value delivered to customers; and evaluation and management of emerging forms of Competition, such as joint ventures, developing a strong customer focus, creating value through supply chain management, developing new products for competitive advantage, matching aggregate supply with customer demand, and designing market channels and influencing customers.

Prerequisites: MBA 401
Can be taken Concurrently: MBA 401

MBA 404 Managing People 4 Credits
An MBA core course that examines how effective organizations are created, maintained, and improved. The course will focus on how good people are attracted to an organization and how to make them productive. Topics include: organizational design, job design, staffing, training and development, performance, teams, influence, diversity, change, ethical decision-making and current people issues facing today's organizations.

Prerequisites: MBA 401
Can be taken Concurrently: MBA 401

MBA 406 Integrative Experience 3 Credits
An MBA course where students apply the body of knowledge acquired in MBA 401 through 405 through a simulation, case presentations and the cross core project. This course places an emphasis on strategic management and takes the point of view of the general manager to view the organization from an overall perspective in the context of the firm's internal and external environment. In doing so, students examine historical perspectives, contemporary theories, and practical applications all in the spirit of helping them develop a broad understanding of strategic management issues and solutions. By combining high-level class discussions, case analyses, a computer simulation competition and the crosscore project this course exposes students to rigorous theoretical analysis while providing hands-on, simulated real world business experiences.

Prerequisites: (MBA 401 and MBA 402 and MBA 403 and MBA 404 and MBA 405)
Can be taken Concurrently: MBA 403

Law Courses
LAW 417 Regulatory Environment of Business 2 Credits
This course is designed to provide students with a basic understanding of the various legal, regulatory, and market constraints in which business operates. Students are introduced to the interplay between legislation, regulations, and court decisions in establishing the regulatory environment in which a business operates as well the allocation of power among federal and state authorities. Conflict of law issues will also be explored for businesses that operate internationally. Contract law, forms of business, and ethics are covered in depth.

Management Courses
MGT 416 Managing Talent 3 Credits
The course is fundamentally about understanding and improving the behavior and performance of individuals in the workplace. As such, we will draw upon key theories in organizational behavior to address human resource issues arising from the employment relationship. Topics will address key areas in the talent pipeline from sourcing and selection, training and development, motivation and performance management, talent management metrics and analytics.

MGT 461 Strategic Management 1 Credit
Strategic Management covers overall organizational issues in determination, analysis, execution, and control within a global environment. This capstone course integrates theories and concepts from production, marketing, finance, and accounting and provides an opportunity to simulate the function of top level management as it relates to the total business environment through a team-based business simulation. Through readings, written assignments, presentations, in-depth group discussions, and a team-based simulation competition, students will broaden their understanding and practice the art of strategic decision making.

Marketing Courses
MKT 415 Marketing Foundations 3 Credits
This course is designed to provide students with a comprehensive analytical framework to develop, implement and evaluate competitive marketing strategies that achieve organizational goals and objectives. It explores the functional marketing operations of organizations and examines the key elements of a marketing manager’s decision making process. Examples of learning modules include: customer and market analysis, segmentation, targeting and positioning, marketing mix decisions (product, price, placement and promotion).

Prerequisites: Must have Excel competency
MKT 425 Brand Strategy 2 Credits
This course is fundamentally about understanding how Brand Equity is built and managed. The course builds on the marketing principles and theories covered in Marketing Foundations, while enabling students to delve into the strategic components that go into building brands and managing brand equity. The course focuses on theories, models and tools that enable managers to develop new and manage existing brands.
Prerequisites: MKT 415

Masters Accounting Courses
MACC 412 IT Auditing 3 Credits
Addresses internal control and audit issues in an Information Technology (IT) environment, structured around the COSO internal control framework. Audit procedures for the review of IT general and application controls are examined. Students perform substantive tests on financial databases using audit software. Topics covered: Internal controls in centralized and distributed IT environments, IT outsourcing, IT governance, Data modeling, network and database security ACL software, SAP process and control issues.

MACC 413 The Corporate Financial Reporting Environment 3 Credits
This course addresses the nature of corporate financial reporting, its role in providing decision-useful information to capital market participants, standard-setting and the FASB conceptual framework, and theoretical and empirical assessments of its performance.

MACC 420 Forensic Accounting and Auditing 3 Credits
This course focuses on forensic skills to enhance audits and other services rendered by accounting professionals. Materials derived primarily from SEC cases to help students understand more complex financial reporting issues such as earnings management and fraud, apply auditing requirements of SAS 99 and Sarbanes-Oxley dealing with fraud, comprehend services beyond the audit which rely on forensic skills, and demonstrate knowledge through role plays in real world scenarios.
Prerequisites: ACCT 320 or BUA2 and MACC 401 and MACC 402 and MACC 403

MACC 424 Governance, Risk and Control 3 Credits
This course focuses on developing in students an understanding of corporate governance, risk oversight and internal control monitoring from an accounting professional’s perspective. Topics include agency theory, fundamentals of corporate governance, risk and internal control, functions of the board of directors and the audit committee, independent auditor and impediments to audit quality, internal auditor’s role, and SEC regulations and laws impacting governance, risk and control. Class discussions, interactive group exercises, role plays, field projects, and real-life cases are used.
Prerequisites: ACCT 320 or BUA2 and MACC 401 and MACC 402 and MACC 403

MACC 427 Reporting and Auditing Fair Value Estimates 3 Credits
Explores the theory and mechanics of financial reporting of assets and liabilities presented at fair value. The course focuses on U.S. GAAP standards relating to the recognition, measurement, valuation, and disclosure of fair value in financial statements. The course also examines management incentives in reporting and issues faced by auditors in providing assurance regarding these estimates.

Project Management Courses
PMGT 409 Project Management Fundamentals 3 Credits
Introduction to project management – survey of the knowledge areas and approaches to managing projects. Looks at the relationship of projects to organizational strategy and culture, how to initiate a project, principles of planning and project execution and control, managing stakeholders, and communicating effectively. A review of the competencies required to address the complexities and challenges of projects. Hands-on approach to developing project management work artifacts and simulated project management game are used.

PMGT 410 Project Requirements and Scope Management 1 Credit
Focuses on understanding the principles and nuances of managing project and product scope: the boundaries of inclusion and exclusion of the product – its features and functions, and of the project – the work involved to create the project’s product. Addresses the methods for eliciting and managing product and project requirements, defining the project scope, creating a scope baseline, and managing changes to control scope creep.
Prerequisites: PMGT 409
Can be taken Concurrently: PMGT 409

PMGT 411 Project Scheduling, Estimating & Budgeting 1 Credit
This course explores the methods and challenges of developing project estimates, schedules, and budgets. Expectations about project timelines and costs cause a great deal of friction and frustration in projects. In this course students will learn how to build a schedule using the critical path method, methods for resource loading, developing contingency reserves, and time and cost estimates. They will also learn how to present schedule information to manage expectations and deal with slips when they occur.
Prerequisites: PMGT 409 and PMGT 410
Can be taken Concurrently: PMGT 409, PMGT 410

PMGT 412 Advanced Scheduling & Scheduling Tools 1 Credit
This course deals with developing a schedule in MS Project in a hands-on class. Students will learn to build a fully resource loaded, networked, and baselined schedule in MS Project, and how to manage from that schedule. Students will also explore the principles of critical chain scheduling, dealing with risks in schedules, and using the schedule to forecast outcomes and communicate effectively with stakeholders about time expectations.
Prerequisites: PMGT 409 and PMGT 410 and PMGT 411

PMGT 413 Project Risk Management 1 Credit
As projects always involve a new and unique endeavor to the performing organization, uncertainty is a part of every project. Effective project management prepares for the risks - both jeopardies and opportunities - presented by these uncertainties. In this class we will explore both the classic and some more advanced methods for dealing with project risks.
Prerequisites: PMGT 409 and PMGT 410
Can be taken Concurrently: PMGT 409, PMGT 410

PMGT 414 Managing Project Quality 1 Credit
Students will explore the key concepts of quality management and how they apply in projects. This class discusses the use of the quality management tools and methods, practices for holding quality reviews, and for developing project quality management plans.
Prerequisites: PMGT 409 and PMGT 410
Can be taken Concurrently: PMGT 409, PMGT 410

PMGT 415 Project Procurement & Negotiation 1 Credit
This course focuses on the tools and practices used in managing procurement on projects, and best practices for negotiation and supplier management. It explores the role of the contract, types of contracts, developing the statement of work, RFP, screening & selection criteria, and the procurement management plan. It also looks at how to manage contractors throughout the project.
Prerequisites: PMGT 409 and PMGT 410
Can be taken Concurrently: PMGT 409, PMGT 410

PMGT 416 Decision Making and Ethics on Projects 1 Credit
This class looks at the factors and processes for making effective and ethical decisions on projects. The unknowns, complexities, time and cost pressures, and cross-functional stakeholders make good decision-making imperative for both long-term and short-term success. Students will use a variety of tools and techniques for team decision-making. Class includes a role-play game based on the Challenger accident to explore issues.
Prerequisites: PMGT 409
Can be taken Concurrently: PMGT 409
The business information systems field is vibrant and exciting. There are a broad range of employment opportunities. Successful completion of the BIS program would invite students to pursue a wide range of career opportunities, including careers as a systems analyst/designer, information systems manager, information systems project manager, and information systems consultant.

The Business Information Systems major requires four (4) courses and two (2) electives beyond the core requirements of the College of Business and Economics. Students are required to take BIS 111, Introduction to Information Systems, as part of the business and economics core. Other courses are as follows:

**Required Courses**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIS 311</td>
<td>Managing Information Systems</td>
<td>3</td>
</tr>
<tr>
<td>BIS 324</td>
<td>Business Data Management</td>
<td>3</td>
</tr>
<tr>
<td>BIS 335</td>
<td>Application Development for Business</td>
<td>3</td>
</tr>
<tr>
<td>BIS 350</td>
<td>Project Management</td>
<td>3</td>
</tr>
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**Elective Courses**

Select two of the following:

<table>
<thead>
<tr>
<th>Course</th>
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</thead>
<tbody>
<tr>
<td>ACCT 311</td>
<td>Accounting Information Systems</td>
<td>3</td>
</tr>
<tr>
<td>BIS 333</td>
<td>Enterprise Security and Risk Management</td>
<td>3</td>
</tr>
<tr>
<td>BIS 342</td>
<td>e-Business Enterprise Applications</td>
<td></td>
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<tr>
<td>or SCM 342</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIS 348</td>
<td>Predictive Analytics in Business</td>
<td></td>
</tr>
<tr>
<td>BIS 372</td>
<td>Special Topics in Information Systems</td>
<td></td>
</tr>
</tbody>
</table>

**Total Credits**: 18

1. Courses focusing on different applications of IS in business, including: Data Warehousing and Mining, HR Applications in IS, Numerical Methods of Business Decisions, etc. Consult Professor Ridings for other related courses.

**Business Information Systems Minor**

This minor provides an overview of the major technical functions in IS, such as design of systems and the development and management of databases. In addition, the student explores the applications of IS to business problems in one of several electives. This minor is available only to students with a declared major in the College of Business and Economics.

Program of Studies: The BIS minor consists of 3 courses equaling 9 credit hours. These credit hours consist of the following courses:

**Required Courses**

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</tr>
<tr>
<td>BIS 333</td>
<td>Enterprise Security and Risk Management</td>
<td></td>
</tr>
</tbody>
</table>

**Total Credits**: 9

**Courses**

**BIS 111 Introduction to Information Systems 3 Credits**

This course examines the fundamental role of information systems in supporting and managing all business functions and enabling firms to compete effectively. Both technical and managerial aspects of information systems are introduced. The course integrates technical infrastructure, database concepts, management decision-making, and business process issues critical to the understanding of operational and strategic information systems. It introduces business applications that support accounting, finance, supply chain management, and marketing.

**Prerequisites**: Must have Excel competency
BIS 300 Apprentice Teaching 1-4 Credits
BIS 311 Managing Information Systems Analysis and Design 3 Credits
This course focuses on managing the requirements analysis and system design methodology and techniques for business information systems. Students learn current methods and techniques for system requirement analysis as well as system design, and apply them to real world projects. It covers cost benefit analysis and risk management of business systems development, JAD and structured walkthroughs, structured and object oriented methodologies, and software package evaluation. It emphasizes the factors for effective communication and integration with users and user systems and encourages interpersonal skills development with client users, team members, and others associated with development, operation, and maintenance of the system.
Prerequisites: ACCT 311 or CSB 311 or BIS 111

BIS 324 Business Data Management 3 Credits
This course covers the fundamentals of database management systems (DBMS), including database development, processing, logical and physical design, access, implementation and administration. Students will gain extensive experience in developing data models, creating relational databases, and formulating and executing complex queries. The focus in the course will be on analyzing the connections between data and business organizational information needs and decisions, and understanding the principles of managing organizational data. The course includes a project with hands-on experience with a large scale database and SQL.
Prerequisites: BIS 311

BIS 333 Enterprise Security and Risk Management 3 Credits
This course explores the management of enterprise IT solutions. The focus is on the management of applications and infrastructure security. Students will be introduced to frameworks for infrastructure management, system administration, critical security principles that enable them to plan, develop, and perform security tasks. The course will address hardware, software, processes, communications, applications, and policies and procedures with respect to enterprise IT Security and Risk Management. These topics are addressed both within and beyond the organization, with attention paid to managing risk and security within audit and compliance standards.
Prerequisites: BIS 111

BIS 335 Application Development for Business 3 Credits
This course provides an introduction to planning, designing, developing and maintenance of high quality computer applications that solve business problems. Students will learn basic systems development and computer programming concepts by designing, coding, and testing in an object oriented computer language. Emphasis will be placed on learning introductory programming concepts, such as declaring variables, control statements, subroutines, functions, and arrays. Additionally, students will develop event-driven graphical user interfaces. Some previous experience with programming helpful but not required.
Prerequisites: BIS 111

BIS 342 (SCM 342) e-Business Enterprise Applications 3 Credits
Introduction to the implications of key information technologies used within and across businesses to conduct e-business. The course covers the functionality of various enterprise applications and their integration: customer relationship management, enterprise resource planning, supply chain management, supplier relationship management, data warehousing and mining, business intelligence, and product lifecycle management.
Prerequisites: BIS 111

BIS 348 Predictive Analytics in Business 3 Credits
The course covers theories and practices in predictive analytics in business. Students will have hands-on experience on analyzing business data for business intelligence and improved business decision making. Includes: key theories, concepts, and models of predictive analytics; and data mining tools to formulate and solve business problems. The course uses data analytics software and real data. Topics include prediction, forecasting, classification, clustering, data-visualization and data reduction techniques. Credits will not be given for both BIS 348 and BIS 448.
Prerequisites: BIS 111 and (ECO 045 or MATH 012 or MATH 231)

BIS 350 (MGT 350) Project Management 3 Credits
Key processes and tenets of project management including scope, time, cost, quality, human resources, communications, risk, procurement, and integration management. Both technical and behavioral aspects of project management are applied within the context of either IS management, HR management, Supply Chain Process Management, Small Business Management. Topics include: expectations management, change management and consulting engagement management. Introduces both software project monitoring tools and project team collaboration techniques and tools. Must have completion of all other courses in either BIS or Management major.
Prerequisites: BIS 335 and BIS 324

BIS 360 Business Information Systems Practicum 3 Credits
The business information systems practicum provides an opportunity for students to work on an intensive consulting engagement with a business. Students work with client firms on individual or team projects, which focus on information systems activities such as developing requirements, designing, and implementing systems. Students complete written reports and make formal presentations to clients. May not be taken concurrently with MGT 311. Cannot be used to satisfy BIS major or minor requirements.

BIS 371 Directed Readings 1-3 Credits
Readings and research information systems; designed for superior students who have special interest in some topic(s) not covered by the regularly scheduled courses. Written term paper(s) required. Must have preparation in information systems acceptable to program coordinator.
Repeat Status: Course may be repeated.

BIS 372 Special Topics in Information Systems 1-3 Credits
Special problems and issues in information systems for which no regularly scheduled course work exists. When offered as group study, coverage varies according to interests of the instructor and students. Must have preparation in information systems acceptable to program coordinator.
Repeat Status: Course may be repeated.

BIS 373 Business Information Systems Internship 1-3 Credits
Based on a student's work experience, a sponsoring faculty member shall direct readings, projects, and other assignments-including a "capstone report." It should be noted that the work experience (at least 80 hours per credit), by itself, is not the basis for academic credit. The faculty directed activity must be provided concurrent with the work. Course registration and related arrangements, including designating a sponsoring faculty member, must be made in advance of the work engagement. This course must be taken Pass/Fail, cannot be used to satisfy BIS major or minor requirements. Declaration of a BIS major or minor, junior standing, and consent of department required.
Prerequisites: BIS 311

BIS 423 Management Information Systems 2 Credits
This course examines the role of information systems (IS) and information technology (IT) in the organization. The focus of the course is the organizational uses of IS and IT to compete effectively. Both technical and managerial aspects of information systems are explored. The course includes technical infrastructure, management decision-making, trends and innovations in IS, and business process issues critical to the understanding of operational and strategic information systems.
Prerequisites: Must have Excel competency

BIS 448 Predictive Analytics in Business 3 Credits
The course covers theories and practices in predictive analytics in business. Students will have hands-on experience on analyzing business data for business intelligence and improved business decision making. Includes: key theories, concepts, and models of predictive analytics; and data mining tools to formulate and solve business problems. The course uses data analytics software and real data. Topics include prediction, forecasting, classification, clustering, data-visualization and data reduction techniques. Credits will not be given for both BIS 348 and BIS 448.

Chemical and Biomolecular Engineering

http://www.lehigh.edu/~inchme/
The Chemical and Biomolecular Engineering Department offers a Bachelor of Science degree in chemical engineering to undergraduate students and offers graduate programs leading to the master of science, master of engineering, and doctor of philosophy degrees in Chemical Engineering, and master of engineering degrees in Biological Chemical Engineering and Chemical Energy Engineering.

Modern chemical engineering is built around the fundamental enabling sciences of biology, chemistry, physics, and mathematics. Its curriculum encompasses three basic organizing principles: Molecular Transformations, Multi-scale Analysis, and System Approaches. Chemical engineers serve a wide variety of technical and managerial functions within the chemical processing industry. For a lifetime of effectiveness they need a sound background in the fundamental sciences of chemistry and physics; a working capability with mathematics, numerical methods, and application of computer solutions; and a broad education in humanities, social sciences, and managerial techniques. These bases are applied in a sequence of chemical engineering courses in which logic and mathematical manipulation are applied to chemical processing problems. With the resulting habits of precise thought coupled to a broad base in scientific and general education, Lehigh graduates have been effective throughout industry and in advanced professional educations. No effort is made toward any specific industry, but adaptation is rapid and the fundamental understanding forms the base for an expanding career.

The program is also designed to prepare a student for graduate study in chemical and biomolecular engineering. Further study at the graduate level leading to advanced degrees is highly desirable if an individual wishes to participate in the technical development of the field. The increasing complexity of modern manufacturing methods requires superior education for men and women working in research, development, and the design fields or for teaching.

PHYSICAL FACILITIES
The Chemical and Biomolecular Engineering Department is the only engineering department located on Lehigh's 780 acres Mountaintop Campus. Here the department occupies approximately one-third of Iacocca Hall, the 200,000-square-foot flagship building that contains offices, classrooms, and laboratories. Additional plant facilities, and the undergraduate chemical processing laboratory occupy approximately 10,000-square-feet in the nearby Imbt building.

These facilities provide excellent support for a wide range of general and special laboratory equipment for undergraduate and graduate studies of the behavior of typical chemical processing units; bioengineering research; nanotechnology; energy; biochemical engineering; polymers; digital computation for process dynamics research; and study of thermodynamics, kinetics, heat transfer, and mass transfer.

The chemical engineering department has established a senior design laboratory in Iacocca Hall featuring 35 PCs, which is dedicated to undergraduate process design courses.

Professors. Hugo S. Caram, PhD (University of Minnesota); Manoj K. Chaudhury, PhD (University at Buffalo, SUNY); Mohamed S El-Aasser, PhD (McGill University); Tsai-An Hsu, PhD (Northwestern University); Anand Jagota, PhD (Cornell University); Christopher J. Kiely, PhD (University of Bristol); Mayuresh V. Kothare, PhD (California Institute of Technology); William L. Luyben, PhD (University of Delaware); Anthony J. McHugh, PhD (University of Delaware); Cesar A. Silebi, PhD (Lehigh University); Israel E. Wachs, PhD (Stanford University)

Associate Professors. Bryan W. Berger, PhD (University of Delaware); Javier Buceta Fernandez, PhD (National University of Distance Education); James F. Gilchrist, PhD (Northwestern University); Steven Mcintosh, PhD (University of Pennsylvania); Jeetain Mittal, PhD (University Texas, Austin); Mark A Snyder, PhD (University of Delaware)

Assistant Professors. Jonas Baltrusaitis, PhD (University of Iowa); Angela C Brown, PhD (Drexel University); Kelly Schultz, PhD (University of Delaware)

Professors Of Practice. Vincent G. Grassi, PhD (Lehigh University); Lori Herz, PhD (Rutgers University); Susan Fueshko Perry, PhD (The Pennsylvania State University); Kemal Tuzla, PhD (Istanbul Technical University)

Emeriti. Marvin Charles, PhD (Polytechnic University); Arthur E. Humphrey, PhD (Columbia University); William E. Schiesser, PhD (Princeton University); Fred P. Stein, PhD (University of Michigan Ann Arbor)

UNDERGRADUATE PROGRAM
The mission of the undergraduate program is “to educate students in the scientific principles of chemical and biomolecular engineering and provide opportunities to explore their applications in the context of a humanistic education that prepares them to address technological and societal challenges.”

PROGRAM EDUCATIONAL OBJECTIVES
To achieve its educational mission, the Department of Chemical and Biomolecular Engineering has established the following set of Program Educational Objectives: Graduates of the Undergraduate Program in Chemical Engineering will:

1. Apply their broad education in chemical engineering to pursue careers in industry, government agencies, consulting firms, educational institutions, financial institutions, business, law, and medicine.
2. Pursue graduate studies, research, or continuing education.
3. Be sensitive to the social, ethical, and technical implications of their work as it affects the environment, safety, and health of citizens worldwide.

MINOR IN BIOTECHNOLOGY
The department of Chemical and Biomolecular Engineering encourages engineering undergraduates to broaden their education by taking a minor. In this regard, a Biotechnology Minor is offered to students majoring in Engineering College. The Biotechnology minor requires 16 credit hours. A detailed listing of the required courses for the Biotechnology Minor can be obtained from the Chemical and Biomolecular Engineering Department.

MINOR IN CHEMICAL ENGINEERING
Minoring in Chemical Engineering provides students both bio-molecular and chemical engineering knowledge that they do not acquire in their major, such as knowledge of bio-chemical systems, transport phenomena, reaction engineering. This will widen their skills and help to increase the cooperation between the disciplines, which will lead to increased possibilities for employment. For further information please contact the department.

CAREER OPPORTUNITIES
Chemical engineers play important roles in all activities bearing on the chemical process industry. These include the functions of research, development, design, plant construction, plant operation and management, corporate planning, technical sales, and market analysis.

The industries that produce chemical and/or certain physical changes in fluids, including petroleum and petrochemicals, rubbers and polymers, pharmaceuticals, bioengineering, metals, industrial and fine chemicals, foods, and industrial gases, have found chemical engineers to be vital to their success. Chemical engineers are also important participants in pollution abatement, energy resources, national defense programs, and more recently in the manufacture of microelectronic devices and integrated circuits.

SPECIAL PROGRAMS AND OPPORTUNITIES
Co-op Program
The department, in conjunction with the P.C. Rossin College of Engineering and Applied Science, operates a cooperative program that is optional for specially selected students who are entering their junior year. This program offers early exposure to industry and an opportunity to integrate an academic background with significant periods of engineering practice. Our program is unique in offering two work experiences and still allowing the co-op students to graduate in four years with their class.

OSI Program
The Opportunities for Student Innovation (OSI) program seeks to develop students’ propensities for critical assessment and innovative solution of meaningful problems. The OSI program offers selected seniors an opportunity to experience team research leading toward technological benefits. Some projects are hosted by industrial
companies and carried out under the supervision of a Lehigh faculty members.

**Minors and Specializations**

Technical minors are available in biotechnology, energy engineering, computer science, environmental engineering, manufacturing systems, materials science and engineering, and polymer science and engineering. Minors are also available from the Business College and the College of Arts and Sciences.

**Overseas**

Study abroad is available in exchange programs that have been established by the department for the junior year at the University of Nottingham (United Kingdom) and for the summer following the junior year at the University of Dortmund (Germany). Please visit http://www.aae.tu-dortmund.de/cms/en/international_Students/International_Summer_Program__ISP_/index.html

**Requirements of the Major**

131 credit hours are required for graduation with the degree of bachelor of science in chemical engineering.

### First Year

<table>
<thead>
<tr>
<th>Semester</th>
<th>First Semester</th>
<th>Credits</th>
<th>Second Semester</th>
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<td>3</td>
<td>MATH 021</td>
<td>4 MATH 022</td>
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<td>2 ENGR 010 or ECO 001</td>
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<td>PHY 011 &amp; PHY 012</td>
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<td>PHY 011 &amp; PHY 012</td>
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<td>-</td>
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### Second Year

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<th>Credits</th>
<th>Second Semester</th>
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<tr>
<td>CHE 031</td>
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<td>3</td>
<td>CHM 031</td>
<td>4 CHE 210</td>
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<tr>
<td>PHY 021</td>
<td>5 CHE 179 &amp; PHY 022</td>
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### Third Year

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<td>CHE 201</td>
<td>4 CHE 211</td>
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<tr>
<td>CHM 110 &amp; CHM 111</td>
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<td>CHM 341</td>
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### Fourth Year

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<th>Second Semester</th>
<th>Credits</th>
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<tr>
<td>CHE 202</td>
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<td>CHE 233</td>
<td>3 ECE 083</td>
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<tr>
<td>CHE 242</td>
<td>3 CHE 234</td>
<td>3</td>
<td>Electives</td>
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<tr>
<td><strong>Total Credits:</strong></td>
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<td>16</td>
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</table>

There are six types of electives:

1. Humanities/Social Sciences: See the requirements (p. 61) set by the P.C. Rossin College of Engineering and Applied Science. Note that ECO 001 is required, as well as Freshman English.
2. Bio-Elective: Students must have AP BIOS credits or must pick one from BIOS 041, BIOE 321, BIOE 349, CHE 341, CHE 395 or CHM 371.
3. Three credit hours from approved courses in other engineering departments (BioE, CEE, CSE, ECE, ISE, MEM, M SE).
4. Chemistry: 3 credit hours of CHEM 300-level or higher, or CHE 380.
5. Chemical Engineering: 3 credit hours of CHE 300 level or higher.
6. Free electives: 6 credit hours in any subject area.

Electives in (2) to (5) above can be combined with any technical minor in RCEAS.

**GRADUATE PROGRAMS**

The Department of Chemical and Biomolecular Engineering offers graduate programs leading to the master of science, master of engineering, and doctor of philosophy degrees in Chemical Engineering and master of engineering degree in Chemical Engineering, Biological Chemical Engineering, and Chemical Energy Engineering. The programs are all custom tailored for individual student needs and professional goals. These individual programs are made possible by a diversity of faculty interests that are broadened and reinforced by cooperation between the department and several research centers on the campus.

A free flow of personnel and ideas between the centers and academic departments ensures that the student will have the widest choice of research activities. The student is also exposed to a wide range of ideas and information through courses and seminars to which both faculty and center personnel contribute. In addition, strong relationships with industry are maintained by the department and the research centers, some of which operate industrially-sponsored liaison programs whereby fundamental non-proprietary research is performed in areas of specific interest to participating sponsors.

While the department has interacted with most of the centers on campus, it has had unusually strong and continuing liaisons with Emulsion Polymers Institute, Process Modeling and Control Research Center, and Materials Research Center. The Department also has a strong relation with the Bioengineering Program.

In addition to interacting with the centers, the department originates and encourages programs that range from those that are classical chemical engineering to those that are distinctly interdisciplinary. The department offers active and growing programs in adhesion and tribology; emulsion polymerization and latex technology; bulk polymer systems; process improvement studies; rheology; computer applications; environmental engineering; thermodynamics; kinetics and catalysis; enzyme technology; and biochemical engineering.

**Career Opportunities**

Master of science, master of engineering, and doctor of philosophy graduates in the chemical engineering area are sought by industry for activities in the more technical aspects of their operations, especially design, process and product development, and research. Many of these graduates also find opportunities in research or project work in government agencies and in university teaching and research.

**Physical Facilities**

The department is well equipped for research in bioengineering, nanotechnology, energy, colloids and surface science, adhesion and tribology, polymer science and engineering, catalysis and reaction kinetics, thermodynamic property studies, fluid dynamics, heat and mass transfer, process dynamics and control, and enzyme engineering and biochemical engineering.

The departmental and university computing facilities include PCs and workstations, connected by a university-wide high speed network, which in turn provides worldwide networking via the Internet.

All of these facilities can access a wide variety of general purpose, and scientific and engineering software via the university and local networks, including software specifically for the steady state and dynamic simulation of chemical engineering systems. The networks are
CHE 017 Materials and Energy Balances of Chemical Processes 3 Credits
Material and energy balances with and without chemical reaction. Introduction to phase equilibrium calculations. Applications in chemical process calculations and in design of staged separations: binary distillation, liquid-liquid extraction. Plant trips and special lectures introducing the profession.
Prerequisites: CHE 031 and CHE 044
Can be taken Concurrently: CHE 044

CHE 044 Fluid Mechanics 3 Credits

CHE 085 Undergraduate Research 1 Credit
Independent study of a problem involving laboratory investigation, design, or theoretical studies under the guidance of a faculty. Consent of the department chair.
Repeat Status: Course may be repeated.

CHE 151 Introduction to Heat Transfer 0.3 Credits
Fundamental principles of heat transfer. Fourier's law, conduction, convection and radiation. Analysis of steady and unsteady state heat transfer. Evaporation and condensation. Applications to the analysis and design of chemical processing units involving heat transfer.
Prerequisites: CHE 031 and CHE 044

CHE 171 (CEE 171, EMC 171, ES 171) Fundamentals of Environmental Technology 4 Credits
Introduction to water and air quality, water, air and soil pollution. Chemistry of common pollutants. Technologies for water purification, wastewater treatment, solid and hazardous waste management, environmental remediation, and air quality control. Global changes, energy and environment. Constraints of environmental protection on technology development and applications. Constraints of economic development on environmental quality. Environmental life cycle analysis and environmental policy. Not available to students in RCEAS.

CHE 179 Professional Development 1 Credit
Elements of professional growth, registration, ethics, and the responsibilities of engineers both as employees and as independent practitioners. Proprietary information and its handling. Patents and their importance. Discussions with the staff and with visiting Lecturers. A few plant trips.

CHE 185 Undergraduate Research I 1-3 Credits
Independent study of a problem involving laboratory investigation, design, or theoretical studies under the guidance of a faculty member.
Repeat Status: Course may be repeated.

CHE 186 Undergraduate Research II 1-3 Credits
A continuation of the project begun under CHE 185. Consent of department chair.
Repeat Status: Course may be repeated.
Prerequisites: CHE 185

CHE 201 Methods of Analysis in Chemical Engineering 4 Credits
Analytical and numerical methods of solution applied to dynamic, discrete and continuous chemical engineering processes. Laplace Transforms. MATLAB based computations. Methods of analysis applied to equilibrium, characteristic value and non-linear chemical engineering problems.
Prerequisites: CHE 044 and CHE 210 and MATH 023 and MATH 205
Can be taken Concurrently: MATH 205

CHE 202 Chemical Engineering Lab I 3 Credits
The laboratory study of chemical engineering unit operations and the reporting of technical results. One three-hour laboratory and one lecture period per week. Independent study and both group and individual reporting.
Prerequisites: CHE 151 and CHE 211 and CHE 244

CHE 203 Chemical Engineering Laboratory II 2 Credits
Laboratory experience with more complex chemical processing situations including processes involving chemical reactions and those controlled automatically.
Prerequisites: CHE 202

CHE 210 Chemical Engineering Thermodynamics 4 Credits
Prerequisites: CHE 031

CHE 211 Chemical Reactor Design 3 Credits
The theory of chemical kinetics to the design and operation of chemical reactors. Plug flow and continuous stirred tank reactors. Homogeneous and heterogeneous reaction kinetics. Design of isothermal and adiabatic reactors.
Prerequisites: CHE 210
CHE 233 Process Design I 0,3 Credits
Design of chemical plants incorporating traditional elements of engineering economics and synthesis of steady-state flowsheets with (1) both heuristic and rigorous optimization methods and (2) consideration of dynamic controllability of the process. Economic principles involved in the selection of process alternatives and determination of process capital, operating costs, and venture profitability. Energy conservation, pinch techniques, heat exchanger networks, and separation sequences. Considerations of market limitations, environmental and regulatory restrictions, and process safety. Use of modern computer aided software for steady-state and dynamic simulation and optimization. Group design projects.
**Prerequisites:** (CHE 211 and CHE 242 and CHE 244)
**Can be taken Concurrently:** CHE 242

CHE 234 Process Design II 3 Credits
Continuation of CHE 233.
**Prerequisites:** CHE 233
**Can be taken Concurrently:** CHE 233

CHE 242 Introduction to Process Control and Simulation 3 Credits
**Prerequisites:** (CHE 201 and CHE 151) and (ENGR 001 or ENGR 097)

CHE 244 Mass Transfer and Separation Processes 3 Credits
**Prerequisites:** CHE 031 and CHE 044 and CHE 210

CHE 280 Unit Operations Survey 3 Credits
The theory of heat, mass and momentum transport. Laminar and turbulent flow of real fluids. Heat transfer by convection, conduction and radiation. Application to a wide range of operations in the chemical and metallurgical process industries.

CHE 281 Chemical Engineering Fundamentals I 4 Credits
Fundamentals of material balances, fluid mechanics and heat transfer. Must have undergraduate degree in a scientific or engineering discipline or one semester undergraduate level general chemistry, one semester undergraduate level physics (statics and dynamics), and two semesters undergraduate calculus. Consent of department required.

CHE 282 Chemical Engineering Fundamentals II 4 Credits
Fundamentals of heat and mass transfer, process energy balances and unit operations. Consent of department required.
**Prerequisites:** CHE 281

CHE 300 Apprentice Teaching 1-4 Credits
Repeat Status: Course may be repeated.

CHE 306 Introduction to Biomedical Engineering and Mathematical Biology 3 Credits
**Prerequisites:** MATH 205

CHE 321 Biomolecular & Cellular Mechanics 3 Credits
Mechanics and physics of the components of the cell, ranging in length scale from fundamental biomolecules to the entire cell. The course covers the mechanics of proteins and other biopolymers in 1D, 2D, and 3D structures, cell membrane structure and dynamics, and the mechanics of the whole cell.
**Prerequisites:** MATH 205 and MATH 231 and PHY 022 and (PHY 013 or PHY 021)

CHE 331 Separation Processes 3 Credits

CHE 334 (MAT 334) Electron Microscopy and Microanalysis 4 Credits
Fundamentals and experimental methods in electron optical techniques including scanning electron microscopy (SEM), conventional transmission (TEM) and scanning transmission (STEM) electron microscopy. Specific topics covered will include electron optics, electron beam interactions with solids, electron diffraction and chemical microanalysis. Applications to the study of the structure of materials are given. Consent of department required.

CHE 339 Neuronal Modeling and Computation 3 Credits
Neuroscience in a computational, mathematical, and engineering framework. Literature surveys and case studies with simulations. Computational aspects of information processing within the nervous system by focusing on single neuron modeling. Single neurons and how their biological properties relate to neuronal coding. Biophysics of single neurons, signal detection and signal reconstruction, information theory, population coding and temporal coding.
**Prerequisites:** ENGR 001 and MATH 205

CHE 341 (BIOE 341) Biotechnology I 3 Credits
Applications of material and energy balances; heat, mass, and momentum transfer; enzyme and microbial kinetics; and mathematical modeling to the engineering design and scale-up of bio-reactor systems. Consent of instructor required. Closed to students who have taken CHE 441 (BIOE 341 and BIOE 441).
**Prerequisites:** MATH 205 and CHE 031 and CHM 031

CHE 342 (BIOE 342) Biotechnology II 3 Credits
Engineering design and analysis of the unit operations used in the recovery and purification of products manufactured by the biotechnology industries. Requirements for product finishing and waste handling will be addressed. Consent of instructor required. Closed to students who have taken CHE 442 (BIOE 342 and BIOE 442).
**Prerequisites:** CHE 031 and CHM 031

CHE 344 (BIOE 344) Molecular Bioengineering 3 Credits
Kinetics in small systems, stochastic simulation of biochemical processes, receptor-mediated adhesion, dynamics of ion-channels, ligand binding, biochemical transport, surface Plasmon resonance, DNA microarray design, and chemical approaches to systems biology. Senior standing in CHE.
**Prerequisites:** MATH 205 and MATH 231

CHE 345 (BIOE 345) Quantitative Biology 3 Credits
Basic concepts in molecular and cellular biology as well as biochemistry. Connects these to engineering principles in order to (1) develop a quantitative understanding of biological systems and (2) understand how applications of methods and principles in biology are used in modern engineering. Topics include protein structure and function, enzymology, membrane transport and trafficking, transcription/translation, signal transduction and models for cellular processes. An important part of this course is also taking topics discussed in lecture and translating them into practice.
**Prerequisites:** MATH 205

CHE 346 Biochemical Engineering Laboratory 3 Credits
Laboratory and pilot-scale experiments in fermentation and enzyme technology, tissue culture, and separations techniques. Consent of instructor required. Closed to students who have taken CHE 446.
**Prerequisites:** CHE 341
**Can be taken Concurrently:** CHE 341

CHE 350 Special Topics 1-3 Credits
A study of areas in chemical engineering not covered in courses presently listed in the catalog.
**Repeat Status:** Course may be repeated.
CHE 373 (CEE 373) Fundamentals of Air Pollution 3 Credits
Introduction to the problems of air pollution including such topics as: sources and dispersion of pollutants; sampling and analysis; technology of economics and control processes; legislation and standards. Must have senior standing in the College of Engineering and Applied Science.

CHE 374 Environmental Catalysis 3 Credits
Pollution emissions in the USA (NOx, SOx, NH3, CO, VOCs, PM, heavy metals and persistent bioaccumulative chemicals) and their sources and fate. Fundamental concepts of catalysis (surface and their characterization, physical adsorption, surface reaction mechanisms and their kinetics). Application of catalysis to a wide range of environmental issues (catalytic combustion of VOCs, automotive catalytic converter, selective catalytic conversion of NOx, etc.) Must have senior standing. Consent of instructor required.

CHE 375 (CEE 375) Environmental Engineering Processes 3 Credits
Processes applied in environmental engineering for air pollution control, treatment of drinking water, municipal wastewater, industrial wastes, hazardous/toxic wastes, and environmental remediation. Kinetics, reactor theory, mass balances, application of fundamental physical, chemical and biological principles to analysis and design.

Prerequisites: CEE 170

CHE 376 (ME 376) Energy: Issues & Technology 3 Credits
Energy usage and supply, fossil fuel technologies, renewable energy alternatives and environmental impacts. The scope will be broad to give some perspective of the problems, but in-depth technical analysis of many aspects will also be developed. Must have college-level introductory courses in chemistry, physics and mathematics. Consent of instructor required.

CHE 377 Electrochemical Engineering 3 Credits
Fundamental concepts of electrochemistry, covering the thermodynamics, kinetics, and transport phenomena that occur in both liquid and solid state electrochemical systems. This course draws upon concepts from physical chemistry, chemical engineering and materials science to address the phenomena that govern the performance of electrochemical devices, and that drive important engineering phenomena such as corrosion. The course will serve as a basis for a career in electrochemistry as it applies to energy issues. Prerequisites: Senior level in CHE or instructor approval.

CHE 380 Senior Research Project (OSI) 1-6 Credits
Independent study of a problem involving laboratory investigation, design, and theory, when possible involves one of the local communities or industries. Team work under the guidance of Faculty advisors. Experiential learning opportunity to bridge educational gap between conventional textbook learning and industrial approaches to real-world technical problem solving. Must have senior standing. Consent of department required.

Repeat Status: Course may be repeated.

CHE 383 Chemical Engineering Fundamentals III 4 Credits
Fundamentals of thermodynamics, reaction kinetics and reactor analysis, and applied mathematics. Consent of department required. Cannot apply towards a Chemical Engineering undergraduate degree.

Prerequisites: CHE 282

CHE 386 Process Control 3 Credits
Open-loop and closed-loop stability analysis using root locus and Nyquist techniques, design of feedback controllers with time and frequency domain specifications. Experimental process identification. Control of multivariable processes. Introduction to sampled-data control theory.

Prerequisites: CHE 242

CHE 387 (ECE 387, ME 387) Digital Control 3 Credits
Sampled-data systems; z-transforms; pulse transfer functions; stability in the z-plane; root locus and frequency response design methods; minimal prototype design; digital control hardware; discrete state variables; state transition matrix; Liapunov stability state feedback control (2 lectures and one laboratory per week).

Prerequisites: CHE 386 or ECE 212 or ME 343

CHE 388 (CHM 388, MAT 388) Polymer Synthesis and Characterization Laboratory 3 Credits
Techniques include: free radical and condensation polymerization; molecular weight distribution by gel chromatography; crystallinity and order by differential scanning calorimetry; pyrolysis and gas chromatography; dynamic mechanical and dielectric behavior; morphology and microscropy: surface properties. Must have senior level standing in CHE, CHM or MAT.

Prerequisites: CHM 341 and CHM 110

CHE 389 (ECE 389, ME 389) Control Systems Laboratory 2 Credits
Experiments on a variety of mechanical, electrical and chemical dynamic control systems. Exposure to state-of-the-art control instrumentation: sensors, transmitters, control valves, analog and digital controllers. Emphasis on comparison of theoretical computer simulation predictions with actual experimental data. Lab teams will be interdisciplinary.

Prerequisites: CHE 242 or ECE 212 or ME 343

CHE 391 (CHM 391) Colloid and Surface Chemistry 3 Credits
Physical chemistry of everyday phenomena. Intermolecular forces and electrostatic phenomena at interfaces, boundary tensions and films at interfaces, mass and charge transport in colloidal suspensions, electrostatic and London forces in disperse systems, gas adsorption and heterogeneous catalysis. Consent of instructor required.

CHE 392 Introduction to Polymer Science 3 Credits
Introduction to concepts of polymer science. Kinetics and mechanism of polymerization, synthesis and processing of polymers, characterization. Relationship of molecular conformation, structure and morphology to physical and mechanical properties.

Prerequisites: CHM 342

CHE 393 (CHM 393, MAT 393) Physical Polymer Science 3 Credits
Structural and physical aspects of polymers (organic, inorganic, natural). Molecular and atomic basis for polymer properties and behavior. Characteristics of glassy, crystalline, and paracrystal-line states (including viscoelastic and relaxation behavior) for single-and multi-component systems. Thermodynamics and kinetics of transition phenomena. Structure, morphology, and behavior. Must have senior level standing in CHE, CHEM, or MAT.

CHE 394 (CHM 394) Organic Polymer Science I 3 Credits
Organic chemistry of synthetic high polymers. Polymer nomenclature, properties, and applications. Functionality and reactivity of monomers and polymers. Mechanism and kinetics of step-growth and chain-growth polymerization in homogenous and heterogenous media. Brief description of emulsion polymerization, ionic polymerization, and copolymerization. Must have completed one year of physical chemistry and one year of organic chemistry.

CHE 400 Chemical Engineering Thermodynamics 3 Credits
Applications of thermodynamics in chemical engineering. Topics include energy and entropy, heat effects accompanying solution, flow of compressible fluids, refrigeration including solution cycles, vaporization and condensation processes, and chemical equilibria. Must have completed an introductory course in thermodynamics.

CHE 401 Chemical Engineering Thermodynamics II 3 Credits
A detailed study of the uses of thermodynamics in predicting phase equilibria in solid, liquid, and gaseous systems. Fugacities of gas mixtures, liquid mixtures, and solids. Solution theories; uses of equations of state; high-pressure equilibria.

CHE 410 Chemical Reaction Engineering 3 Credits
The application of chemical kinetics to the engineering design and operation of reactors. Non-isothermal and adiabatic reactions. Homogeneous and heterogeneous catalysis. Residence time distribution in reactors.
CHE 413 Heterogeneous Catalysis and Surface Characterization 3 Credits
History and concepts of heterogeneous catalysis. Surface characterization techniques, and atomic structure of surfaces and adsorbed monolayers. Kinetics of elementary steps (adsorption, desorption, and surface reaction) and overall reactions. Catalysis by metals, metal oxides, and sulfides. Industrial applications of catalysis: selective oxidation, pollution control, ammonia synthesis, hydrogenation of carbon monoxide to synthetic fuels and chemicals, polymerization, hydrotreating, and cracking.

CHE 415 Transport Processes 4 Credits
A combined study of the fundamentals of momentum transport, energy transport and mass transport and the analogies between them. Evaluation of transport coefficients for single and multicomponent systems. Analysis of transport phenomena through the equations of continuity, motion, and energy. 
Prerequisites: CHE 461 or ENGR 452 or CHE 452

CHE 419 (MECH 419) Asymptotic Methods in the Engineering Sciences 3 Credits

CHE 421 (BIOE 421) Biomolecular & Cellular Mechanics 3 Credits
Mechanics and physics of cell components, from fundamental biomolecules to the entire cell. The mechanics of proteins and other biopolymers in 1D, 2D, and 3D structures, cell membrane structure and dynamics, and the mechanics of the whole cell. This course is a graduate version of CHE 321 (BioE/Phy 321). The lecture content will be the same as in CHE 321 (BioE/Phy 321), but students enrolled in CHE 421 (BioE 421) will have more advanced assignments. Closed to students who have completed CHE 321 (BioE/Phy 321). Must have graduate standing or consent of instructor.

CHE 428 Rheology 3 Credits
An intensive study of momentum transfer in elastic viscous liquids. Rheological behavior of solution and bulk phase polymers with emphasis on the effect of molecular weight, molecular weight distribution and branching. Derivation of constitutive equations based on both molecular theories and continuum mechanics principles. Application of the momentum equation and selected constitutive equations to geometries associated with viscometric flows. Consent of instructor required.
Prerequisites: CHE 461 or CHE 452

CHE 430 Mass Transfer 3 Credits
Theory and developments of the basic diffusion and mass transfer equations and transfer coefficients including simultaneous heat and mass transfer, chemical reaction and dispersion effects. Applications to various industrially important operations including continuous contact mass transfer, absorption, humidification, etc. Brief coverage of equilibrium stage operations as applied to absorption and to binary and multicomponent distillation.

CHE 433 (ECE 433, ME 433) State Space Control 3 Credits
State-space methods of feedback control system design and design optimization for invariant and time-varying deterministic, continuous systems; pole positioning, observability, controllability, modal control, observer design, the theory of optimal processes and Pontryagin’s Maximum Principle, the linear quadratic optimal regulator problem, Lyapunov functions and stability theorems, linear optimal open-loop control; introduction to the calculus of variations; introduction to the control of distributed parameter systems. Intended for engineers with a variety of backgrounds. Examples will be drawn from mechanical, electrical and chemical engineering applications.
Prerequisites: CHE 386 or ME 343 or ECE 212

CHE 434 (ECE 434, ME 434) Multivariable Process Control 3 Credits
A state-of-the-art review of multivariable methods of interest to process control applications. Design techniques examined include loop interaction analysis, frequency domain methods (Inverse Nyquist Array, Characteristic Loci and Singular Value Decomposition) feed forward control, internal model control and dynamic matrix control. Special attention is placed on the interaction of process design and process control. Most of the above methods are used to compare the relative performance of intensive and extensive variable control structures.
Prerequisites: CHE 433 or ME 433 or ECE 433

CHE 436 (ECE 436, ME 436) Systems Identification 3 Credits
The determination of model parameters from time history and frequency response data by graphical, deterministic and stochastic methods. Examples and exercises taken from process industries, communications and aerospace testing. Regression, quasilinearization and invariant-imbedding techniques for nonlinear system parameter identification included.

CHE 437 (ECE 437, ME 437) Stochastic Control 3 Credits
Prerequisites: CHE 433 or ME 433 or ECE 433

CHE 438 Process Modeling and Control Seminar 1 Credit
Presentations and discussions on current methods, approaches, and applications. Credit cannot be used for the M.S. degree.

CHE 439 (BIOE 439) Neuronal Modeling and Computation 3 Credits
This course is a graduate version of CHE 339 (BIOE 339). While the lecture content will be the same as the 300-level course, students in the 400-level class will be expected to complete an independent term project. Closed to students who have completed CHE 339 (BIOE 339). Must have graduate standing in Chemical Engineering or Bioengineering.

CHE 440 Chemical Engineering in the Life Sciences 3 Credits
Introduction of important topics in life sciences to chemical engineers. Topics include protein and biomolecule structures and characterization, recombinant DNA technology, immunoaffinity technology, combinatorial chemistry, metabolic engineering, bioinformatics. Must have Bachelor’s degree in science or engineering.

CHE 441 (BIOE 441) Biotechnology I 3 Credits
See the course description listed for CHE 341 (BIOE 341). In order to receive 400-level credits, the student must do an additional, more advanced term project, as defined by the instructor at the beginning of the course. Closed to students who have taken CHE 341 (BIOE 341).

CHE 442 (BIOE 442) Biotechnology II 3 Credits
See the course description listed for CHE 342 (BIOE 342). In order to receive 400-level credits, the student must do an additional, more advanced term project, as defined by the instructor at the beginning of the course. Closed to students who have taken CHE 342 (BIOE 342).

CHE 444 Bioseparations 3 Credits

CHE 446 Biochemical Engineering Laboratory 3 Credits
Laboratory and pilot-scale experiments in fermentation and enzyme technology, tissue culture, and separations techniques. Closed to students who have taken CHE 346.
Prerequisites: CHE 341 or CHE 444 or CHE 342
Can be taken Concurrently: CHE 342

CHE 447 (BIOE 447) Molecular Bioengineering 3 Credits
This course is a graduate version of CHE 344 (BIOE 344). While the lecture content will be the same as the 300-level course, students enrolled in CHE 444 will have more advanced assignments. Closed to students who have completed CHE 344 (BIOE 344).
CHE 448 Topics in Biochemical Engineering 3 Credits
Analysis, discussion, and review of current literature for a topical area of biotechnology. May be repeated for credit with the consent of the instructor. Consent of instructor required.
Repeat Status: Course may be repeated.

CHE 449 (BIOE 449) Metabolic Engineering 3 Credits
Quantitative perspective of cellular metabolism and biochemical pathways. Methods for analyzing stoichiometric and kinetic models, mass balances, flux in reaction networks, and metabolic control. Solving problems using advanced mathematics and computer programming. Closed to students who have completed BIOE 349. Must have graduate standing in Chemical Engineering or Bioengineering.

CHE 450 Special Topics 1-12 Credits
An intensive study of some field of chemical engineering not covered in the more general courses. Credit above three hours is granted only when different material is covered.

CHE 451 Problems in Research 1 Credit
Study and discussion of optimal planning of experiments and analysis of experimental data. Discussion of more common and more difficult techniques in the execution of chemical engineering research.

CHE 452 (ENGR 452) Mathematical Methods in Engineering 3 Credits
Analytical techniques relevant to the engineering sciences are described. Vector spaces; eigenvalues; eigenvectors. Linear ordinary differential equations; diagonalizable and non-diagonalizable systems. Inhomogeneous linear systems; variation of parameters. Non-linear systems; stability; phase plane. Series solutions of linear ordinary differential equations; special functions. Laplace and Fourier transforms; application to partial differential equations and integral equations. Sturm-Liouville theory. Finite Fourier transforms; planar, cylindrical, and spherical geometries.

CHE 453 Teaching Apprentice 1 Credit
Students will work under the guidance of individual Faculty instructors to participate in some of the following teaching tasks: Development of the course syllabus, preparation and grading of homework and exams, holding a recitation and/or lecture section. Must have graduate standing in ChE department.
Repeat Status: Course may be repeated.

CHE 454 Seminar 0-3 Credits
Critical discussion of recent advances in chemical engineering.

CHE 455 Seminar 1-3 Credits
Critical discussion of recent advances in chemical engineering. Credit above one hour is granted only when different material is covered.

CHE 460 Chemical Engineering Project 1-6 Credits
An intensive study of one or more areas of chemical engineering, with emphasis on engineering design and applications. A written report is required.
Repeat Status: Course may be repeated.

CHE 473 Environmental Separation and Control 3 Credits
Theory and application of adsorption, ion exchange, reverse osmosis, air stripping and chemical oxidation in water and wastewater treatment. Modeling engineered treatment processes.
Prerequisites: CEE 470

CHE 480 Research 3 Credits
Investigation of a problem in chemical engineering.

CHE 481 Research 3 Credits
Continuation of CHE 480.

CHE 482 (CHM 482, MAT 482) Mechanical Behaviors of Polymers 3 Credits

CHE 483 (CHM 483) Emulsion Polymers 3 Credits
Examination of fundamental concepts important in the manufacture, characterization, and application of polymer latexes. Topics to be covered will include colloidal stability, polymerization mechanisms and kinetics, reactor design, characterization of particle surfaces, latex rheology, morphology considerations, polymerization with functional groups, film formation and various application problems.

CHE 485 (CHM 485, MAT 485) Polymer Blends and Composites 3 Credits
Synthesis, morphology, and mechanical behavior of polymer blends and composites. Mechanical blends, block and graft copolymers, interpenetrating polymer networks, polymer impregnated concrete, and fiber and particulate reinforced polymers are emphasized. Must have completed any introductory course in polymers.

CHE 486 Polymer Processing 3 Credits
Application of fundamental principles of mechanics, fluid dynamics and heat transfer to the analysis of a wide variety of polymer flow processes. A brief survey of the rheological behavior of polymers is also included. Topics include pressurization, pumping, die forming, calendering, coating, molding, fiber spinning and elastic phenomena.

CHE 490 Thesis 1-6 Credits
CHE 492 (CHM 492, MAT 492) Topics in Polymer Science 3 Credits
Intensive study of topics selected from areas of current research interest such as morphology and mechanical behavior, thermodynamics and kinetics of crystallization, new analytical techniques, molecular weight distribution, non-Newtonian flow behavior, second order transition phenomena, novel polymer structures. Credit above three hours is granted only when different material is covered.
Prerequisites: CHE 392 or CHE 392 or CHM 392 or CHM 392

CHE 499 Dissertation 1-15 Credits
Repeat Status: Course may be repeated.

Chemistry

Chemistry is a versatile subject area and the pursuit of a career in chemistry can be a most intellectually satisfying experience. No other basic science touches and shapes as many aspects of modern society as does chemistry. The study of chemistry has provided solutions to complex problems and has improved the quality of all phases of human life from soft contact lenses and synthetic blood to longer-lasting paint and alternative fuels. A particular strength of this department is in surface and interface chemistry, which bridges many areas of modern science and technology.

Chemists at all levels of education find a market for their skills and knowledge in many employment areas. Chemists provide the technical backbone for the manufacturing industries (pharmaceuticals, plastics, paper, semiconductor electronics technology, and agriculture), for service industries (clinical and forensic laboratories, academe, environmental protection, and information science) and for governmental positions in regulatory agencies and in science policy analyses. Many chemists are employed in nontraditional areas, such as patent law, insurance underwriting, sales, product management, journalism, and even banking.

The alluring challenge of chemistry inspires many bachelor degree recipients to study for advanced degrees within the discipline of chemistry and in other areas, as well. Chemistry or biochemistry is the strongest preparation for graduate studies or for professional school in the health-related disciplines (medicine, pharmacology, and biochemistry), and for other science programs (materials science, polymers, biotechnology, environmental studies, and mineralogy).

The study of chemistry opens doors to satisfying careers, to a stimulating view of the world, and to a professional life in which one’s natural tendency to ask “Why?” can lead to personally rewarding endeavors. The undergraduate curriculum in chemistry contains many of the prerequisites for biology, earth and environmental sciences, materials science, molecular biology, physics, and chemical engineering. This allows students to transfer credits among these majors through the sophomore year.
Chemistry students have the opportunity to design their undergraduate curricula for specialization in a variety of fields through the ChemFlex curriculum.

THE CHEMFLEX CURRICULUM

The Department of Chemistry offers degrees in both the College of Arts and Sciences and the College of Engineering and Applied Sciences. Students in the College of Arts and Sciences have three options: the B. S. in Chemistry, the B. A. in Chemistry, and the B. S. in Pharmaceutical Chemistry. In addition to these options, the College of Engineering and Applied Sciences offers an interdepartmental B. S. in Biochemistry in collaboration with the Department of Biological Sciences. For students in the College of Engineering and Applied Sciences, we offer the B. S. in Chemistry.

In the College of Arts and Sciences, the traditional degree certified by the American Chemical Society is offered; the B. S. degree in the College of Engineering is very similar to the certified degree. All B. S. programs have a Common Chemistry Core and similar collateral science requirements. These programs are pre-professional in nature, and students planning to attend graduate school in chemistry or an allied science should elect the B. S. program in the college to which they have been admitted. The traditional B. A. Program in the College of Arts and Sciences is not a pre-professional program and may be elected by students who do not plan to do graduate work in chemistry or allied sciences but who desire a stronger background in chemistry than is provided by a chemistry minor.

In addition to the traditional certified B. S. degree and B. A. degree, the B. A. and B. S. Chemistry programs in the College of Arts and Sciences feature an alternative flexible curriculum, called ChemFlex, which enables a student to concentrate in a specific area. The concentrations possible for the B. S. are Physical/Analytical, Polymers, and Materials. The B. A. has two areas of concentration: Business and the Health Professions. All concentrations in ChemFlex share a Common Chemistry Core; all students complete the core and then follow one of two paths (Path A or Path B) as outlined in the following lists.

Students may transfer from a B. S. program to a B. A. program easily, but the reverse is more difficult. Students in a B. A. program who make the decision to attend graduate school in chemistry or allied sciences can achieve a minimum preparation for this transition by electing 307 Advanced Inorganic Chemistry.

DEPARTMENT MODERN LANGUAGE AND LITERATURE REQUIREMENT

The modern foreign language requirement is met by one of three options:

1. Completion of the second semester of a modern foreign language;
2. Certification of language equivalent to this level taken in high school; or
3. Substitution of six credits of science electives. If science electives are chosen, the non-science distribution requirement must still be met.

Professors. Gregory S. Ferguson, PhD (Cornell University); Robert A. Flowers, II, PhD (Lehigh University); Ned D. Heindel, PhD (University of Delaware); Steven L. Regen, PhD (Massachusetts Institute of Technology); John D. Simon, PhD (Harvard University); David A. Vicic, PhD (University of Rochester)

Associate Professors. Kerney Jebrell Glover, PhD (University of California San Diego); Kai Manfred Martin Landskron, PhD (University of Munich); James E. Roberts, PhD (Northwestern University); Dmitri V. Vezhenov, PhD (Harvard University)

Assistant Professors. Mark Shiow-Yih Chen, PhD (Harvard University); Heather Jaeger, PhD (University Georgia Athens); Marcos Pires, PhD (Purdue University); Damien Thenvenin, PhD (University of Delaware); Nathan Wittenberg, PhD (The Pennsylvania State University); Xiaoji G. Xu, PhD (University of British Columbia)

Professors Of Practice. Suzanne Marie Fernandez, PhD (University of Utah); Andy W. Ho, PhD (Harvard University); Rebecca S. Miller, PhD (Duke University)

Emeriti. Jack A. Alhadeff, PhD (Oregon Health Science University); Natalie M. Foster, PhD (Lehigh University); Kamil Klier, PhD (Acad Sciences Czech Republic); John W. Larsen, PhD (Purdue University Calumet); Joseph R. Merkel, PhD (University of Maryland College Park); Fortunato J. Micale, PhD (Lehigh University); Keith J. Schray, PhD (The Pennsylvania State University); Gary W. Simmons, PhD (University of Virginia); Robert S. Sprague, PhD (University of Illinois Urbana); James E. Sturm, PhD (University of Notre Dame); Daniel Zeroka, PhD (University of Pennsylvania)

DEGREES IN THE COLLEGE OF ARTS AND SCIENCES

In the College of Arts and Sciences the Chemistry Department offers three degrees: a B. S. in Chemistry, a B. A. in Chemistry and a B. S. in Pharmaceutical Chemistry with an interdepartmental B. S. Biochemistry degree with the Department of Biological Sciences. The ChemFlex Curriculum allows the flexibility for a student to develop a concentration in a specific area if he/she wishes to do so. The specific concentrations are noted in the following Table.

Table: ChemFlex Curriculum Overview

<table>
<thead>
<tr>
<th>Specialization Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B.S. Chemistry (ACS)</strong></td>
</tr>
<tr>
<td><strong>B.S. Chemistry Analytical/Physical</strong></td>
</tr>
<tr>
<td><strong>B.S. Chemistry Polymers</strong></td>
</tr>
<tr>
<td><strong>B.S. Chemistry Materials</strong></td>
</tr>
<tr>
<td><strong>B.A. Chemistry</strong></td>
</tr>
<tr>
<td><strong>B.A. Chemistry Business</strong></td>
</tr>
<tr>
<td><strong>B.A. Chemistry Health Professions</strong></td>
</tr>
<tr>
<td><strong>B.S. Pharmaceutical Chemistry</strong></td>
</tr>
<tr>
<td><strong>B.S. Biochemistry (interdepartmental degree)</strong></td>
</tr>
<tr>
<td>1. Common Chemistry Core</td>
</tr>
<tr>
<td>2. Courses required for specific concentration</td>
</tr>
<tr>
<td>3. Path A (see below)</td>
</tr>
<tr>
<td>4. Path B (see below)</td>
</tr>
</tbody>
</table>

With regard to the B.S. in Pharmaceutical Chemistry, the pharmaceutical industry is focused on exploring the biochemistry of disease and designing or finding drugs to cure or ameliorate disease. Biochemists, organic chemists, biologists, and chemical engineers collaborate to achieve this end. The majority of chemists hired today go into the pharmaceutical industry. The B.S. in Pharmaceutical Chemistry is a chemistry degree option which focuses on core chemistry, biochemistry, and molecular biology to prepare students for careers in this field. Since it is a highly interdisciplinary field it requires the breadth of knowledge offered by this degree program.

Freshman chemistry courses

The freshman courses CHM 030 and CHM 040 have similar course content. If both courses are taken, only credit for CHM 040, the more advanced course, will be awarded.

Common Chemistry Core

Select one of the following: 8

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM 040</td>
<td>Honors General Chemistry I</td>
</tr>
<tr>
<td>CHM 041</td>
<td>Honors General Chemistry II</td>
</tr>
<tr>
<td>CHM 030 &amp; CHM 031</td>
<td>Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems</td>
</tr>
<tr>
<td>CHM 110 &amp; CHM 111</td>
<td>Organic Chemistry I and Organic Chemistry Laboratory I</td>
</tr>
<tr>
<td>CHM 112 &amp; CHM 113</td>
<td>Organic Chemistry II and Organic Chemistry Laboratory II</td>
</tr>
<tr>
<td>CHM 332</td>
<td>Analytical Chemistry</td>
</tr>
<tr>
<td>Concentrations (see below)</td>
<td></td>
</tr>
<tr>
<td>CHM 201</td>
<td>Technical Writing</td>
</tr>
<tr>
<td>CHM 301</td>
<td>Chemistry Seminar</td>
</tr>
<tr>
<td>CHM 307</td>
<td>Advanced Inorganic Chemistry</td>
</tr>
</tbody>
</table>

Total Credits 28-33
Other writing intensive courses may be substituted with the approval of the advisor but any substitute course should have a science focus.

CHM 301 may be substituted by any course having a major presentation component with the approval of the major advisor.

Collateral requirements

Path A

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MATH 021</td>
<td>Calculus I</td>
<td>4</td>
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<tr>
<td>MATH 022</td>
<td>Calculus II</td>
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<tr>
<td>MATH 023</td>
<td>Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>MATH 205</td>
<td>Linear Methods</td>
<td>3</td>
</tr>
<tr>
<td>PHY 011</td>
<td>Introductory Physics I</td>
<td>5</td>
</tr>
<tr>
<td>&amp; PHY 012</td>
<td>and Introductory Physics Laboratory I</td>
<td>5</td>
</tr>
<tr>
<td>PHY 021</td>
<td>Introductory Physics II</td>
<td>5</td>
</tr>
<tr>
<td>&amp; PHY 022</td>
<td>and Introductory Physics Laboratory II</td>
<td>5</td>
</tr>
<tr>
<td>ENGR 010</td>
<td>Applied Engineering Computer Methods</td>
<td>2</td>
</tr>
<tr>
<td>or CSE 002</td>
<td>Fundamentals of Programming</td>
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Total Credits: 27

Path B

<table>
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<th>Course Title</th>
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<td>Survey of Calculus I</td>
<td>4</td>
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<tr>
<td>MATH 052</td>
<td>Survey of Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 043</td>
<td>Survey of Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>PHY 010</td>
<td>General Physics I</td>
<td>5</td>
</tr>
<tr>
<td>&amp; PHY 012</td>
<td>and Introductory Physics Laboratory I</td>
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</tr>
<tr>
<td>PHY 013</td>
<td>General Physics II</td>
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<td>&amp; PHY 022</td>
<td>and Introductory Physics Laboratory II</td>
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</table>

Total Credits: 19

SPECIALIZATIONS

B.S. Chemistry - Analytical/Physical Concentration

B.S. Chemistry (ACS certified Degree)

Common Core

Select one of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHM 040</td>
<td>Concepts, Models and Experiments I</td>
<td>8</td>
</tr>
<tr>
<td>&amp; CHM 041</td>
<td>and Concepts, Models and Experiments II</td>
<td></td>
</tr>
<tr>
<td>CHM 030</td>
<td>Introduction to Chemical Principles I</td>
<td>8</td>
</tr>
<tr>
<td>&amp; CHM 031</td>
<td>and Chemical Equilibria in Aqueous Systems</td>
<td>8</td>
</tr>
<tr>
<td>CHM 110</td>
<td>Organic Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHM 111</td>
<td>and Organic Chemistry Laboratory I</td>
<td>4</td>
</tr>
<tr>
<td>CHM 112</td>
<td>Organic Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHM 113</td>
<td>and Organic Chemistry Laboratory II</td>
<td>4</td>
</tr>
<tr>
<td>CHM 332</td>
<td>Analytical Chemistry</td>
<td>3</td>
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</table>

See Concentrations - Physical chemistry: 3-8

<table>
<thead>
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<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHM 201</td>
<td>Technical Writing 1</td>
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</tr>
<tr>
<td>CHM 301</td>
<td>Chemistry Seminar 2</td>
<td>1</td>
</tr>
<tr>
<td>CHM 307</td>
<td>Advanced Inorganic Chemistry</td>
<td>3</td>
</tr>
</tbody>
</table>

Collateral Requirement - Path A

<table>
<thead>
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<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MATH 021</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 022</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 023</td>
<td>Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>MATH 205</td>
<td>Linear Methods</td>
<td>3</td>
</tr>
<tr>
<td>PHY 011</td>
<td>Introductory Physics I</td>
<td>5</td>
</tr>
<tr>
<td>&amp; PHY 012</td>
<td>and Introductory Physics Laboratory I</td>
<td>5</td>
</tr>
<tr>
<td>PHY 021</td>
<td>Introductory Physics II</td>
<td>5</td>
</tr>
<tr>
<td>&amp; PHY 022</td>
<td>and Introductory Physics Laboratory II</td>
<td>5</td>
</tr>
<tr>
<td>ENGR 010</td>
<td>Applied Engineering Computer Methods</td>
<td>2</td>
</tr>
<tr>
<td>or CSE 002</td>
<td>Fundamentals of Programming</td>
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</tr>
</tbody>
</table>

Total Credits: 69-74

B.S. Chemistry - Physical Chemistry Concentration

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM 334</td>
<td>Advanced Chemistry Laboratory I</td>
<td>3</td>
</tr>
<tr>
<td>CHM 335</td>
<td>Advanced Chemistry Laboratory II</td>
<td>3</td>
</tr>
<tr>
<td>CHM 341</td>
<td>Molecular Structure, Bonding and Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>CHM 342</td>
<td>Thermodynamics &amp; Kinetics</td>
<td>3</td>
</tr>
<tr>
<td>CHM 343</td>
<td>Physical Chemistry Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>CHM 371</td>
<td>Elements of Biochemistry I</td>
<td>1-3</td>
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Advanced Chemistry Elective Requirement

Select one of the following:

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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>CHM 358</td>
<td>Advanced Organic Chemistry</td>
<td>3</td>
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<tr>
<td>CHM 372</td>
<td>Advanced Research Chemistry Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>CHM 376</td>
<td>Advanced Research Chemistry Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>CHM 391</td>
<td>Colloid and Surface Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHE 392</td>
<td>Introduction to Polymer Science</td>
<td>3</td>
</tr>
<tr>
<td>CHM 393</td>
<td>Physical Polymer Science</td>
<td>3</td>
</tr>
<tr>
<td>CHM 394</td>
<td>Organic Polymer Science I</td>
<td>3</td>
</tr>
<tr>
<td>PHY 363</td>
<td>Physics of Solids</td>
<td>3</td>
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Total Credits: 73-80

Common Core

Select one of the following:

<table>
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<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHM 040</td>
<td>Honors General Chemistry I</td>
<td>8</td>
</tr>
<tr>
<td>&amp; CHM 041</td>
<td>and Honors General Chemistry II</td>
<td></td>
</tr>
<tr>
<td>CHM 030</td>
<td>Introduction to Chemical Principles I</td>
<td>8</td>
</tr>
<tr>
<td>&amp; CHM 031</td>
<td>and Chemical Equilibria in Aqueous Systems</td>
<td>8</td>
</tr>
<tr>
<td>CHM 110</td>
<td>Organic Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHM 111</td>
<td>and Organic Chemistry Laboratory I</td>
<td>4</td>
</tr>
<tr>
<td>CHM 112</td>
<td>Organic Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHM 113</td>
<td>and Organic Chemistry Laboratory II</td>
<td>4</td>
</tr>
<tr>
<td>CHM 332</td>
<td>Analytical Chemistry</td>
<td>3</td>
</tr>
</tbody>
</table>

See Concentrations - Physical chemistry: 3-8

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM 201</td>
<td>Technical Writing 1</td>
<td>2</td>
</tr>
<tr>
<td>CHM 301</td>
<td>Chemistry Seminar 2</td>
<td>1</td>
</tr>
<tr>
<td>CHM 307</td>
<td>Advanced Inorganic Chemistry</td>
<td>3</td>
</tr>
</tbody>
</table>

Collateral Requirement - Path A

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 021</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 022</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 023</td>
<td>Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>MATH 205</td>
<td>Linear Methods</td>
<td>3</td>
</tr>
<tr>
<td>PHY 011</td>
<td>Introductory Physics I</td>
<td>5</td>
</tr>
<tr>
<td>&amp; PHY 012</td>
<td>and Introductory Physics Laboratory I</td>
<td>5</td>
</tr>
<tr>
<td>PHY 021</td>
<td>Introductory Physics II</td>
<td>5</td>
</tr>
<tr>
<td>&amp; PHY 022</td>
<td>and Introductory Physics Laboratory II</td>
<td>5</td>
</tr>
<tr>
<td>ENGR 010</td>
<td>Applied Engineering Computer Methods</td>
<td>2</td>
</tr>
<tr>
<td>or CSE 002</td>
<td>Fundamentals of Programming</td>
<td></td>
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</table>

Total Credits: 69-74

Specialization Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM 334</td>
<td>Advanced Chemistry Laboratory I</td>
<td>3</td>
</tr>
<tr>
<td>CHM 335</td>
<td>Advanced Chemistry Laboratory II</td>
<td>3</td>
</tr>
<tr>
<td>CHM 341</td>
<td>Molecular Structure, Bonding and Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>CHM 342</td>
<td>Thermodynamics &amp; Kinetics</td>
<td>3</td>
</tr>
<tr>
<td>CHM 343</td>
<td>Physical Chemistry Laboratory</td>
<td>2</td>
</tr>
</tbody>
</table>

Other writing intensive courses may be substituted with the approval of the advisor but any substitute course should have a science focus.

CHM 301 may be substituted by any course having a major presentation component with the approval of the major advisor.
Lehigh University 2016-2017 135

B.S. Chemistry - Polymers Concentration

Common Core
Select one of the following: 8

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM 040 &amp; CHM 041</td>
<td>Honors General Chemistry I and Honors General Chemistry II</td>
</tr>
<tr>
<td>CHM 030 &amp; CHM 031</td>
<td>Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems</td>
</tr>
<tr>
<td>CHM 110 &amp; CHM 111</td>
<td>Organic Chemistry I and Organic Chemistry Laboratory I</td>
</tr>
<tr>
<td>CHM 112 &amp; CHM 113</td>
<td>Organic Chemistry II and Organic Chemistry Laboratory II</td>
</tr>
<tr>
<td>CHM 332</td>
<td>Analytical Chemistry</td>
</tr>
</tbody>
</table>

See Concentrations - Physical chemistry 3-8

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM 201</td>
<td>Technical Writing</td>
</tr>
<tr>
<td>CHM 301</td>
<td>Chemistry Seminar</td>
</tr>
<tr>
<td>CHM 307</td>
<td>Advanced Inorganic Chemistry</td>
</tr>
</tbody>
</table>

Collateral Requirement - Path A

MATH 021  Calculus I  4
MATH 022  Calculus II  4
MATH 023  Calculus III  4
MATH 205  Linear Methods  3
PHY 011  Introductory Physics I  5
& PHY 012  and Introductory Physics Laboratory I  5
PHY 021  Introductory Physics II  5
& PHY 022  and Introductory Physics Laboratory II  5
ENGR 010  Applied Engineering Computer Methods  2
or CSE 002  Fundamentals of Programming

Specialization Courses

CHM 334  Advanced Chemistry Laboratory I  3
CHM 335  Advanced Chemistry Laboratory II  3
CHM 341  Molecular Structure, Bonding and Dynamics  3
CHM 342  Thermodynamics & Kinetics  3
CHM 343  Physical Chemistry Laboratory  2
MAT 033  Engineering Materials and Processes  3

Total Credits 72-77

1 Other writing intensive courses may be substituted with the approval of the advisor but any substitute course should have a science focus.
2 CHM 301 may be substituted by any course having a major presentation component with the approval of the major advisor.

B.S. Chemistry - Materials Concentration

Common Core
Select one of the following: 8

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>CHM 040 &amp; CHM 041</td>
<td>Honors General Chemistry I and Honors General Chemistry II</td>
</tr>
<tr>
<td>CHM 030 &amp; CHM 031</td>
<td>Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems</td>
</tr>
<tr>
<td>CHM 110 &amp; CHM 111</td>
<td>Organic Chemistry I and Organic Chemistry Laboratory I</td>
</tr>
<tr>
<td>CHM 112 &amp; CHM 113</td>
<td>Organic Chemistry II and Organic Chemistry Laboratory II</td>
</tr>
<tr>
<td>CHM 332</td>
<td>Analytical Chemistry</td>
</tr>
</tbody>
</table>

See Concentrations - Physical chemistry 3-8

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM 201</td>
<td>Technical Writing</td>
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<tr>
<td>CHM 301</td>
<td>Chemistry Seminar</td>
</tr>
<tr>
<td>CHM 307</td>
<td>Advanced Inorganic Chemistry</td>
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</tbody>
</table>

Collateral Requirement - Path A

MATH 021  Calculus I  4
MATH 022  Calculus II  4
MATH 023  Calculus III  4
MATH 205  Linear Methods  3
PHY 011  Introductory Physics I  5
& PHY 012  and Introductory Physics Laboratory I  5
PHY 021  Introductory Physics II  5
& PHY 022  and Introductory Physics Laboratory II  5
ENGR 010  Applied Engineering Computer Methods  2
or CSE 002  Fundamentals of Programming

Specialization Courses

CHM 334  Advanced Chemistry Laboratory I  3
CHM 335  Advanced Chemistry Laboratory II  3
CHM 341  Molecular Structure, Bonding and Dynamics  3
CHM 342  Thermodynamics & Kinetics  3
CHM 343  Physical Chemistry Laboratory  2
MAT 033  Engineering Materials and Processes  3

Total Credits 72-77

1 Other writing intensive courses may be substituted with the approval of the advisor but any substitute course should have a science focus.
2 CHM 301 may be substituted by any course having a major presentation component with the approval of the major advisor.

B.A. Chemistry

Common Core
Select one of the following: 8

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM 040 &amp; CHM 041</td>
<td>Honors General Chemistry I and Honors General Chemistry II</td>
</tr>
<tr>
<td>CHM 030 &amp; CHM 031</td>
<td>Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems</td>
</tr>
<tr>
<td>CHM 110 &amp; CHM 111</td>
<td>Organic Chemistry I and Organic Chemistry Laboratory I</td>
</tr>
<tr>
<td>CHM 112 &amp; CHM 113</td>
<td>Organic Chemistry II and Organic Chemistry Laboratory II</td>
</tr>
<tr>
<td>CHM 332</td>
<td>Analytical Chemistry</td>
</tr>
</tbody>
</table>

See Concentrations - Physical chemistry 3-8

<table>
<thead>
<tr>
<th>Course</th>
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</tr>
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<tbody>
<tr>
<td>CHM 201</td>
<td>Technical Writing</td>
</tr>
<tr>
<td>CHM 301</td>
<td>Chemistry Seminar</td>
</tr>
<tr>
<td>CHM 307</td>
<td>Advanced Inorganic Chemistry</td>
</tr>
</tbody>
</table>

Collateral Requirement
Select one of the following: 19-28

Path A

MATH 021  Calculus I  4
MATH 022  Calculus II  4
MATH 023  Calculus III  4
MATH 205  Linear Methods  3
PHY 011  Introductory Physics I  5
& PHY 012  and Introductory Physics Laboratory I  5
PHY 021  Introductory Physics II  5
& PHY 022  and Introductory Physics Laboratory II  5
ENGR 010  Applied Engineering Computer Methods  2
or CSE 002  Fundamentals of Programming

Path B

MATH 051  Survey of Calculus I  4
MATH 052  Survey of Calculus II  4
MATH 043  Survey of Linear Algebra  4
PHY 010  General Physics I  5
& PHY 012  and Introductory Physics Laboratory I  5
PHY 013  General Physics II  5
& PHY 022  and Introductory Physics Laboratory II  5

Specialization Courses
Select one of the following: 3

CHM 341 Molecular Structure, Bonding and Dynamics
CHM 342 Thermodynamics & Kinetics
CHM 194 Physical Chemistry for Biological Sciences
CHM 343 Physical Chemistry Laboratory 2
CHM elective 2

Total Credits 57-71

1 Other writing intensive courses may be substituted with the approval of the advisor but any substitute course should have a science focus.
2 CHM 301 may be substituted by any course having a major presentation component with the approval of the major advisor.

B.A. Chemistry - Business Concentration

Common Core

Select one of the following: 8

CHM 040 Concepts, Models and Experiments I and Concepts, Models and Experiments II
CHM 030 Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems
CHM 110 Organic Chemistry I and Organic Chemistry Laboratory I
CHM 112 Organic Chemistry II and Organic Chemistry Laboratory II
CHM 332 Analytical Chemistry

See Concentrations - Physical chemistry 3-8

CHM 201 Technical Writing 1
CHM 301 Chemistry Seminar 2
CHM 307 Advanced Inorganic Chemistry 3

Collateral Requirement

Select one of the following: 19-28

Path A
MATH 021 Calculus I
MATH 022 Calculus II
MATH 023 Calculus III
MATH 205 Linear Methods
PHY 011 Introductory Physics I and Introductory Physics Laboratory I
PHY 021 Introductory Physics II and Introductory Physics Laboratory II
ENGR 010 Applied Engineering Computer Methods
or CSE 002 Fundamentals of Programming

Path B
MATH 051 Survey of Calculus I
MATH 052 Survey of Calculus II
MATH 043 Survey of Linear Algebra
PHY 010 General Physics I and Introductory Physics I
PHY 013 General Physics II and Introductory Physics Laboratory II
ENGR 010 Applied Engineering Computer Methods
or CSE 002 Fundamentals of Programming

Specialization Courses

CHM elective 3

Select one of the following: 3

CHM 341 Molecular Structure, Bonding and Dynamics
CHM 342 Thermodynamics & Kinetics
CHM 194 Physical Chemistry for Biological Sciences
CHM 343 Physical Chemistry Laboratory 2
ECO 001 Principles of Economics 4

BUS 125 Behavioral Skills Workshop 1
BUS 126 Information Analysis and Financial Decision Making I 3
BUS 127 Information Analysis and Financial Decision Making II 3
BUS 225 Developing, Producing, and Marketing Products and Services I 3
BUS 226 Developing, Producing, and Marketing Products and Services II 3
BUS 326 Business Strategy 1
MATH 012 Basic Statistics 3

Total Credits 77-91

1 Other writing intensive courses may be substituted with the approval of the advisor but any substitute course should have a science focus.
2 CHM 301 may be substituted by any course having a major presentation component with the approval of the major advisor.
3 MATH 012 may be substituted by any statistics course.

B.A. Chemistry - Health Professions Concentration

Common Core

Select one of the following: 8

CHM 040 Concepts, Models and Experiments I and Concepts, Models and Experiments II
CHM 030 Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems
CHM 110 Organic Chemistry I and Organic Chemistry Laboratory I
CHM 112 Organic Chemistry II and Organic Chemistry Laboratory II
CHM 332 Analytical Chemistry

See Concentrations - Physical chemistry 3-8

CHM 201 Technical Writing 1
CHM 301 Chemistry Seminar 2
CHM 307 Advanced Inorganic Chemistry 3

Collateral Requirement

Select one of the following: 19-28

Path A
MATH 021 Calculus I
MATH 022 Calculus II
MATH 023 Calculus III
MATH 205 Linear Methods
PHY 011 Introductory Physics I and Introductory Physics Laboratory I
PHY 021 Introductory Physics II and Introductory Physics Laboratory II
ENGR 010 Applied Engineering Computer Methods
or CSE 002 Fundamentals of Programming

Path B
MATH 051 Survey of Calculus I
MATH 052 Survey of Calculus II
MATH 043 Survey of Linear Algebra
PHY 010 General Physics I and Introductory Physics Laboratory I
PHY 013 General Physics II and Introductory Physics Laboratory II
ENGR 010 Applied Engineering Computer Methods
or CSE 002 Fundamentals of Programming

Specialization Courses

CHM elective 3

Select one of the following: 3

CHM 341 Molecular Structure, Bonding and Dynamics
CHM 342 Thermodynamics & Kinetics
CHM 194  Physical Chemistry for Biological Sciences
CHM 343  Physical Chemistry Laboratory
BIOS 115 & BIOS 116  Biology Core II: Genetics and Biology Core II: Genetics Laboratory
BIOS 041 & BIOS 042  Biology Core I: Cellular and Molecular and Biology Core I: Cellular and Molecular Lab
MATH 012  Basic Statistics

Additional courses in BioS are recommended.

Total Credits 67-81

1 Other writing intensive courses may be substituted with the approval of the advisor but any substitute course should have a science focus.
2 CHM 301 may be substituted by any course having a major presentation component with the approval of the major advisor.
3 MATH 012 may be substituted by any statistics course.

B.S. Pharmaceutical Chemistry

Common Core
Select one of the following: 8
CHM 040  Concepts, Models and Experiments I and Concepts, Models and Experiments II
CHM 041

CHM 030  Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems
CHM 031

CHM 110 & CHM 111  Organic Chemistry I and Organic Chemistry Laboratory I
CHM 112 & CHM 113  Organic Chemistry II and Organic Chemistry Laboratory II
CHM 332  Analytical Chemistry

See Concentrations - Physical Chemistry 3-8

CHM 201  Technical Writing
CHM 301  Chemistry Seminar
CHM 307  Advanced Inorganic Chemistry

Collateral Requirement
Select one of the following: 19-28
Path A
MATH 021  Calculus I
MATH 022  Calculus II
MATH 023  Calculus III
MATH 205  Linear Methods
PHY 011 & PHY 012  Introductory Physics I and Introductory Physics Laboratory I
PHY 021 & PHY 022  Introductory Physics II and Introductory Physics Laboratory II
ENGR 010 or CSE 012  Applied Engineering Computer Methods or Fundamentals of Programming
Path B
MATH 051  Survey of Calculus I
MATH 052  Survey of Calculus II
MATH 043  Survey of Linear Algebra
PHY 010 & PHY 012  General Physics I and Introductory Physics Laboratory I
PHY 013 & PHY 022  General Physics II and Introductory Physics Laboratory II

Specialization Courses
Select one of the following: 3
CHM 194  Physical Chemistry for Biological Sciences
CHM 341  Molecular Structure, Bonding and Dynamics
CHM 342  Thermodynamics & Kinetics
CHM 358  Advanced Organic Chemistry
CHM 371  Elements of Biochemistry I
CHM 372  Elements of Biochemistry II
Advanced CHM Electives
BIOS 041 & BIOS 042  Biology Core I: Cellular and Molecular and Biology Core I: Cellular and Molecular Lab
BIOS 115  Biology Core II: Genetics
MATH 012  Basic Statistics

Total Credits: 71-87

1 Other writing intensive courses may be substituted with the approval of the advisor but any substitute course should have a science focus.
2 CHM 301 may be substituted by any course having a major presentation component with the approval of the major advisor.
3 MATH 012 may be substituted by any statistics course.

MODEL ROSTER WHEN PATH A IS FOLLOWED

First Year  CR
College Seminar 3-4
CHM 040 4
CHM 041 4
ENGL 001 3
ENGL 002 3
MATH 021 4
MATH 022 4
PHY 011 4
PHY 012 1

30-31

Second Year  CR
CHM 110 & CHM 111 4
CHM 112 & CHM 113 4
PHY 021 & PHY 022 5
MATH 023 4
MATH 043 3
ENGR 010 or CSE 012 2
distribution requirements - free electives 9

31

Total Credits: 61-62

Note that some concentrations would insert courses such as MATH 012, BIOS 041/BIOS 042 (B.S. Pharmaceutical Chemistry), ECO 001 (B.A.-Business), etc.

junior year/senior year (30-32 credits)

Student will need to meet with major advisor in order to formulate courses to be taken.

MODEL ROSTER WHEN PATH B IS FOLLOWED

First Year  CR
College Seminar 3-4
CHM 040 4
CHM 041 4
ENGL 001 3
ENGL 002 3
MATH 051 4
MATH 052 3
PHY 010 4

junior year/senior year (30-32 credits)

Student will need to meet with major advisor in order to formulate courses to be taken.
PHYS 012 1

Second Year CR
CHM 110 & CHM 111 4
CHM 112 & CHM 113 4
PHY 013 & PHY 022 4
MATH 043 3
distribution requirements - free electives 15

Total Credits: 29-30

Note that some concentrations would insert courses such as MATH 012, BIOS 041/BIOS 042 (B.S. Pharmaceutical Chemistry), ECO 001 (B.A.-Business), etc.

junior year/senior year (30-32 credits)
Student will need to meet with major advisor in order to formulate courses to be taken.

B.S. DEGREE IN CHEMISTRY, COLLEGE OF ENGINEERING & APPLIED SCIENCE
Summary of Requirements
College distribution 24
Physics, math, and computing 28
Chemistry 46
Unrestricted electives 25

Total Credits 123

Model Roster
First Year
First Semester Second Semester CR CR
ENGL 001 3 ENGL 002 3
MATH 021 4 MATH 022 4
ENGR 010 2 ENGR 005 2
Select one of the following: 4-5 Select one of the following: 4-5
CHM 030 1 4 CHM 030 1 4
PHY 011 5 PHY 011 5
& PHY 012 1 & PHY 012 1

Total Credits: 22-23

Second Year
First Semester Second Semester CR CR
CHM 110 & CHM 111 4 CHM 112 & CHM 113 4
PHY 021 & PHY 022 5 MATH 205 3
MATH 023 4 ECO 001 4
modern foreign language requirement (See details in introduction) 4 Humanities/Social Science requirement 4

Total Credits: 17

Third Year
First Semester Second Semester CR CR
Select one of the following: 2-3 CHM 307 & CHM 335 6
CHM 201 2 CHM 342 & CHM 343 5
Or approved writing-intensive course 3 modern foreign language requirement 4

Total Credits: 15

CHM 332 & CHM 334 6 free electives 4
CHM 341 3
Distribution requirement/ elective 4
modern foreign language requirement (See details in introduction) 4

Total Credits: 24-25

Fourth Year
First Semester Second Semester CR CR
CHM 301 1 Advanced chemistry elective 3
CHM 371 3 free electives 11
Advanced chemistry elective 3
Distribution requirement 7

Total Credits: 14-14

1 Required natural science courses, one taken fall semester and the other taken in spring
2 Note: It is recommended that, where possible, students planning to major in chemistry take CHM 040 in the fall semester and CHM 041 in the spring semester of the freshman year. For such students the elective in the spring semester is displaced to a subsequent semester. The CHM 030/CHM 031 sequence may be substituted.
3 See list of choices for the advanced chemistry elective requirement under the B.S. degree in chemistry/College of Arts and Sciences.
4 This becomes a free elective if the advanced chemistry elective requirement was taken in the fall of the senior year.

ACCELERATED COMBINED B.S. - M.S. DEGREE OPTIONS IN CHEMISTRY
Individual degree paths can be designed to earn either the B.S. or both B.S. and M.S. degrees in Chemistry over a reduced or accelerated time frame. A discussion with the Chemistry faculty advisor during the first academic year is required to successfully complete any of the following options:

1. If you have more than 20 credits total of AP or transfer courses, it may be possible to earn the B.S. in three years and the M.S. in four. This path may require up to two summers of courses and/or research for most students.
2. If you have 30 or more AP or transfer credits, then it may be possible to be supported as a Teaching Assistant or Research Assistant during the fourth year as a graduate student to finish the M.S. degree, although such support is not guaranteed. The B.S. degree must be completed in three years, and up to two summers of courses and/or research may be required.
3. If you have limited or no AP or transfer credits, then two paths are available: A) A five year path is possible with one summer of research work after the B.S. degree is finished in four years. B) A five year path with support during the fifth year as a TA or RA may be possible if courses are excluded from the undergraduate degree (requiring course overloads), and one summer of research is generally required, but support is not guaranteed.

Accelerated B.S. degree options are also possible for some students. See the Chemistry faculty advisor to develop a customized program for your situation.

B.S. IN BIOCHEMISTRY
An interdepartmental B.S. in Biochemistry major is offered in the College of Arts and Sciences. Faculty in both Chemistry (Glover, Pires and Thévenin) and Biological Sciences (Lowe-Krentz and Iovine) serve as advisors depending on student interest. Majors should be declared in the Department of Biological Sciences. Please see the section on Biochemistry (p. 90) for details of the major.
MINOR IN CHEMISTRY
A minor in chemistry may be achieved by completing the following requirements:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM 031</td>
<td>Chemical Equilibria in Aqueous Systems</td>
<td>4</td>
</tr>
<tr>
<td>or CHM 041</td>
<td>Concepts, Models and Experiments II</td>
<td>4</td>
</tr>
<tr>
<td>CHM 110</td>
<td>Organic Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHM 111</td>
<td>and Organic Chemistry Laboratory I</td>
<td></td>
</tr>
<tr>
<td>CHM 332</td>
<td>Analytical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHM 341</td>
<td>Molecular Structure, Bonding and Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>or CHM 342</td>
<td>Thermodynamics &amp; Kinetics</td>
<td></td>
</tr>
<tr>
<td>CHM 343</td>
<td>Physical Chemistry Laboratory</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td><strong>Total Credits</strong></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>

Necessary pre- or co-requisites for the above would be CHM 030 or CHM 040 and MATH 021.

Students who wish to minor in chemistry but whose major program requires any of the above courses may achieve the minor with substitutions approved by the department chair.

GRADUATE PROGRAMS IN CHEMISTRY
The department of chemistry offers graduate studies leading to several advanced degrees. Master of science and doctor of philosophy degrees in chemistry may be obtained by study and research in any appropriate area of chemistry.

The following information on admissions, proficiency examinations and other policies applies to both the master of science and doctor of philosophy degrees in chemistry.

Admission to graduate study in chemistry assumes that a student has met, or is willing to meet though further study, minimum undergraduate requirements for a bachelor’s degree in chemistry. This would include (beyond two semesters of introductory chemistry) two semesters of organic chemistry, two semesters of physical chemistry, two semesters of analytical chemistry and one semester of inorganic chemistry. A promising student whose degree is in a field related to chemistry (e.g., biology, chemical engineering) may be admitted to graduate study in chemistry provided that any deficiencies in basic chemistry preparation are made up in the first year of graduate study, noting that some of the courses required for this may not carry graduate credit.

The chemistry department administers proficiency examinations at the advanced undergraduate level in analytical, biochemistry, inorganic, organic and physical chemistry to all regular graduate students at the time of matriculation. Each student is required to take three examinations. Information regarding material to be covered on these examinations will be sent to each student several months in advance of matriculation. It is expected that each student will prepare diligently for these tests. A student who performs well on one or more of these tests has an opportunity to take advanced level and special topics courses at an earlier than normal time and may in fact begin graduate research during the first year. A Ph.D. candidate must show proficiency in three areas and an M.S. candidate in two areas within the first year in residence. A student who fails one or more of the proficiency examinations will meet with Professor Miller, faculty graduate administrator, to determine an appropriate course of action in light of the exam performance, projected major and degree aspiration. Two optional routes are available for demonstration of proficiency. (1) The student through self-study and auditing of appropriate courses may prepare for a retaking of a proficiency examination at the beginning of the second semester in residence. (2) Alternatively, the student may enroll in appropriate 400 level courses during the first year in residence. A grade of B- or better in an appropriate 400 level course will be considered equivalent to passing the proficiency examination in that area. Courses taken as a means of demonstrating proficiency will be acceptable for the M.S. or Ph.D. graduate program.

Master of Science in Chemistry degree
There are no other specifically required courses for the M.S. degree, allowing each student to design a curriculum that fits their needs and interests. Normally, work for the master’s degree can be completed in 18 calendar months of full-time study.

The Master of Science in Chemistry degree requires a total of 30 credits.

Select one of the following options: 30

Option A
A minimum of 30 course credits

Option B
A minimum of 27 course credits

CHM 421 Chemistry Research (literature review paper)

Option C
A minimum of 24 course credits

CHM 421 Chemistry Research (experimental research)

Each option requires:
A minimum of 18 credits at the 400 level (15 of which must be in chemistry)

CHM 481 Chemistry Seminar (one credit)

Total Credits 30

Doctor of Philosophy Degree
Completion of a doctor of philosophy degree program normally requires a minimum of four years fulltime work after entrance with a bachelor’s degree. There are few specific course credit requirements for the Ph.D.; however, approved degree programs generally have at least 24 hours of course work (including any applied toward a master’s degree) and 6 credits of research. Thus, the program consists of approximately one-third formal course work and two-thirds independent study and research. There is a two-credit seminar requirement (CHM 481). After Ph.D. proficiency has been established and the research advisor selected (this must be done by the end of the first year in residence), the major hurdles are the doctoral examination in the student’s area of concentration. This exam must be passed by the end of 2 1/2 years of residence. If this hurdle is surmounted, the remaining time is spent completing (and ultimately defending) the dissertation research under the guidance of the research advisor and the dissertation committee.

Course Work 1
CHM 421 Chemistry Research 16
CHM 481 Chemistry Seminar 2

Total Credits 24

1 Including any applied toward a master’s degree.

CURRENT RESEARCH PROJECTS
Current research projects of interest are listed below.

Analytical Chemistry
NMR studies of organic solids and polymers; electrochemical reduction and oxidation mechanisms of organic compounds; development of novel immunoassays.

Biochemistry
Membrane protein interactions; structural characterization of membrane proteins; production of membrane proteins; biophysical characterization of membrane proteins; medicinal assay development; medical diagnostics; cryogenics; microfluids; biomaterials; multidrug resistance; selective drug delivery; anti-cancer therapy; antibiotic drug discovery; cell surface remodeling; immunotherapy; activity based probes; fluorescence assay development.

Inorganic Chemistry
Synthesis, characterization, and reactivity of transition metal complexes and nanoparticles; coordination chemistry and molecular self-assembly at metal surfaces; electrochemistry at metal and metal-oxide electrodes; synthesis and characterization of mesoporous solids from transition metal and main-group element precursors; applications of mesoporous solids for carbon sequestration; formation of multilayered thin films of inorganic and organic-inorganic hybrid materials; and application of lanthanide catalysis in organic synthesis.
Materials and Polymer Chemistry

Inorganic and organometallic chemistry in the synthesis of thin-film materials; synthesis at and dynamics of polymer interfaces; acoustic, optical, permeability, dielectric and mechanical behavior of thin films; laser light scattering and small-angle X-ray scattering studies on polymer solutions; polyelectrolytes and ion-containing solutions; nanofabrications in polymer systems; organic-inorganic hybrid solid state materials; synthesis and characterization of novel mesoporous materials.

Organic Chemistry

Synthesis of medicinal agents, correlation of molecular structure with pharmacological behavior; chemical models for biochemical reactions; chemistry of monolayers and organized molecule assemblages; drug carriers; synthetic ion conductors; Langmuir-Blodgett films; organometallic reaction mechanisms; organofluorine chemistry; protein folding and renaturation; molecular recognition; calorimetry; electrochemical studies of electron transfer reactions; synthetic methods development.

Physical Chemistry

Chemistry at surfaces and interfaces of catalysts, alloys, electrodes, thin films, and biosensors using an array of surface sensitive methods: spectroscopic ellipsometry, scanning probe microscopy, angle resolved X-ray photoelectron spectroscopy, electrochemistry; intermolecular interactions in soft matter; single-molecule force spectroscopy; chemically sensitive imaging at nanoscale; development of optics-based tools for chemical analysis; femtosecond ultrafast spectroscopy; investigation of charge transfer in energy materials; development of instrumentation and experimental methodologies for the cryogenic spectroscopy of ions; deposition of ions into solid rare-gas matrices; ion-ion and ion-molecule reactions in matrices; freeze-frame spectroscopy — utilizing kinetic control inherent to cryogenic spectroscopy to elucidate reaction mechanisms (in particular of nanocatalysis with metal clusters) in step-wise fashion.

Computational Chemistry

Characterization of electronic properties and structures of molecules, molecular complexes, and extended systems from ab initio methods; development of quantum-classical methods for non-adiabatic dynamics; real-time simulations of non-radiative relaxation and electron-hole recombination in semiconducting nanocrystals; charge and energy transfer rates and mechanisms in metal-organic hybrid polymers.

MAJOR INSTRUMENTATION

Chemistry research spans all areas: analytical, biochemistry, inorganic, organic, and physical. Special equipment available for graduate research in chemistry is as follows.

Research facilities

LC/MS/MS, GC-MS, MALDI-TOF-MS, HPLCs, GCs, ultracentrifuges, cold rooms, cell disintegrator, zone and disc electrophoresis apparatus, column chromatograph, autoclave, freezers (-80°C), rotary evaporator, Milli-Q water purification system, shaking heated water baths, spectropolarimeter with circular dichroism capability. Cell culture facilities — complete with optical microscopes having fluorescent and photographic capabilities. Catalysis facility — fully automated high pressure reactors with on-line gas chromatographs. Electron optical facilities — transmission electron microscopy with x-ray fluorescence analysis capability, scanning electron microscope, and scanning electron microscope. Gas chromatographs. Liquid chromatographs — high performance for analytical and preparative work. NMR spectrometers — 400 MHz for both solids and solutions, and 500 MHz for solutions. Photochemistry equipment — lamps and filters for selected wavelength work. Polarographs, chronopotentiometers, electrophoresis apparatus, electrochemical impedance, electrochemical scanning tunneling microscope, potentiostats, and rotating disk electrode. Portable data interface (8-channel 50 KHz), digital readout polarimeter, Vibron elastoviscometers, differential refractometer.

Spectrometers

UV/visible double beam automated, fluorescence, UV/visible/near IR, Fourier transform IR with diffuse reflectance, photoacoustic and attenuated reflectance capability, and GC mass spectrometers. Surface analysis facilities — rotating anode high-sensitivity high-energy resolution ESCA with imaging capability (ESCA is equipped with automated angular data acquisition). Surface science facility — Low energy electron diffraction (LEED), photocorrelation spectroscopy for submicron particle analysis. Ellipsometer, contact angle capabilities, gas adsorption apparatus (BET), atomic force microscope, instructional scanning tunneling microscope, and light scanning. Microcalorimeter (flowing with UV and refractive index detectors), differential scanning calorimeter (DSC).

Courses

CHM 030 Introduction to Chemical Principles 4 Credits
An introduction to important topics in chemistry: atomic structure, properties of matter, chemical reactions, energy, structure and bonding in organic and inorganic compounds, chemical equilibrium. The course features a lecture tightly linked to a three-hour studio experience that combines laboratory work and recitation. Attribute/Distribution: NS

CHM 031 Chemical Equilibria in Aqueous Systems 4 Credits
An introduction to: intermolecular forces and their influence on physical properties and phase behavior; chemical kinetics; thermodynamics in chemical systems; and electrochemistry. The course includes a detailed treatment of equilibria in aqueous solutions, including acid-base, precipitation-solubility, metal-ligand, oxidation-reduction and distribution equilibria. The laboratory work emphasizes the qualitative and quantitative analysis of equilibria in aqueous media. Three lectures and one three-hour laboratory period. Prerequisites: (CHM 030 or CHM 040) and (MATH 021 or MATH 031 or MATH 051 or MATH 076)
Can be taken Concurrently: MATH 021, MATH 031, MATH 051, MATH 076 Attribute/Distribution: NS

CHM 040 Honors General Chemistry I 4 Credits
A first-semester course in chemistry for students planning to major in chemistry, biochemistry, chemical engineering, materials science, or other chemistry-related fields. Chemical and physical properties, structures, bonding concepts, and quantitative analysis. Laboratory includes synthesis, separation and analysis procedures; computer applications to chemistry. Three lectures, one laboratory.
Attribute/Distribution: NS

CHM 041 Honors General Chemistry II 4 Credits
Continuation of Chemistry 40. Three lectures, one laboratory. Prerequisites: (CHM 040 or CHM 030) and (MATH 021 or MATH 031 or MATH 051)
Attribute/Distribution: NS

CHM 110 Organic Chemistry I 3 Credits
Systematic survey of the typical compounds of carbon, their classification, and general relations; study of synthetic reactions. Prerequisites: CHM 031 or CHM 041 Attribute/Distribution: NS

CHM 111 Organic Chemistry Laboratory I 1 Credit
Preparation of pure organic compounds. Modern techniques of characterization. Prerequisites: CHM 110 Can be taken Concurrently: CHM 110 Attribute/Distribution: NS

CHM 112 Organic Chemistry II 3 Credits
Continuation of CHM 110. Prerequisites: CHM 110 Attribute/Distribution: NS

CHM 113 Organic Chemistry Laboratory II 1 Credit
Continuation of Organic Chemistry Laboratory I. Prerequisites: CHM 111 and CHM 112 Can be taken Concurrently: CHM 111, CHM 112 Attribute/Distribution: NS

CHM 177 Introduction to Research 1-2 Credits
For advanced freshmen and sophomore chemistry majors. Consent of department chair required. Repeat Status: Course may be repeated. Attribute/Distribution: NS
CHM 194 Physical Chemistry for Biological Sciences 3 Credits
The principles and applications of physical chemical concepts to systems of biological interest, including the gas laws, thermodynamics of metabolic reactions, colligative properties, electrochemical equilibria, reaction kinetics and enzyme catalysis, and transport of macromolecules and viruses.
Prerequisites: (CHM 030 or CHM 040) and (CHM 031 or CHM 041)
Attribute/Distribution: NS

CHM 201 Technical Writing 2 Credits
Principal types of written communications used by professional chemists including informative abstracts, research proposals, progress reports, executive summaries for nonchemist decision makers and proper written experimental procedures, tables, schemes and figures. Must have junior standing in chemistry major.
Attribute/Distribution: ND

CHM 250 Special Topics 1-4 Credits
Selected topics in chemistry.
Repeat Status: Course may be repeated.
Attribute/Distribution: NS

CHM 300 Apprentice Teaching 3 Credits
Can be taken Concurrently: CHM 341, CHM 194
Attribute/Distribution: NS

CHM 301 Chemistry Seminar 1 Credit
A course designed for seniors will involve the literature research of a topic of the student’s choosing followed by a 35 minute oral presentation to the class and professor. Must have senior standing.

CHM 307 Advanced Inorganic Chemistry 3 Credits
Introduction to transition metal complexes; theories of bonding; kinetics and mechanisms of transition metal complex reactions; selected aspects of organometallic chemistry; bioinorganic chemistry.
Prerequisites: CHM 341 or CHM 194

CHM 332 Analytical Chemistry 3 Credits
Theory and practice of chemical analysis. Principles of quantitative separations and determinations; theory and application of selected optical and electrical instruments in analytical chemistry; interpretation of numerical data, design of experiments, solute distribution in separation methods.
Prerequisites: (CHM 031 or CHM 041) and CHM 110
Attribute/Distribution: NS

CHM 334 Advanced Chemistry Laboratory I 3 Credits
Exploration of synthetic methods and analysis techniques for inorganic and organic compounds. Determination of product structures and quantitative analysis using modern chemical analysis techniques, including NMR, GC-MS, GC, HPLC, FT-IR, and XPS.
Prerequisites: (CHM 110 and CHM 111 and CHM 112 and CHM 113 and CHM 332)
Can be taken Concurrently: CHM 332
Attribute/Distribution: NS

CHM 335 Advanced Chemistry Laboratory II 3 Credits
Content related to CHM 334.
Prerequisites: (CHM 334)

CHM 336 Clinical Chemistry 3 Credits
Applications of analytical chemistry to clinical problems. Discussion of methods in common use and the biochemical/medical significance of the results.
Prerequisites: CHM 332 or CHM 112
Attribute/Distribution: NS

CHM 337 Crystallography and Diffraction 3 Credits
Introduction to crystal symmetry, point groups, and space groups. Emphasis on materials characterization by X-ray diffraction and electron diffraction. Specific topics include crystallographic notation, stereographic projections, orientation of single crystals, textures, phase identification, quantitative analysis, stress measurement, electron diffraction, ring and spot patterns, convergent beam electron diffraction (CBED), and space group determination. Applications in mineralogy, metallurgy, ceramics, microelectronics, polymers, and catalysts. Lectures and laboratory work. Prerequisites may be waived if student has senior standing in chemistry.
Prerequisites: MAT 203 or EES 131
Attribute/Distribution: NS

CHM 341 Molecular Structure, Bonding and Dynamics 3 Credits
Nature of chemical bonding as related to structure and properties of molecules and extended systems. Quantum chemistry of atoms and molecules applied to chemical transformations and spectroscopic transitions. Symmetry analysis and selection rules. Interpretation of electronic, vibrational and rotational spectra.
Prerequisites: (MATH 022 or MATH 096 or MATH 032) and (PHY 011 or PHY 013) and (CHM 031 or CHM 041)
Attribute/Distribution: NS

CHM 342 Thermodynamics & Kinetics 3 Credits
Development of the principles of classical and statistical thermodynamics and their application to chemical systems. In classical thermodynamics emphasis will be on systems in which composition is of major concern: solutions, chemical and phase equilibria. Kinetic theory of gases; chemical reaction kinetics; chemical reaction dynamics.
Prerequisites: (CHM 031 or CHM 041) and (PHY 013 or PHY 021) and (MATH 022 or MATH 023)

CHM 343 Physical Chemistry Laboratory 2 Credits
Laboratory studies that illustrate and extend the various fields of study in experimental physical chemistry as discussed in CHM 341 and CHM 342. This course fulfills the junior year writing intensive course requirement in CAS.
Prerequisites: (CHM 194 or CHE 210) or (CHM 341 and CHM 342)
Can be taken Concurrently: CHM 342
Attribute/Distribution: NS

CHM 350 Special Topics 1-3 Credits
Selected advanced topics in chemistry.
Repeat Status: Course may be repeated.
Attribute/Distribution: NS

CHM 358 Advanced Organic Chemistry 3 Credits
Reaction mechanism types and supporting physical-chemical data. Classes of mechanisms include elimination, substitution, rearrangement, oxidation-reduction, enolate alkylations, and others. Must have completed one year of organic chemistry.
Prerequisites: CHM 112
Attribute/Distribution: NS

CHM 371 (BIOS 371) Elements of Biochemistry I 3 Credits
A general study of carbohydrates, proteins, lipids, nucleic acids and other biological substances and their importance in life processes. Protein and enzyme chemistry are emphasized. Must have completed one year of organic chemistry.
Prerequisites: CHM 112
Attribute/Distribution: NS

CHM 372 (BIOS 372) Elements of Biochemistry II 3 Credits
Dynamic aspects of biochemistry: enzyme reactions including energetics, kinetics and mechanisms, metabolism of carbohydrates, lipids, proteins and nucleic acids, photosynthesis, electron transport mechanisms, coupled reactions, phosphorylations, and the synthesis of biological macromolecules.
Prerequisites: (BIOS 371 or CHM 371) and BIOS 041
Attribute/Distribution: NS

CHM 375 Research Chemistry Laboratory 1-3 Credits
An introduction to independent study or laboratory investigation under faculty guidance. Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: NS
CHM 376 Advanced Research Chemistry Laboratory 1-6 Credits
Advanced independent study or laboratory investigation under faculty guidance. Consent of faculty research supervisor. Repeat Status: Course may be repeated. Attribute/Distribution: NS

CHM 377 (BIOS 377) Biochemistry Laboratory 3 Credits
Laboratory studies of the properties of chemicals of biological origin and the influence of chemical and physical factors on these properties. Laboratory techniques used for the isolation and identification of biochemicals. Prerequisites: (BIOS 371 or CHM 371) and (BIOS 031 or BIOS 041) Can be taken Concurrently: BIOS 371, CHM 371 Attribute/Distribution: NS

CHM 388 (CHE 388, MAT 388) Polymer Synthesis and Characterization Laboratory 3 Credits
Techniques include: free radical and condensation polymerization; molecular weight distribution by gel chromatography; crystallinity and order by differential scanning calorimetry; pyrolysis and gas chromatography; dynamic mechanical and dielectric behavior; morphology and microscopy; surface properties. Prerequisites: (CHM 341 or CHE 210 or CHM 342) and CHM 110 Attribute/Distribution: NS

CHM 389 Honors Project 1-6 Credits
Repeat Status: Course may be repeated.

CHM 391 (CHE 391) Colloid and Surface Chemistry 3 Credits
Physical chemistry of everyday phenomena. Intermolecular forces and electrostatic phenomena at interfaces, boundary tensions and films at interfaces, mass and charge transport in colloidal suspensions, electrostatic and London forces in disperse systems, gas adsorption and heterogeneous catalysis. Prerequisites: CHM 342 Attribute/Distribution: NS

CHM 393 (CHE 393, MAT 393) Physical Polymer Science 3 Credits
Structural and physical aspects of polymers (organic, inorganic, natural). Molecular and atomic basis for polymer properties and behavior. Characteristics of glassy, crystalline, and paracrystal-line states (including viscoelastic and relaxation behavior) for single- and multi-component systems. Thermodynamics and kinetics of transition phenomena. Structure, morphology, and behavior. Must have senior level standing in CHE, CHEM, or MAT. Attribute/Distribution: NS

CHM 394 (CHE 394) Organic Polymer Science I 3 Credits
Organic chemistry of synthetic high polymers. Polymer nomenclature, properties, and applications. Functionality and reactivity or monomers and polymers. Mechanism and kinetics of step-growth and chain-growth polymerization in homogenous and heterogenous media. Brief description of emulsion polymerization, ionic polymerization, and copolymerization. Must have completed one year of physical chemistry and one year of organic chemistry. Prerequisites: CHM 112 or CHM 342 or CHE 210 Attribute/Distribution: NS

CHM 400 First Year Graduate Student Seminar 0 Credits
First year graduate student seminar course and introduction to research. Topics include: research opportunities in the department, introduction to instrumentation facilities, ethics in science, use of library facilities, effective teaching methods.

CHM 405 Organometallic Chemistry 3 Credits
The chemistry of compounds containing carbon to metal bonds. Among topics covered are the following: organic compounds of the representative elements from Group I to IV; the chemistry of ferrocene and related pi-bonded organometallic complexes; metal carbonyl and nitrosyl complexes; dioxygen and dinitrogen complexes; organic synthesis utilizing organometallic catalysts.

CHM 407 Advanced Inorganic Chemistry 3 Credits
Introduction to transition metal complexes; theories of bonding; kinetics and mechanisms of transition metal complex reactions; selected aspects of organometallic chemistry; bio-inorganic chemistry. Must have completed one semester of physical chemistry and have CAS graduate student status.

CHM 412 Chemistry Research 1-6 Credits
Research in one of the following fields of chemistry: analytical, inorganic, organic, physical, polymer, biochemistry.

CHM 423 Bio-Organic Chemistry 3 Credits
An examination of biochemistry on the basis of organic chemical principles. Emphasis on reaction mechanisms of biochemical transformations and methods for elucidation of these mechanisms, i.e., kinetics, isotope effects, exchange techniques, inhibition studies, substrate analog effects and organic model studies.

CHM 424 Medicinal and Pharmaceutical Chemistry 3 Credits
Principles of drug design, structure-reactivity relationships in antibacterial, antimalarial, antiinflammatory and psychoactive drugs; synthesis and modes of action of pharmacologically active agents radioactive pharmaceuticals. Prerequisites: CHM 358

CHM 425 Pharmaceutical Regulatory Affairs 1: Drug Discovery to Approval 3 Credits
Coverage includes the stages of the drug approval process and how these relate to the laboratory activities that provide the scientific basis of the New Drug Application (NDA). Lectures treat drug discovery, chemical process development of the active pharmaceutical ingredient (API), and pharmaceutical process development of the drug product. Regulatory issues in screening and testing, the management of the preclinical trials, and the management of clinical trials will be covered. Attribute/Distribution: NS

CHM 426 3 Credits
Principles and applications of statistical mechanics to chemical problems. A study of the techniques for evaluating the properties of matter in bulk from the properties of molecules and their interactions.

CHM 427 Thermodynamics & Kinetics 3 Credits
Development of the principles of classical and statistical thermodynamics and their applications to chemical systems. In classical thermodynamics, emphasis will be on systems in which composition is of major concern: solutions, chemical and phase equilibria. Kinetic theory of gases; chemical reaction kinetics. Must have CAS graduate student status. This course cannot be taken by students who have already taken CHM 342.

CHM 428 Pharmaceutical Regulatory Affairs-II-Biomarkers for Pharmaceutics and Diagnostics: Laws & Regulation 3 Credits
For decades diagnostic products and technologies have been used to monitor or detect a variety of indicators for disease and infection. Each year, over 4,000 devices are reviewed by the U.S. Food & Drug Administration for safety and efficacy before being allowed to enter the marketplace. Today, regulations have set in motion the use of Biomarkers as a key element for new pharmaceutical development. Biomarkers in a way similar to Diagnostic markers will become a method to demonstrate safety and efficacy of experimental drugs during human trials. This course will review the history of Biomarker and medical device law and regulations in the United States. It will also define the current scientific requirements for Biomarkers to meet the new regulations. Case studies will be used to educate participants on the use of Biomarkers in pharmaceutical development as well as Design Controls, Quality System Regulations, Manufacturing Requirements for diagnostic testing technologies. Specific examples include Nucleic Acid Diagnostics, Cardiovascular Stents, Drug Delivery, Cancer Diagnostics, and Consumer Self-Testing. Students will also use knowledge gained to prepare class presentations to address current issues within the field. This course is one of four courses required to fulfill the requirements for a Certificate in Regulatory Affairs. It may be applied as a 400-level credit in the Masters of Chemistry degree program. Attribute/Distribution: NS
CHM 430 Chemical and Biochemical Separations 3 Credits
Theory and applications of equilibrium and nonequilibrium separation techniques at both the analytical and preparative levels. Solvent and buffer extractions, chromatographic separations (e.g., thin layer, partition, gas liquid, gel filtration, ion exchange, affinity, supercritical fluid), electrophoretic separations (e.g., gel, capillary, isoelectric focusing, immunoelctrophoresis), centrifugal separations (e.g., differential, velocity sedimentation, density gradient) and other separation methods (e.g., dialysis, ultrafiltration). Examples will focus on biological applications.

CHM 431 Contemporary Topics in Analytical Chemistry 1 Credit
Discussion of the current literature in analytical chemistry, including spectroscopy, separations, and electrochemistry. Students find current papers and lead discussions.
Repeat Status: Course may be repeated.

CHM 432 Chemometrics 3 Credits
Mathematical and statistical methods for experimental design, calibration, signal resolution, and instrument control and optimization.

CHM 434 Advanced Topics in Spectroscopy 3 Credits
Fundamentals of interactions of electromagnetic radiation with matter: electronic, vibrational, scattering based spectroscopies, instrumentation and signal processing. Advanced applications to the analysis of molecular structure and chemical processes including surface analysis, time-resolved spectroscopies, and ultrasensitive spectroscopic techniques.

CHM 436 Special Topics in Analytical Chemistry 1-3 Credits
Topics of contemporary interest in analytical chemistry.
Repeat Status: Course may be repeated.

CHM 437 (BIOS 437) Pathophysiological Chemistry 3 Credits
Biochemical basis of human diseases involving abnormal metabolism of proteins, nucleic acids, carbohydrates, and lipids. Emphasis on the correlation of the clinical presentation of disease processes seen as physiological dysfunctions with clinical laboratory methods. Lectures, student presentations, and clinical case discussions. Must have completed one semester of biochemistry.

CHM 438 Analytical Chemistry 3 Credits
Theory and practice of chemical analysis. Principles of quantitative separations and determinations; theory and application of selected optical and electronic instruments in analytical chemistry; interpretation of numerical data; design of experiments; solute distribution in separation methods. Must have CAS graduate student status.

CHM 442 Pharmaceutical Regulatory Affairs 3: Analytical Methods, Calibration, and Data Manipulation 3 Credits
A review of the FDA guidance and common industry practices. A presentation of the more user-friendly and higher accuracy analytical methods, which are supplanting traditional analyses. Lectures will cover the eight fundamentals of analytical method validation: accuracy, linearity, precision, limits of detection, selectivity, limits of quantification, specificity, and ruggedness of method. In addition, the student will be taught what to do when the results do not meet the Acceptance Criteria. Lectures also cover evaluation of data streams for supporting conclusions.

CHM 443 (MAT 443) Solid-State Chemistry 3 Credits
Crystal structure, diffraction in crystals and on surfaces, bonding and energy spectra in solids dielectrics, surface states and surface fields in crystals. Must have completed one course in linear algebra and one course in quantum mechanics.

CHM 444 Molecular Structure, Bonding and Dynamics 3 Credits
Nature of chemical bonding as related to structure and properties of molecules and extended systems. Quantum chemistry of atoms and molecules applied to chemical transformations and spectroscopic transitions. Symmetry analysis and selection rules. Interpretation of electronic, vibrational and rotational spectra. Must have CAS graduate student status.

CHM 452 Advanced Organic Chemistry 3 Credits
Reaction mechanism types and supporting physical chemical data. Classes of mechanisms include elimination, substitution, rearrangement, oxidation reduction, enolate alkylations, and others. Must have completed one year of organic chemistry and have CAS graduate student status.

CHM 453 Heterocyclic Compounds 3 Credits
An intensive study of the syntheses, reactions and properties of heteroaromatic compounds including derivatives of thiophene, pyrrole, furan, indole, pyridine, quinoline, the azoles and the diazines all considered from the viewpoint of modern theories of structure and reaction mechanisms.
Prerequisites: CHM 358 or CHM 452

CHM 455 Organic Reactions 3 Credits
Prerequisites: or CHM 452, CHM 358 or CHM 452

CHM 456 Spectral Analysis 3 Credits
Use of data from nuclear magnetic resonance, infrared, ultraviolet, and mass spectrometric techniques for the determination of structure of organic compounds. Emphasis on information from one- and two-dimensional proton and carbon NMR, and a mechanistic interpretation of data from mass spectrometry.

CHM 457 Organic Reaction Mechanisms 3 Credits
Intensive in class problem solving that involves the formulation of reasonable reaction mechanisms for complex multistep pathways, i.e., organic transformations that proceed via highly energetic intermediates such as carbocations, carbanions, free radicals, carbenes, and nitrenes.

CHM 458 Topics in Organic Chemistry 1-3 Credits
An intensive study of limited areas in organic chemistry.
Repeat Status: Course may be repeated.

CHM 462 3 Credits
This course focuses on the physical tools that exist to obtain information about biological macromolecules, with an emphasis on spectroscopic and imaging techniques (e.g., circular dichroism, fluorescence spectroscopy, FRET, BRET, calorimetry, analytical ultracentrifugation, X-ray crystallography, electron microscopy, dynamic light scattering, surface plasmon resonance). Lectures and discussion of research articles are used to illustrate the use of the different tools and methods.

CHM 463 Pharmaceutical Regulatory Affairs 4: Commercial Production, Validation, and Process Qualification 3 Credits
This course covers the scientific principles and the registry requirements for polymeric implants, controlled-release drug depot units, pumps, point-of-care testing kits, contrast media for MRI, x-ray, and ultrasound and all FDA controlled products not defined as therapeutic pharmaceuticals.

CHM 465 Protein Separation & Biophysical Analysis 3 Credits
Laboratory studies of techniques and principles used for the isolation, characterization, and biophysical analysis of proteins.
Attribute/Distribution: NS

CHM 467 (BIOS 467) Principles of Nucleic Acid Structure 3 Credits
An examination of the principles underlying nucleic acid structure including stereochemistry, electrostatics, hydration, torsional constraints, sequence specific effects, and interaction with nuclear proteins. Special emphasis will be placed on DNA structure. Must have completed one year of biochemistry and one year of physical chemistry or have consent of the department chair.

CHM 468 (BIOS 468) Principles of Protein Structure 3 Credits
An examination of the principles underlying protein structure including stereochemistry, preferred tertiary structures, protein homology, excluded volume effects, time dependent structural fluctuations, and prediction of protein structure from sequence information. Must have completed one year of biochemistry and one year of physical chemistry or consent of department required.
CHM 469 (BIO 469) Biochemical Problem Solving I 1 Credit
Applications of material covered in BIOS/CHM 371 including techniques used in research.

CHM 470 (BIO 470) Biochemical Problem Solving II 1 Credit
Applications of concepts covered in BIOS/CHM 372 including techniques used in research.

CHM 472 (BIO 472) Lipids and Membranes 3 Credits
Structure, physical properties and functions of lipids and their biological aggregates. Techniques for studying lipid assemblies, enzymes which act on lipids, membrane proteins and lipoproteins will also be discussed. Consent of department chair.

Prerequisites: BIOS 372 or CHM 372

CHM 474 Pharmaceutical Regulatory Affairs 5: Pharmaceutics 3 Credits
This course covers the development of therapeutic products subsequent to the initial discovery of the active pharmaceutical ingredient (API) through to the final dosage form. Both small molecule drugs and biotechnological pharmaceuticals will be included. Issues of API formulation, choice of excipients, control of release, target specificity, mode of delivery, drug-drug interactions, and product stabilization will be addressed with special reference to the regulatory issues involved at that stage of drug development. This course builds upon a foundation in organic, analytical, and biochemistry.

CHM 475 Advanced Topics in Chemistry 1 Credit
Audiovisual courses in topics such as acid-base theory, NMR, chromatography, electroanalytical chemistry and mass-spectroscopy interpretation; course material obtained from the American Chemical Society.

Repeat Status: Course may be repeated.

CHM 477 (BIO 477) Topics in Biochemistry 1-3 Credits
Selected areas of biochemistry, such as mechanisms of enzyme action, new developments in the chemistry of lipids, nucleic acids, carbohydrates and proteins. Must have completed one semester of biochemistry.

Repeat Status: Course may be repeated.

CHM 479 (BIO 479) Biochemical Techniques 3 Credits
Laboratory studies of the techniques and principles involved in the isolation, identification, and biochemical transformation of carbohydrates, lipids, nucleic acids and proteins.

Repeat Status: Course may be repeated.

CHM 480 (BIO 480) Advanced Biochemical Preparations 1-3 Credits
An advanced laboratory course in the preparation, isolation, purification, and identification of biochemically produced materials. Emphasis is placed on materials and procedures of current interest in biochemistry. Must have completed two semesters of biochemistry.

Repeat Status: Course may be repeated.

CHM 481 Chemistry Seminar 1-6 Credits
Student presentations on current research topics in the student’s discipline but not on subjects close to the thesis. A one-hour presentation and attendance at other presentations are required for credit.

Repeat Status: Course may be repeated.

CHM 482 (CHE 482, MAT 482) Mechanical Behaviors of Polymers 3 Credits
Mechanical behavior of polymers. Characterization of experimentally observed viscoelastic response of polymeric solids with the aid of mechanical model analogs. Topics include time-temperature superposition, experimental characterization of large deformation and fracture processes, polymer adhesion, and the effects of fillers, plasticizer, moisture, and aging on mechanical behavior.

Repeat Status: Course may be repeated.

CHM 483 (CHE 483) Emulsion Polymers 3 Credits
Fundamental concepts important in manufacture, characterization, and application of polymer latexes. Topics include colloidal stability, polymerization mechanisms and kinetics, reactor design, characterization of particle surfaces, latex rheology, morphology considerations, polymerization with functional groups, film formation and various application problems.

CHM 485 (CHE 485, MAT 485) Polymer Blends and Composites 3 Credits
Synthesis, morphology, and mechanical behavior of polymer blends and composites. Mechanical blends block and graft copolymers, interpenetrating polymer networks, polymer impregnated solids and fiber and particulate-reinforce polymers are emphasized.

Repeat Status: Course may be repeated.

CHM 487 Topics in Colloid and Surface Chemistry 3 Credits
Applications of colloid chemistry; special topics in surface chemistry. Lectures and seminar.

Repeat Status: Course may be repeated.

CHM 488 Advanced Topics in Physical Chemistry 1-3 Credits
Advanced topics in physical chemistry, such as photochemistry and molecular beam dynamics, Fourier transform spectroscopy, kinetics of rapid reactions, theory of magnetic resonance, liquids and solutions.

Repeat Status: Course may be repeated.

CHM 489 Organic Polymer Science II 3 Credits
Continuation of CHM 394. Theory and mechanism of ionic vinyladdition chaingrowth polymerization. Chain copolymerization by radical and ionic mechanism. Mechanism of ring-opening polymerization, stereochemistry of polymerization including ionic, coordination, and Ziegler-Natta mechanisms. Reactions of polymers, including crosslinking, reaction of functional groups, graft and block copolymers, and polymer carriers and supports.

CHM 490 Thesis 1-6 Credits
Repeat Status: Course may be repeated.

CHM 492 (CHE 492, MAT 492) Topics in Polymer Science 3 Credits
Intensive study of topics selected from areas of current research interest such as morphology and mechanical behavior, thermodynamics and kinetics of crystallization, new analytical techniques, molecular weight distribution, non-Newtonian flow behavior, second-order transition phenomena, novel polymer structures. Credit above three hours is granted only when different material is covered.

CHM 494 Quantum Chemistry 3 Credits
Principles and applications of quantum mechanics to chemical problems. Applications to chemical bonding, molecular structure, reactivity and spectroscopy.

CHM 499 Dissertation 1-15 Credits
Repeat Status: Course may be repeated.

Civil and Environmental Engineering

CIVIL ENGINEERING

Civil engineering occupies a prominent position as one of the major fields in the engineering profession. Civil engineers are concerned with all aspects of the conception, planning, design, construction, operation, and maintenance of major physical works and facilities that are essential to modern life. Civil engineering projects are typically characterized by extreme size, complexity, durability, and cost. Examples include bridges, buildings, transportation facilities, tunnels, coastal facilities, dams, foundations, and waterways.

The Mission of our Civil Engineering Bachelor of Science degree program is to educate students in the principles and methods essential to the practice and advancement of civil and environmental engineering. Our goal is to prepare students to apply and continually cultivate knowledge that will enable them to become successful practitioners, innovators and leaders in serving the needs of a complex society.

The Program Educational Objectives of our accredited Civil Engineering Bachelor of Science program are to prepare Civil Engineering Graduates to:

1. Develop careers in civil engineering and other professionally related fields.
2. Seek additional professional training and personal development.
3. Apply their skills to develop innovative solutions and technologies.
4. Pursue professional licensure and/or certification.
5. Advance to become members of professional societies and future leaders in their profession.

To achieve the program education objectives, the civil engineering program has adopted the following eleven ABET student outcomes:
To achieve the program education objectives, the environmental engineering graduates to:

1. Develop careers in environmental engineering and other professionally related fields
2. Seek additional professional training and personal development.
3. Apply their skills to develop innovative solutions and technologies.
4. Pursue professional licensure and/or certification.
5. Advance to become members of professional societies and future leaders in their profession.

To achieve the program education objectives, the environmental engineering program has adopted the following eleven ABET student outcomes:

- An ability to apply knowledge of mathematics, science, and engineering
- An ability to design and conduct experiments, as well as to analyze and interpret data
- An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- An ability to function on multidisciplinary teams
- An ability to identify, formulate, and solve engineering problems
- An understanding of professional and ethical responsibility
- An ability to communicate effectively
- The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- A recognition of the need for, and an ability to engage in life-long learning
- A knowledge of contemporary issues
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

ENVIRONMENTAL ENGINEERING

Environmental Engineering is an interdisciplinary branch of the engineering profession where science and engineering principles are combined to provide healthy soil, water and air; remediate contaminated sites; and to improve the overall quality of the environment through the development of sustainable processes. Example activities include design of water and wastewater treatment facilities, detecting and modeling fate and transport of contaminants in both natural and engineered environments; developing technology-based solutions for restoring environmental quality; and developing and/or modifying industrial processes for ecological preservation and enhanced sustainability.

The Mission of our Environmental Engineering Bachelor of Science degree program is to educate students in the principles and methods essential to the practice and advancement of the interdisciplinary field of environmental engineering. The program is proactive and continues to incorporate new and emerging paradigms in all aspects of teaching and education while maintaining rigorous standards in traditional approaches to engineered solutions of environmental problems. Graduates of the program possess technical expertise required to maintain a healthy balance between societal welfare, economic growth and the environment surrounding us.

The Program Educational Objectives of our accredited Environmental Engineering Bachelor of Science program are to prepare environmental engineering graduates to:

1. Develop careers in environmental engineering and other professionally related fields
2. Seek additional professional training and personal development.
3. Apply their skills to develop innovative solutions and technologies.
4. Pursue professional licensure and/or certification.
5. Advance to become members of professional societies and future leaders in their profession.

To achieve the program education objectives, the environmental engineering program has adopted the following eleven ABET student outcomes:

- An ability to apply knowledge of mathematics, science, and engineering
- An ability to design and conduct experiments, as well as to analyze and interpret data
- An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- An ability to function on multidisciplinary teams
- An ability to identify, formulate, and solve engineering problems
- An understanding of professional and ethical responsibility
- An ability to communicate effectively
- The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- A recognition of the need for, and an ability to engage in life-long learning
- A knowledge of contemporary issues
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

EDUCATIONAL AND CAREER OPPORTUNITIES

In each curriculum, emphasis is placed on the development of a solid knowledge of civil or environmental engineering fundamentals. Both undergraduate programs include a strong base of mathematics, including calculus, probability and statistics, and the physical sciences, followed by a course in planning and engineering economics. A broad range of required and elective courses in engineering science, analysis and design in the areas listed above meet each set of program objectives. Elective courses in both programs extend across the areas of structural, geotechnical, hydraulic, environmental, construction, project management, and transportation engineering. Additional elective courses in the environmental program are available from chemical engineering, chemistry, biology, and earth and environmental science. Five-year programs are available for students interested in a second bachelor’s degree in a major in the College of Arts and Sciences (see listings under Arts-Engineering (p. 82); Civil Engineering and Earth and Environmental Sciences (p. 154)).

Three civil and environmental engineering programs prepare individuals for entry into the engineering profession or for entry into high-quality programs of graduate study. With proper selection of electives, students may also prepare for entrance into schools of law or medicine, or into master’s-level programs in engineering management or business administration. For additional useful information visit our departmental website www.lehigh.edu/~incee/.

Professors. Panayiotis Diplas, PhD (University of Minnesota Twin Cities); Dan M. Frangopol, SCD (Universite de Liege); Gerard P. Lennon, PhD (Cornell University); Clay Joshua Naito, PhD (University of California Berkeley); Sibel Pamukcu, PhD (Louisiana State University); Stephen P. Pessiki, PhD (Cornell University); James M. Ricles, PhD (University of California Berkeley); Richard Sause, Jr., PhD (University of California Berkeley); Arup K. Sengupta, PhD (University of Houston University Park); Richard N. Weisman, PhD (Cornell University); John L. Wilson, PhD (University of Pittsburgh)

Associate Professors. Derick G. Brown, PhD (Princeton University); Kristen Jellison, PhD (Massachusetts Institute of Technology); Peter Mueller, DSc (ETH Zurich); Shamim N. Pakzad, PhD (University of California Berkeley); Muhammad T. Suleiman, PhD (Iowa State University)

Assistant Professors. Paolo Bocchini, PhD (University of Bologna); John Thomas Fox, PhD (The Pennsylvania State University); Spencer E. Quiel, PhD (Princeton University); Tara J. Troy, PhD (Princeton University)

Professors Of Practice. Jennifer H. Gross, MS (University Texas, Austin); Mesut Pervizpour, PhD (Lehigh University)

Emeriti. John Hartley Daniels, PhD (Lehigh University); Hsai-Yang Fang, PhD (West Virginia Univ); John W. Fisher, PhD (Lehigh University); Ti Huang, PhD (University of Michigan Ann Arbor); Alexis Ostapenko, SCD (Massachusetts Institute of Technology); Robert M. Sorensen, PhD (University of California Berkeley); David A. Van Horn, PhD (Iowa State University); Ben T. Yen, PhD (Lehigh University)

- Civil Engineering (p. 145)
- Environmental Engineering (p. 146)
- Technical Minor in Environmental Engineering (p. 147)

B.S. IN CIVIL ENGINEERING

Required Courses

A total of 130 credit hours are required for graduation with the degree of Bachelor of Science in Civil Engineering.
### Recommended Sequence of Courses

The HSS Advanced Requirement of 13 credits is shown below as three 3-credit courses and one 4-credit course. Other options are possible.

#### First Year

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<td>CEE 262 or 264</td>
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#### Fourth Year

<table>
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<tr>
<th>Semester</th>
<th>Credits</th>
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<tr>
<td>CEE 203</td>
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<td>CEE 290</td>
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<tr>
<td>AE CEE Approved Electives²</td>
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<td>AE CEE Approved Electives²</td>
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<td>HSS Humanities/Social Sciences Elective</td>
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<td>HSS Humanities/Social Science Elective</td>
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<tr>
<td>FE Free Elective</td>
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<td>FE Free Elective</td>
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</tr>
</tbody>
</table>

#### Total Credits: 130

1. Basic Science Elective; list of approved courses is available from CEE department.
2. Seventeen CEE elective credits approved by the CEE department; list available from department.

The selection of elective courses is to be in consultation with student’s academic adviser in the Department of Civil and Environmental Engineering.

### B.S. IN ENVIRONMENTAL ENGINEERING

#### Required Courses

A total of 131 credit hours are required for graduation with the degree Bachelor of Science in Environmental Engineering.

#### Recommended Sequence of Courses

The HSS Advanced Requirement of 13 credits is shown below as three 3-credit courses and one 4-credit course. Other options are possible.

#### First Year

<table>
<thead>
<tr>
<th>Semester</th>
<th>Credits</th>
<th>Course</th>
<th>Credits</th>
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<tr>
<td>ENGL 001</td>
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<td>ENGL 002</td>
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<tr>
<td>MATH 021</td>
<td>4</td>
<td>MATH 022</td>
<td>4</td>
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<td>CHM 030</td>
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<td>MATH 022</td>
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<tr>
<td>ENGR 005</td>
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<td>ENGR 010</td>
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<tr>
<td>FE Free Elective</td>
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#### Second Year

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<th>Semester</th>
<th>Credits</th>
<th>Course</th>
<th>Credits</th>
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<tr>
<td>Select one of the following:</td>
<td>4</td>
<td>CEE 170</td>
<td>4</td>
</tr>
<tr>
<td>CEE 003, MECH 002, or MECH 003</td>
<td>3</td>
<td>CEE 272</td>
<td>2</td>
</tr>
<tr>
<td>CEE 012</td>
<td>2</td>
<td>CHM 031</td>
<td>4</td>
</tr>
<tr>
<td>MATH 023</td>
<td>4</td>
<td>MATH 205</td>
<td>3</td>
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<tr>
<td>ECO 001</td>
<td>4</td>
<td>PHY 021  &amp; PHY 022</td>
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<tr>
<td>EES 022</td>
<td>1</td>
<td>ESR Earth Science Requirement³</td>
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</tbody>
</table>

#### Total Credits: 131

1. HSS Advanced requirement is 13 credits, four credits of which must be an approved environmental studies course; list of approved courses is available from CEE department.
2. Nine approved elective credits to satisfy proficiency in four focus areas of water supply and resources, environmental chemistry, waste management and biological processes; approved list available from CEE department.
3. Earth Science Requirement, list of approved courses is available from CEE department.
4. Environmental Biology Requirement, list of approved courses is available from CEE department.

The selection of elective courses is to be in consultation with student’s academic adviser in the Department of Civil and Environmental Engineering.
TECHNICAL MINOR IN ENVIRONMENTAL ENGINEERING

A technical minor in Environmental Engineering is available for students outside the department. At least two of the courses must be from the CEE department.

CHM 031 Chemical Equilibria in Aqueous Systems (Prerequisite) 4

Select three of the following required courses: 9-10

CEE 170 Introduction to Environmental Engineering
CEE 274 Environmental Water Chemistry
CEE/CHE 373 Fundamentals of Air Pollution
CEE/CHE 375 Environmental Engineering Processes

Select one additional course from the required list or from the following: 3

CEE 222 Water Resources Engineering
CEE/EES 323 Environmental Groundwater Hydrology
CEE/EES 327 Surface Water Quality Modeling
CEE 345 Geo-Environmental Engineering
CEE 370 Environmental Separation and Control
CEE 371 Reaction Kinetics in Environmental Engineering

Other courses may be selected with the minor adviser’s approval.

GRADUATE PROGRAMS

The Department of Civil and Environmental Engineering (CEE) has graduate degree programs leading to Master’s and Ph.D. degrees in: Civil Engineering, Structural Engineering, and Environmental Engineering.

The department offers advanced work in the specialty areas of structural engineering, geotechnical engineering, water resources engineering, and environmental engineering. Degrees offered are:

M.Eng., M.S., Ph.D. in Structural Engineering
M.Eng., M.S., Ph.D. in Civil Engineering
M.Eng., M.S., Ph.D. in Environmental Engineering

The programs educate students through coursework and independent study and research. Our programs are designed to provide students with the knowledge and analytical problem-solving capabilities needed to lead and innovate within multi-disciplinary teams in technologically-complex environments.

Graduate studies in the department of civil and environmental engineering enable the student to build upon the broad background of undergraduate education in preparation for professional practice at an advanced level, for research and development, or for teaching.

A graduate program leading to the M.S. normally is concentrated in one, or possibly two, of the technical specialty areas, and consists of a number of courses designed to fulfill the individual student’s program objectives. Each candidate for the M.S. is required to submit a thesis representing three to six credit hours (CEE 491), or alternatively, a report based on a research course of at least three credits (CEE 429, CEE 439, CEE 449, CEE 479 or CEE 481). The balance of the program will consist of courses in the specialty area(s).

A graduate program leading to the M.Eng. degree stresses engineering applications and design. The department offers two different M.Eng. degrees. The M.Eng. in Structural Engineering focuses specifically on structural engineering. Candidates for the M.Eng. in Structural Engineering degree complete a group design project and an individual project as part of a 3-course design project sequence (CEE 416, CEE 417, CEE 418). The M.Eng. degrees in Civil Engineering and Environmental Engineering allow students to select courses across the various specialty areas of civil and environmental engineering. Candidates for the M.Eng. degrees in Civil Engineering and Environmental Engineering have the option to complete an individual engineering project or a research report, representing 3 to 6 credits (CEE 480), or may take 30 course credits with no project or report.

The doctoral program, which leads to the Ph.D., normally includes courses in the major field, courses in minor fields, and a dissertation presenting results of original research. Holders of master’s degrees planning to become candidates for the Ph.D. take a qualifying examination. After qualification, the candidate, the candidate’s departmental Ph.D. committee, and the department chair formulate the program of work.

The departmental laboratories are located in the Fritz Engineering Laboratory and in the STEPS Building. The laboratories offer outstanding facilities for research and instruction in structural engineering, geotechnical engineering, water resources engineering, and environmental engineering. In particular, the structural testing equipment includes dynamic testing machines, a five-million-pound universal hydraulic testing machine, and other state-of-the-art facilities. Included in the latter are the facilities of the Center for Advanced Technology for Large Structural Systems (ATLSS center) located on the montainotop campus. These include the largest 3-dimensional test bed in the U.S.A. and specialized earthquake testing facilities of the NSF George E. Brown, Jr. Network Earthquake Engineering Simulation (NEES). The water resources facilities include a wave tank, several flumes, a 10-cfs recirculating flow system, and two multipurpose tanks for model studies. The geotechnical facilities include state-of-the-art, fully automated triaxial compression and permeability machines for multiple simultaneous tests. The environmental facilities include state-of-the-art laboratories and analytical instrumentation for analysis of chemical, physical and microbiological systems.

In addition to departmental courses, a number of courses offered by the departments of mechanical engineering and mechanics, chemistry, chemical engineering, materials science and engineering, earth and environmental sciences, and biology may also be considered a part of the major field in civil and environmental engineering. A number of research and teaching assistantships are available to provide financial support to students of outstanding promise. The research or teaching activities required of holders of assistantships provides a valuable educational experience that supplements the formal course offerings. A very limited number of scholarships and fellowships are available to provide financial support for full-time study.

Courses

CEE 003 Engineering Statics 3 Credits
Prerequisites: PHY 011 and (MATH 022 or MATH 096)
Can be taken Concurrently: MATH 022, MATH 096

CEE 010 (ARCH 010) Engineering/Architectural Graphics and Design 3 Credits
Graphical communication of civil engineering and architectural projects using manual techniques and commercial state-of-the-art computer software. Topics include visualization and sketching; orthographic, isometric and other drawings; points, lines and planes in descriptive geometry; site design; overview of geographical information systems and 3-D applications. Teamwork on design projects with oral and graphical presentations. Open to a limited number of architecture, design arts or other students with project roles consistent with students’ background. Not available to students who have taken ME 010.

CEE 011 Surveying 1 Credit
Theory and practice of basic engineering surveying measurements and analysis. Topics to include field note taking, datums and measurement precision, equipment and techniques for measuring distance, elevation and angles, electronic distance measurement, topographic surveys, GPS and hydrographic surveys. Hands on experience with the use of survey levels, transits/theodolites and a total station will be provided.

CEE 012 Civil Engineering Statistics 2 Credits
Basic engineering statistics with a civil engineering orientation. Topics to include: random variables and histograms; central tendency, dispersion and skew; probability density functions and cumulative distribution functions, basic probability concepts and selected probability models, return period analysis, linear regression and least squares, correlation analysis, propagation of errors.
CEE 059 Strength of Materials 3 Credits
Principles stress and strain; Hooke's law, Mohr’s circle for stress, transverse shear in beams, extension, torsion, and bending; beam deflections, column buckling, combined stresses, and plastic yield criteria.
Prerequisites: (CEE 003 or MECH 003) and MATH 023
Can be taken Concurrently: MATH 023
CEE 104 Readings in Civil Engineering 1-4 Credits
Study of selected technical papers, with abstracts and reports. Consent of the department chair required.

CEE 117 Numerical Methods in Civil Engineering 2 Credits
Techniques for computer solution of linear and non-linear simultaneous equations; eigenvalue analysis; finite differences; numerical integration; numerical solutions to ordinary differential equations. Case studies in the various branches of civil engineering.
Prerequisites: MATH 205
Can be taken Concurrently: MATH 205

CEE 121 Mechanics of Fluids 3 Credits
Fluid properties and statics; concepts and basic equations for fluid dynamics. Forces caused by flowing fluids and energy required to transport fluids. Dynamics similitude and modeling of fluid flows. Includes laboratory experiments to demonstrate basic concepts.
Prerequisites: MECH 002 or MECH 003 or CEE 003

CEE 123 Civil Engineering Materials 3 Credits
Properties of commonly used civil engineering materials including aggregate, Portland cement concrete, asphalt, concrete, wood, metals, and polymer based synthetics. Standard test methods. Includes laboratory work and reporting of results.
Prerequisites: CEE 059 or MECH 012

CEE 142 Soil Mechanics 3 Credits
Physical properties of soils; mineralogy, composition and fabric. Phase and weight-volume relationships, consistency, gradation and classification of soils. Fluid flow through porous media. Stress-strain behavior; stresses within a soil mass, deformation behavior, measurement of stress-strain properties, shear strength of soil. Volume change in soils; compressibility, pore water pressure, consolidation and settlement. Laboratory experiments to measure physical and mechanical properties of soils.
Prerequisites: MECH 002 or MECH 003 or CEE 003

CEE 159 Structural Analysis I 4 Credits
Elastic analysis of statically determinate beams, frames, and trusses; deflections by the methods of virtual work and moment area; influence lines for determinate structures; modeling for structural analysis; flexibilty, stiffness, and approximate methods of analysis of indeterminate structures.
Prerequisites: MECH 012 or CEE 059

CEE 170 Introduction to Environmental Engineering 4 Credits
Prerequisites: CHM 030

CEE 171 (CHE 171, EMC 171, ES 171) Fundamentals of Environmental Technology 4 Credits
Introduction to water and air quality, water, air and soil pollution. Chemistry of common pollutants. Technologies for water purification, wastewater treatment, solid hazardous waste management, environmental remediation, and air quality control. Global changes, energy and environment. Constraints of environmental protection on technology development and applications. Constraints of economic development on environmental quality. Environmental life cycle analysis and environmental policy. Not available to students in RCEAS.

CEE 202 CEE Planning and Engineering Economics 3 Credits
The planning and management of civil engineering projects. Modeling and optimization methods, project management techniques. Financial decision-making among alternatives. Present value and discounted cash flow analysis; incremental analysis and rate-of-return criteria.

CEE 203 Professional Development 2 Credits
Elements of professionalism; professional ethics; engineering registration; continuing education; responsibilities of an engineer in industry, government, private practice; role of professional and technical societies.

CEE 205 Design Problems 1-3 Credits
Supervised individual design problems, with report. Consent of the department chair required.
Repeat Status: Course may be repeated.

CEE 207 Transportation Engineering 3 Credits
Principles of the design of transportation facilities with emphasis on highways and airports in the areas of geometric, drainage, and pavement design. Design problems.
Prerequisites: CEE 011

CEE 211 Research Problems 1-3 Credits
Supervised individual research problems, with report. Consent of the department chair required.
Repeat Status: Course may be repeated.

CEE 222 Water Resources Engineering 3 Credits
Pipe and pump hydraulics, surface and ground water hydrology, and open channel hydraulics. Laboratory experiments in applied hydraulics.
Prerequisites: CEE 121 or ME 231

CEE 242 Geotechnical Engineering 3 Credits
The principles related to analysis and evaluation of earthwork infrastructure. Site characterization and in-situ testing of soils. Advanced stress-strain behavior, failure theories and stress path application. 2D fluid flow in porous media, flow nets, uplift forces, and liquefaction. Stability of earthen structures; slopes, dams and levees. Stability of retaining structures; lateral earth pressures. Introduction to shallow foundations; bearing capacity and settlement. Team project.
Prerequisites: CEE 142

CEE 258 Structural Laboratory 3 Credits
Prerequisites: CEE 262 and CEE 264

CEE 259 Structural Analysis II 3 Credits
Analysis of statically indeterminate structures, methods of slope deflection and moment distribution; consideration of side-sway and nonprismatic members. Influence lines for determinate and indeterminate structures. Flexibility and stiffness matrix methods for computerized analysis. Use of computer library programs.
Prerequisites: CEE 159

CEE 262 Fundamentals of Structural Steel Design 3 Credits
Introduction to steel structures. Behavior, strength and design of structural members, including members subjected to axial tension, axial compression, flexure and combined compression and flexure. Basic methods of joining members to form a structural system. Use of design specifications.
Prerequisites: CEE 159

CEE 264 Fundamentals of Structural Concrete Design 3 Credits
Analysis, design, and detailing of reinforced concrete members and simple systems for strength and serviceability requirements, including beams, columns, and slabs. Introduction to prestressed concrete.
Prerequisites: CEE 159

CEE 266 Construction Management 3 Credits
An overview of management and construction techniques used in engineering ventures and projects. Scheduling, estimation, construction methods, financial controls, contracts, labor practices and organizational forms. Case studies and lectures from industry.
Prerequisites: CEE 202
CEE 272 Environmental Risk Assessment 2 Credits
Effects of chemical releases on human health; ecological risks. Application of risk assessment methodology, including hazard identification, exposure assessment, toxicity assessment, and risk characterization. Accounting for uncertainty in data during risk management, risk reduction and implementation of regulations and environmental policy.

CEE 274 Environmental Water Chemistry 3 Credits
Chemical principles and applications of those principles to the analysis and understanding of aqueous environmental chemistry in natural waters and wastewaters. The chemistry of ionic equilibria, redox reactions, precipitation/dissolution, acid-base concepts, buffer capacity, complexation, hydrolysis and biological reactions. Prerequisites: CHM 031 or CEE 170

CEE 275 Environmental, Geotechnics and Hydraulics Laboratory 2 Credits
Applying fundamentals of soil properties, hydraulics and environmental science through appropriate laboratory experiments for solution of environmental engineering problems. Experiments will include solute transport in surface and subsurface medium; characterization of soils, sludges and water; treatment of water and wastewater including biological processes. Illustration of techniques to generate design parameters for scale-up. Prerequisites: CEE 170 and CEE 274 Can be taken Concurrently: CEE 274

CEE 279 Microbial Ecology 4 Credits
The role of microorganisms in the environment. Topics include: Survey of microbial classification, structure, and metabolism; study of microbes at population, community, and ecosystem levels of organization; the role of microbes in biogeochemical cycles; application of microbes to bioremediation and resource recovery problems. Prerequisites: EES 152

CEE 281 Special Topics 1-3 Credits
A study of selected topics in civil and environmental engineering not included in other formal courses. A design project or an interdisciplinary study of a problem related to civil or environmental engineering may be included. Civil and environmental engineering students working on design projects involving students from other departments or colleges working in cross-disciplinary teams may be included. A report is required. Consent of the department chair required. Repeat Status: Course may be repeated.

CEE 290 CEE Design Project 3 Credits
Supervised design projects. Multidisciplinary teams applying the fundamentals of engineering science and the concepts of planning and systems analysis in the design of practical engineering works. The scope includes needs analysis, formulation of the design problem statement and evaluative criteria; analysis of alternative solutions and the generation of specifications. Includes most of the following considerations: economic, sustainability, manufacturability, ethical, social, environmental, aesthetic, political, health and safety. Practicing professional engineers are invited to serve as consultants. Written and oral reports are required. Must have senior standing in CEE department.

CEE 301 Modeling Environmental Systems 3 Credits
Apply flow and contaminant transport models to engineered environments and surface and subsurface natural environments. Formulation of problem statements in terms of ordinary and partial differential equations, boundary conditions, and parameters. Apply finite difference techniques using contemporary software. Solution of systems of linear and nonlinear equations. Introduction to finite elements. Prerequisites: CEE 121 or MATH 205

CEE 316 (EES 316) Hydrogeology 3,4 Credits
Water plays a critical role in the physical, chemical, and biological processes that occur at the Earth’s surface. This course is an introduction to surface and groundwater hydrology in natural systems, providing fundamental concepts and a process-level understanding using the hydrologic cycle as a framework. Geochemistry will be integrated to address natural variations and the human impact on the environment. Topics covered include: watershed hydrology, regional and local groundwater flow, water chemistry, and management of water resources. Lectures and recitation/laboratory. Prerequisites: (EES 080 and EES 115 or EES 131 or EES 152) or (CEE 170) Can be taken Concurrently: EES 115, EES 131, EES 152 Attribute/Distribution: NS

CEE 320 (EES 320) Engineering Hydrology 3 Credits

CEE 322 Advanced Water Resources Engineering 3 Credits
Advanced topics in fluid mechanics, free surface flows, hydraulic structures, advanced topics in pipe hydraulics including pipe network systems. Prerequisites: CEE 222

CEE 323 (EES 323) Environmental Groundwater Hydrology 3 Credits
The study of subsurface water, its environment, distribution, and movement. Included are flow patterns, well hydraulics, and an introduction to the movement of contaminants. Design problems are included to simulate flow with analytical and numerical models, and contaminant migration using analytical models. Prerequisites: CEE 121 or CEE 316 or EES 316 or ME 231 or CHE 044 Attribute/Distribution: NS

CEE 327 (EES 327) Surface Water Quality Modeling 3 Credits
Fundamentals of modeling water quality parameters in receiving water bodies, including rivers, lakes, and estuaries. Modeling of dissolved oxygen, nutrients, temperature, and toxic substances. Emphasis on water quality control decisions as well as mechanics and model building. Prerequisites: (CEE 121 or ME 231 or CHE 044) and CEE 222

CEE 335 Coastal Engineering 3 Credits
Linear wave theory and wave characteristics; survey of nonlinear theories; tides, tsunamis, storm surge and basin resonance; wind-generated wave spectra, statistics and forecasting; wave-structure interaction; nearshore circulation and sediment transport; interaction of littoral processes with structures. Prerequisites: CEE 121 or ME 231 or CHE 044

CEE 340 Advanced Foundation Engineering 3 Credits
Current theory and practice relating to the design of deep foundations supporting buildings and other structures. Construction practices; analysis and design (bearing capacity, settlement, dynamic effects); site investigations; load-resistance-factor design (LRFD) criteria for foundations. Prerequisites: CEE 242

CEE 341 Ground Improvement and Site Development 3 Credits
Soil stabilization; grouting and injection methods; preloading and dynamic consolidation; deep compaction; drainage and dewatering; application of geotextiles and geomembranes; soil nailing and reinforcement methods. Use of in-situ test for soil properties and site characterization; procedures and calibration methods for the basic in-situ tests - SPT, CPT, CPTU, DMT; theoretical, experimental and empirical interpretive methods for in-situ test results. Prerequisites: CEE 242
CEE 342 Experimental Geotechnical Engineering 3 Credits
Experimental studies dealing with the measurement of soil and other particulate materials properties, and behavior in the laboratory. Test procedures, calibration, data acquisition, interpretation of apparatus limitations and potential error sources, specimen preparation, data analysis and interpretation; designing experiments. Senior standing required.
Prerequisites: CEE 242

CEE 344 Behavior of Soils as Engineering Materials 3 Credits
Soil mineralogy, bonding, crystal structure and surface characteristics; clay-water electrolyte system; soil fabric and its measurement; soil structure and physical property relationships; soil depositional and compositional characteristics; engineering properties of soils as they relate to soil mineralogy, fabric and composition: volume change behavior, intergranular stresses, shear strength and deformation behavior, conduction behavior, coupled and direct flow phenomena.
Prerequisites: CEE 242

CEE 345 Geo-Environmental Engineering 3 Credits
Principles of interaction of soil and rock with various environmental cycles. Physical and chemical properties of soil. Soil fabric and its measurement, clay-water electrolyte system, electrical double layer and DLVO theory; contaminated site characterization, groundwater flow and contaminant transport; detection and quantification technologies; waste containment systems, landfills, liner systems, leachate collection; soil and groundwater cleanup technologies.
Prerequisites: CEE 242

CEE 346 Fundamentals of Designing with Geosynthetics 3 Credits
Fundamental and current theories of designing soil structures with geosynthetics. Roads and highway applications; reinforced embankments; slope stabilization; waste containment systems; erosion control; filtration and drainage.
Prerequisites: CEE 242

CEE 347 Foundation Engineering 3 Credits
Prerequisites: CEE 242

CEE 352 Structural Dynamics 3 Credits
Prerequisites: MATH 205 and CEE 159 and MECH 102

CEE 354 Sensors, Signals, and Systems 3 Credits

CEE 358 Random Vibrations 3 Credits
Review of probability theory. General characterization and models of random functions for engineering applications (seismic ground motion, wind velocity, ocean waves, mechanical vibrations). Vibration of deterministic systems under random dynamic loads; applications to wind and seismic engineering. Uncertain systems under random perturbations, simulation of random functions for numerical solutions (non-stationary, non-Gaussian, multi-variate processes, multi-dimensional fields).
Prerequisites: CEE 352
Can be taken Concurrently: CEE 352

CEE 359 Finite Element Method in Structural Engineering 3 Credits
The finite element method: fundamental concepts, theory, modeling, and implementation for various kinds of elements. Applications to problems in the behavior of structural elements and systems including analysis of trusses, beams, plates, and frames and bridge systems. Extensions to nonlinear analysis and advanced topics. Use of contemporary commercial software.
Prerequisites: CEE 259

CEE 364 Advanced Project Management 3 Credits
Prerequisites: (CEE 266)

CEE 365 Finite Element Method in Structural Engineering 3 Credits

CEE 366 Environmental Separation and Control 3 Credits
Theory and application of adsorption, ion exchange, reverse osmosis, air stripping and chemical oxidation in water and wastewater treatment. Modeling engineered treatment processes.
Prerequisites: CEE 371

CEE 370 Reaction Kinetics in Environmental Engineering 3 Credits
Theory of reaction kinetics and its application to the design and operation of chemical, physico-chemical and biological reactions in water, wastewater, and hazardous waste treatment. Basic design equations for various types of reactors and migration of pollutants in the environment.
Prerequisites: CEE 375 or CHE 375

CEE 371 Environmental Biotechnology 3 Credits
Introduction to the problems of air pollution including such topics as: sources and dispersion of pollutants, sampling and analysis; technology of economics and control processes; legislation and standards. Must have senior standing in the College of Engineering and Applied Science.

CEE 372 (CHE 372) Fundamentals of Air Pollution 3 Credits

CEE 375 (CHE 375) Environmental Engineering Processes 3 Credits
Processes applied in environmental engineering for air pollution control, treatment of drinking water, municipal wastewater, industrial wastes, hazardous/toxic wastes, and environmental remediation. Kinetics, reactor theory, mass balances, application of fundamental physical, chemical and biological principles to analysis and design.
Prerequisites: CEE 170

CEE 376 Environmental Biotechnology 3 Credits
Fundamentals of microbiology and biochemistry applied to natural and engineered environmental systems. Systems ecology, energetics and kinetics of microbial growth, nutrition and toxicology, use of microorganisms for pollution monitoring and control. Pathogenicity and disease transmission, water quality using biological indices.
Prerequisites: CEE 375 or CHE 375
CEE 377 Environmental Engineering Design 3 Credits
Team-oriented course to develop design skills in the area of environmental engineering. Project components typically include: air pollution, drinking water, municipal wastewater, industrial wastes, hazardous/toxic wastes, and environmental remediation. Project work typically includes: a background report, a design report, and an oral presentation. Tools used in the design process may include simulation models. Must have senior standing in CEE department.
Prerequisites: CEE 375

CEE 378 Hazardous Waste Treatment and Management 3 Credits
Regulations for collection, transportation, disposal and storage of hazardous wastes. Containment systems, monitoring, new and available technologies to minimize, transform, destroy, detoxify and eliminate the hazardous components of the wastes. Environmentally benign processes and life cycle analysis.
Prerequisites: CEE 375 or CHE 375

CEE 379 (EES 379) Environmental Case Studies 3-4 Credits
Case studies will be used to explore the impact of politics, economics, society, technology, and ethics on environmental projects and preferences. Environmental issues in both affluent and developing countries will be analyzed. Multidisciplinary student teams will investigate site characterization; environmental remediation design; environmental policy; and political, financial, social, and ethical implications of environmental projects.
Prerequisites: (EES 022 or CEE 375 or CHE 375)

CEE 381 Special Topics 1-3 Credits
A study of selected topics in civil and environmental engineering, not included in other formal courses. A report is required. Consent of the department chair required.

CEE 385 Research Procedures Seminar 1 Credit
Planning and execution of research projects, survey of current research, elements of proposals and budgets. Literature search procedures. Presentation of data, and of written and oral reports. Guidelines for visual aids.

CEE 401 Modeling Environmental Systems 1-3 Credits
Apply flow and contaminant transport models to engineered environments and surface and subsurface natural environments. Formulation of problem statements in terms of ordinary and partial differential equations, boundary conditions, and parameters. Apply finite difference techniques using contemporary software. Solution of systems of linear and nonlinear equations. Introduction to finite elements. Students cannot receive credit for both CEE 401 and CEE 301.
Prerequisites: CEE 121 or MATH 205

CEE 404 Mechanics and Behavior of Structural Members 3 Credits

CEE 405 Analytical and Numerical Methods I 3 Credits
Prerequisites: MATH 205

CEE 406 Structural Reliability of Components and Systems 3 Credits
Probabilistic time-invariant failure analysis of structural components and systems. Statistics and probability; component time-invariant reliability analysis; system time-invariant reliability analysis; reliability-based structural design; and reliability of structural systems using Monte-Carlo simulation. Solutions suitable for practical computer implementation.

CEE 407 Mathematics II 3 Credits
Advanced calculus, linear algebra, and other mathematical topics relevant to the study of Civil Engineering.

CEE 409 Finite Element Method in Structural Mechanics 3 Credits
Basic principles and equations governing the finite element method. Analysis of planar, axisymmetric, plate and articulated structures, with emphasis on analytical modeling. Accuracy and convergence studies, utilizing different discretizations and various types of elements. Case studies include application and extension to material nonlinearities, bridges, containment vessels, and soil-structure interaction.
Prerequisites: CEE 405

CEE 410 Computational Fluid Dynamics and Heat Transfer 3 Credits
Basic concepts and computational techniques for the analysis of fluid systems, including heat transfer.

CEE 412 Methodologies of Structural Design 2 Credits

CEE 414 Analysis and Design of Steel and Composite Structural Members 3 Credits
Prerequisites: CEE 262

CEE 415 Analysis and Design of Ductile Steel Structural Systems 3 Credits

CEE 417 Design Project I 3 Credits
Introduction to the overall M.Eng. design project for a civil infrastructure facility. Design decision making and communication processes. Roles of various players in the execution of the project (e.g. owner, architect, engineer, fabricator, construction manager, contractor), and the mechanisms of communication of information in the design process (e.g. design drawings, shop drawings, erection drawings, as-built drawings). Roles of codes and standards. Enrollment limited to students in M.Eng. program.

CEE 418 Design Project II 3 Credits
Task-specific teams will be organized to perform preliminary designs of different design options for the overall design project. Determination of project goals, performance requirements, and functional specifications. Winnowing and selection of alternatives for final design. Professor of practice and external specialists will guide examination and evaluation of design options based on cost and performance criteria.
Prerequisites: CEE 416

CEE 419 Structural Behavior Laboratory 3 Credits
Experimental study of behavior of members, assemblages and structural systems. Introduction to methods and equipment used in laboratory simulations, numerical simulations, laboratory and in-situ measurements. Planning, executing and reporting experimental studies on performance of materials and large-scale structural systems. Non-destructive evaluation and damage assessment.
Prerequisites: CEE 262 and CEE 264

CEE 420 Surface Wave Mechanics 3 Credits
Elements of hydrodynamics and wave boundary conditions; linear wave theory and wave characteristics; nonlinear wave theories and application; wind wave generation, analysis and prediction; long waves; design wave determination; laboratory investigation of surface waves. Consent of instructor required.
CEE 424 Surface Water Hydrology 3 Credits
Prerequisites: CEE 320 or EES 320

CEE 425 Hydraulics of Sediment Transport 3 Credits

CEE 427 Transport of Contaminants in Groundwater 3 Credits
Theory of groundwater flow and transport of contaminants in the groundwater system. State-of-the-art groundwater flow and contaminant transport models used to solve governing equations of groundwater flow and transport of chemically reactive solutes. Selected case studies will be analyzed.
Prerequisites: CEE 323 or EES 323

CEE 428 Advanced Topics in Hydraulics 1-3 Credits
Recent developments in hydromechanics and hydraulics. Topics to be selected from: wave mechanics, theory of flow through porous media, dispersion, hydrodynamic forces on structures, potential flow, free streamline theory, open channel hydraulics, computer methods. Consent of department required.
Repeat Status: Course may be repeated.
Prerequisites: CEE 322

CEE 429 Hydraulic Research 1-6 Credits
Individual research problems with reports.
Repeat Status: Course may be repeated.

CEE 431 Life-Cycle of Structural Systems 3 Credits
Assessing the life-cycle performance of new and existing structural systems, designing structures for lifetime performance, and optimizing the remaining life of existing structures, considering uncertainties in structural performance, demands placed on structural systems, structural maintenance and monitoring, and costs.

CEE 432 Structural Safety and Risk 3 Credits
Assessing safety and risk of structural systems during their specified service life, designing structures for specified safety and risk criteria for a prescribed service life, introducing Markov, queueing and availability models, statistics of extremes, time-variant safety and structural health monitoring, and optimal decision making under uncertainty based on single objective or multiple objectives.

CEE 433 Structural Optimization 3 Credits
Problem formulation, relative merit of various numerical optimization techniques, possible difficulties in applications, and how alternative formulations and methods can be combined to solve different design problems. Numerical optimization techniques are in general terms and their application to structural design.

CEE 436 Advanced Topics in Coastal Engineering 1-3 Credits
Advanced study of selected topics in coastal engineering such as: nonlinear wave theory, design of coastal structures, shore protection and stabilization, numerical solution of coastal hydrodynamics. Selection of topics will depend on particular qualifications of staff, as well as on the interests of the students.
Repeat Status: Course may be repeated.

CEE 437 Transport of Contaminants in Groundwater 3 Credits
Prerequisites: CEE 320 or EES 320

CEE 438 Advanced Topics in Hydraulics 1-3 Credits
Recent developments in hydromechanics and hydraulics. Topics to be selected from: wave mechanics, theory of flow through porous media, dispersion, hydrodynamic forces on structures, potential flow, free streamline theory, open channel hydraulics, computer methods. Consent of department required.
Repeat Status: Course may be repeated.
Prerequisites: CEE 322

CEE 443 Advanced Soil Mechanics 3 Credits
Characterization of particulate media; particle-fluid interaction; load deformation, thermoelastic and viscoelastic behavior; elastic waves in particulate media; electromagnetic properties; empirical and analytical models. Must have completed a course in soil mechanics.

CEE 447 Advanced Topics in Geotechnical Engineering 1-3 Credits
Advanced studies in selected subjects related to geotechnical engineering. The general areas may include: stress-strain-time relationships of soils, colloidal phenomena in soils, ground water flow and see page, soil dynamics, soil plasticity, numerical methods applied to soil mechanics, earth dam design, theories of layered systems and their application to pavement design, rock mechanics. The studies specifically undertaken in any particular semester depend on the availability of staff and the interest of students. Consent of department chair required.
Repeat Status: Course may be repeated.

CEE 448 Constitutive Laws in Soil Mechanics 3 Credits
Basic methods and constitutive laws used for the analysis of boundary value problems in soil mechanics. Linear elasticity, nonlinear elastic, linear elastic-perfectly plastic and non-linear elastoplastic models; critical state soil mechanics; application of select computational models. Consent of instructor required.

CEE 449 Geotechnical Research 1-6 Credits
Individual research problems relating to soil engineering, with report. Must have completed a course in soil mechanics.

CEE 450 Advanced Structural Analysis 1 I Credits
Prerequisites: CEE 259

CEE 452 Fatigue and Fracture of Structures - An Interdisciplinary View 3 Credits
This course examines the fatigue and fracture characteristics of steel structures from metallurgical, mechanical and structural engineering views. Both theory and experimental background are provided and applied to case studies and code development.

CEE 453 Nonlinear Analysis of Structural Components and Systems 3 Credits
Nonlinear analysis of structural components and systems, considering the effects of material and geometric nonlinearities. Solution strategies; material constitutive models; nonlinear member section analysis; computational plasticity; nonlinear beam-column element formulations; second order analysis; structural stability; and nonlinear time history analysis of structural dynamic systems.
Prerequisites: CEE 352 and CEE 404 and CEE 450

CEE 454 Sensors, Signals, and Systems 3 Credits
CEE 455 Advanced Structural Dynamics 3 Credits
Analysis and design of structures to resist wind, earthquake, and blast loading. Matrix methods and computer applications. Non-linear and elasto-plastic response. Damping characteristics of structures and structural components, spectral analysis, dynamic instability. Characteristics of aerodynamic and seismic forces and explosions. Introduction to vibration of three-dimensional structural systems.
Prerequisites: CEE 352 or MECH 406 and CEE 405

CEE 456 Behavior and Design of Earthquake Resistant Structures 3 Credits
Prerequisites: CEE 352

CEE 457 Behavior and Design of Blast Resistant Structures 3 Credits
Design and assessment of structures subject to blast demands generated from accidental or intentional detonation of high explosives. Topics include determination of blast demands, characterization of pressure distributions on structural systems and components, estimation of the response of systems to dynamic pressure demands, modeling techniques for structural components, dynamic time history analysis of systems, determination of allowable response limits and stand-off requirements for facilities, and design structures to resist the effects of close-in detonation of high explosives and the impact of ballistic fragments.

CEE 458 Random Vibrations 3 Credits
Review of probability theory. General characterization and models of random functions for engineering applications (seismic ground motion, wind velocity, ocean waves, mechanical vibrations). Vibration of deterministic systems under random dynamic loads; applications to wind and seismic engineering. Uncertain systems under random perturbations, simulation of random functions for numerical solutions (non-stationary, non-Gaussian, multi-variate processes, multi-dimensional fields). Students cannot receive credit for both CEE 358 and CEE 458.
Prerequisites: CEE 352

CEE 459 Advanced Topics in Plastic Theory 3 Credits
Fundamentals of the mathematical theory of plasticity; the general theorems of limit analysis and their applications to beams under combined loading, arches, space frames, plates and shells. Limit analysis of two- and three-dimensional problems in soil, concrete, rock, and metal. Current developments.
Prerequisites: CEE 404

CEE 461 Advanced Bridge Engineering 3 Credits
Students in CEE 461 cover the same topics described under CEE 361, but in more depth. In addition each student conducts an intensive study of a bridge-related topic of his or her choice. A short written technical report on the findings of this study is required.
Prerequisites: CEE 262 and CEE 264

CEE 462 Stability of Structural Systems 3 Credits
Stability analysis of structures systems, including moment-resisting and braced frames, trusses, and plate and box girders. Bracing requirements. Elastic and inelastic second-order analysis. Design considerations. Special topics.
Prerequisites: CEE 404

CEE 463 Advanced Mechanics of Reinforced Concrete 3 Credits
Consistent mechanics for the design of reinforced concrete with or without prestress. Limit theorems of the theory of plasticity and their application to beams, slabs, and disturbed regions. Applications may include beams in flexure and combined flexure, axial load, and torsion; slabs (strip method, yield line analysis); corbels, deep beams, and other disturbed regions (truss models, strut-and-tie models, and associated failure mechanisms).
Prerequisites: CEE 404

CEE 466 Advanced Finite Element Methods 3 Credits
Review of linear elastic Finite Element (FE) method and weak formulation of equilibrium. Implementation of a linear elastic FE code. Special topics including shear locking, reduced integration, non-homogeneous essential conditions, and imposed strains. Dynamic FE analysis: theory and implementation of modal and time-history analyses. Techniques to model structural masses and damping. Stochastic FE analysis: theory and implementation of methods to analyze uncertain structures. Examples using scientific and commercial software to highlight practical modeling issues. Lab-sessions and student projects are included.
Prerequisites: CEE 366

CEE 467 Advanced Topics in Structural Engineering 1-3 Credits
Advanced study of selected topics in structural mechanics and engineering, such as: finite element methods, suspension system; space frames; stability of nonlinear systems; coldformed and lightweight construction; optimization and reliability; second-order phenomena in structures; interaction of structures with the environment; structural use of plastics; composite construction, etc. Selection of topics will depend on particular qualifications of the staff, as well as on the interests of the students. Consent of department chair required.
Repeat Status: Course may be repeated.

CEE 468 Stability of Elastic Structures 3 Credits
Prerequisites: MATH 205

CEE 470 Reaction Kinetics in Environmental Engineering 3 Credits
Theory of reaction kinetics and its application to the design and operation of chemical, physico-chemical and biological reactors in water and wastewater treatment. Basic design equations for various types of reactors and migration of pollutants in the environment. Students cannot receive credit for both CEE 371 and CEE 470.

CEE 471 Environmental Risk Assessment 3 Credits
Effects of chemical releases on human health; ecological risks. Application of risk assessment methodology, including hazard identification, exposure assessment, toxicity assessment, and risk characterization. Accounting for uncertainty in data during risk management, risk reduction and implementation of regulations and environmental policy. Term project.

CEE 472 Water and Wastewater Treatment Facilities 3 Credits
Theory and design of water and wastewater treatment facilities. Physical, chemical, and biological treatment processes for water and wastewater treatment.
Prerequisites: CEE 375 or CHE 375

CEE 473 Environmental Separation and Control 3 Credits
Theory and application of adsorption, ion exchange, reverse osmosis, air stripping and chemical oxidation in water and wastewater treatment. Modeling engineered treatment processes. Students cannot receive credit for both CEE 473 and CEE 370.
Prerequisites: CEE 470

CEE 474 Aquatic Chemistry 3 Credits
Applying basic principles of aqueous chemistry for quantifying complex, environmental systems. Specific examples of air-water-soil interactions and consequent effects. Heterogeneous equilibria with more than one solid phase. Kinetics and thermodynamics of some important ionic and biological reactions.
Prerequisites: CEE 274
CEE 475 Advanced Topics in Environmental Engineering 1-3 Credits
Advanced concentrated study of a selected topic in environmental engineering such as non-point source pollution control, water reuse systems, new concepts in treatment technology, toxic substance control, etc. The instructor and student select topic. May include specialized laboratory research, literature review, and specialty conference attendance. Consent of department chair required.
Repeat Status: Course may be repeated.

CEE 476 Environmental Biotechnology 3 Credits
Fundamentals of microbiology and biochemistry applied to natural and engineered environmental systems. Systems ecology, energetics and kinetics of microbial growth, nutrition and toxicology, use of microorganisms for pollution monitoring and control. Pathogenicity and disease transmission, water quality using biological indices.
Prerequisites: CEE 375 or CHE 375

CEE 477 Environmental Engineering Processes 3 Credits
Processed applied in environmental engineering for air pollution control, treatment of drinking water, municipal wastewater, industrial wastes and environmental remediation. Kinetics, reactor theory, mass balances, application of fundamental physical, chemical and biological principles to analysis and design. Students cannot receive credit for both CEE 378 and CEE 477.
Prerequisites: CEE 170

CEE 478 Toxic and Hazardous Wastes 3 Credits
Regulations for collection, transportation, disposal and storage of hazardous wastes. Containment systems, monitoring, types of liners, new and available technologies to eliminate or recover the hazardous components of the wastes. Students cannot receive credit for both CEE 378 and CEE 478.
Prerequisites: CEE 274 or CEE 375 or CHE 375

CEE 479 Environmental Engineering Research 1-6 Credits
Individual research problems in environmental engineering with report.
Repeat Status: Course may be repeated.

CEE 480 Independent Study 1-3 Credits
An intensive study of one or more areas of civil and environmental engineering that is not normally covered in other courses. Consent of instructor is required. A written report may be required.
Repeat Status: Course may be repeated.

CEE 481 MS or MEng Project 1-6 Credits
A design project or focused study of a problem related to civil and environmental engineering. May be used in lieu of CEE 491. A written report is required. Consent of the instructor is required.
Repeat Status: Course may be repeated.

CEE 491 Thesis 1-6 Credits

CEE 499 Dissertation 1-15 Credits

Civil and Environmental Engineering and Earth and Environmental Sciences
This program is designed for students interested in combining programs in two departments: Civil & Environmental Engineering and Earth & Environmental Science, leading to two bachelor of science degrees, one in Civil Engineering or Environmental Engineering and the other in Earth and Environmental Sciences. Both degrees would be awarded at the end of the fifth year. This program is one of the dual degree programs mentioned in the Five-Year Programs section. The student will have a primary advisor in the P.C. Rossin College of Engineering and Applied Sciences and a secondary advisor in the Arts and Sciences College. The programs provides alternatives for students who may decide not to complete the dual-degree program. Students who make this decision prior to the beginning of the fourth year may qualify at the end of that year for the bachelor of science in civil or environmental engineering, as well as a minor in earth and environmental sciences. Also, if a student decides after two years to pursue only a bachelor of science degree in the EES department, it is possible to complete the requirements in four years. If the decision to work toward this degree is made during the fourth year, at least one additional semester is required to qualify for either B.S. degree. Interested students should consult with the respective departmental advisors to create a schedule of courses to resolve conflicts or if a specified course is not offered that semester. Required courses and major electives for the different EES B.S. degree programs are listed in the catalog entry for EES. Cross-listed EES/CEE courses used to satisfy Civil Engineering Approved Electives can reduce the individual semester and total program credits when chosen to satisfy EES program requirements. Additional useful information can be found on the web sites (www.lehigh.edu/~incee/ and www.ees.lehigh.edu).

REQUIRED COURSES FOR B.S. IN ENVIRONMENTAL SCIENCE AND B.S. IN CIVIL ENGINEERING

Recommended Sequence of Courses
The HSS Advanced Requirement of 13 credits is shown below as three 3-credit courses and one 4-credit course. Other options are possible. A total of 173 credit hours are needed for both degrees depending on how many credits in the EES are satisfied by taking CEE Approved Electives that are cross-listed with EES courses.

First Year

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<tr>
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Second Year

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Third Year

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<td>Level Elective</td>
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Fourth Year

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<td>CEE 262 or 264</td>
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<td>EES 100-300</td>
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<td>Science Elective</td>
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Notes:
- Credits listed are for a 3-credit course. Other options are possible.
- A total of 173 credit hours are needed for both degrees.
- The HSS Advanced Requirement of 13 credits is shown below as three 3-credit courses and one 4-credit course. Other options are possible.
- A total of 173 credit hours are needed for both degrees depending on how many credits in the EES are satisfied by taking CEE Approved Electives that are cross-listed with EES courses.
<table>
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<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
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<td>EES 100-300 Level Elective</td>
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<tr>
<td>EES 100-300 Level Elective</td>
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<td><strong>Fifth Year</strong></td>
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<td>First Semester</td>
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<td>AE CEE Civil Engineering Approved Elective</td>
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<tr>
<td>EES 100-300 Level Elective</td>
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<td><strong>Total Credits:</strong></td>
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</table>

**Recommended Courses for B.S. in Environmental Science and B.S. in Environmental Engineering**

The HSS Advanced Requirement of 13 credits is shown below as three 3-credit courses and one 4-credit course. Other options are possible.

**Required Courses for B.S. in Environmental Science and B.S. in Environmental Engineering**

The HSS Advanced Requirement of 13 credits is shown below as three 3-credit courses and one 4-credit course. Other options are possible.

**Recommended Sequence of Courses**

A total of 173 credit hours are needed for both degrees. Some EES requirements are simultaneously satisfied by taking Environmental Engineering Technical Electives that are cross-listed with EES courses.

**First Year**

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>ENGL 001</td>
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<td>ENGR 005</td>
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<td>ENGR 010</td>
</tr>
<tr>
<td>HSS Humanities/ Social Science Elective</td>
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<td>EES Gateway Elective</td>
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<td><strong>Total Credits:</strong></td>
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**Second Year**

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<tr>
<th>Course</th>
<th>Credits</th>
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<tr>
<td>MATH 023</td>
<td>4</td>
<td>MATH 205</td>
</tr>
<tr>
<td>CEE 003, MECH 002, or MECH 003</td>
<td>3</td>
<td>PHY 021 &amp; PHY 022</td>
</tr>
<tr>
<td><strong>Total Credits:</strong></td>
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<td>16</td>
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</table>

**Total Credits: 173**

1. HSS advanced requirement is 13 credits, four credits of which must be CEE approved Environmental Studies (ES) course.
2. 9 approved elective credits to satisfy proficiency in three focus areas of water supply and resources, environmental chemistry, and hazardous waste management; approved list available from CEE department.
3. Earth Science Requirement, list of approved courses are available from CEE department.
MAJOR IN CLASSICAL CIVILIZATION
This major allows the student to gain an overview of Greco-Roman culture through the literature, archaeology, and history along with basic language study. A minimum of 36 credits is expected, but adjustments may be made for prior language study. Students need to consult the Program Director to determine appropriate adjustments to the guidelines for major requirements.

Select four of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tr>
<td>CLSS/ENGL/THTR 054</td>
<td>Greek Tragedy</td>
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<tr>
<td>CLSS/ENGL 056</td>
<td>Topics in Greek and Roman Literature</td>
</tr>
<tr>
<td>CLSS/ENGL/THTR 058</td>
<td>Greek and Roman Comedy</td>
</tr>
<tr>
<td>CLSS/ANTH/ART/ARCH 174</td>
<td>Greek Archaeology</td>
</tr>
<tr>
<td>CLSS/ANTH/ART/ARCH 176</td>
<td>Roman Archaeology</td>
</tr>
</tbody>
</table>

Any two courses in ancient history 8
At least one elective from the remaining program offerings 4
(ANTH 178 may be included)
Two semesters of elementary Latin or Greek 8

Total Credits 36

MAJOR IN CLASSICS
This major allows the student to concentrate in ancient Greek, Latin or both. Specific programs for this major are worked out for each student with due consideration for the individual’s particular previous study of the language(s). Thus a student may begin ancient Greek or Latin at Lehigh and successfully complete a major in it. A minimum of 36 credits is expected, but adjustments may be made for prior language study. Students need to consult the Program Director to determine appropriate adjustments to the guidelines for major requirements.

Required Major Courses
Select one of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>LAT 001</td>
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<tr>
<td>&amp; LAT 002</td>
<td>and Elementary Latin II</td>
</tr>
<tr>
<td>GRK 001</td>
<td>Elementary Ancient Greek I</td>
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<tr>
<td>&amp; GRK 002</td>
<td>and Elementary Ancient Greek II</td>
</tr>
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Select one of the following:

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<tbody>
<tr>
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<td>Intermediate Latin</td>
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<tr>
<td>&amp; LAT 012</td>
<td>and Intermediate Latin</td>
</tr>
<tr>
<td>GRK 011</td>
<td>Intermediate Ancient Greek</td>
</tr>
<tr>
<td>&amp; GRK 012</td>
<td>and Intermediate Ancient Greek</td>
</tr>
</tbody>
</table>

Three advanced courses in the major language minimum. 12

Classical Studies

The study of Classics examines first the origins and growth of Greek and Roman culture in the Mediterranean area and second its impact on that area (and others) until the present. This study is by nature interdisciplinary: the study of language and literature, history, philosophy and religion, archaeology, economics and science all contribute to an appreciation of Greco-Roman civilization.

Students in either major or minor programs may concentrate in various combinations of these and other disciplines as they relate to ancient civilization. The diversity of the program should encourage the student to follow her or his special interests while simultaneously gaining an overview of classical civilization.

Courses in ancient Greek and Latin lead to proficiency in language while introducing the student to major literary texts. The Joseph A. Maurer Classics Prize is awarded yearly, at the discretion of the program, to the senior(s) who has demonstrated outstanding achievement in Classics (ancient Greek or Latin) and/or classical civilization. Courses in classical civilization require no knowledge of the ancient languages; they offer introductions to various disciplines of Classics with frequent reference to modern perspectives. Upper-level courses tend to be small, fostering closeness between faculty and students.

Petitions are required for freshmen to take 100-level or higher courses and for sophomores to take 200-level or higher courses.

Major Programs
Students may major either in Classical Civilization or in Classics. The Classics major offers a comprehensive view of language and culture; it is possible to begin an ancient language at Lehigh and to complete the major program successfully. The Classical Civilization major enables the student to gain a broad perspective on Greek and Roman civilization. The program welcomes double majors and the educational perspectives to be derived from combining ancient and modern studies.

Classics as a major has stood the test of time, offering helpful preparation for careers in widely diverse fields in the professions, business, and public service. Lehigh Classics majors have gone on to law school, to the ministry, to business school, with appropriate science courses to medical school, to graduate work in Classics, and to all kinds of entry-level employment.

Departmental Honors
A student may be recommended for program honors by vote of the program based on the student’s course work.

Minor Program
The program has three minors: Classics, Latin, and Classical Civilization. The minor in Classics combines language study and civilization courses (with a minimum of two courses in the languages). The minor in Latin focuses exclusively on the study of Latin. For the minor in Classical Civilization, students may take any combination of courses in Classical Civilization (any courses designated CLSS). All the minors require a minimum of 16 credits. The program can arrange individual courses of study. Classical Studies Minor Declaration Form (http://catalog.lehigh.edu/coursesprogramsandcurricula/artsandsciences/classicalstudies/Classical_Studies_Minor_Declaration_Form_2015.pdf).

Study Abroad
Lehigh University is a cooperating institution of the Intercollegiate Center for Classical Studies at Rome. Lehigh students are eligible for tuition grants in Athens and Rome.

MAJOR PROGRAMS
Students may major either in Classical Civilization or in Classics. The Classics major offers a comprehensive view of language and culture; it is possible to begin an ancient language at Lehigh and to complete the major program successfully. The Classical Civilization major enables the student to gain a broad perspective on Greek and Roman civilization. The program welcomes double majors and the educational perspectives to be derived from combining ancient and modern studies.

Classics as a major has stood the test of time, offering helpful preparation for careers in widely diverse fields in the professions, business, and public service. Lehigh Classics majors have gone on to law school, to the ministry, to business school, with appropriate science courses to medical school, to graduate work in Classics, and to all kinds of entry-level employment.

MAJOR IN CLASSICAL CIVILIZATION
This major allows the student to gain an overview of Greco-Roman culture through the literature, archaeology, and history along with basic language study. A minimum of 36 credits is expected, but adjustments may be made for prior language study. Students need to consult the Program Director to determine appropriate adjustments to the guidelines for major requirements.

Select four of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLSS/ENGL 052</td>
<td>Classical Epic</td>
</tr>
<tr>
<td>CLSS/ENGL/THTR 054</td>
<td>Greek Tragedy</td>
</tr>
<tr>
<td>CLSS/ENGL 056</td>
<td>Topics in Greek and Roman Literature</td>
</tr>
<tr>
<td>CLSS/ENGL/THTR 058</td>
<td>Greek and Roman Comedy</td>
</tr>
<tr>
<td>CLSS/ANTH/ART/ARCH 174</td>
<td>Greek Archaeology</td>
</tr>
<tr>
<td>CLSS/ANTH/ART/ARCH 176</td>
<td>Roman Archaeology</td>
</tr>
</tbody>
</table>

Any two courses in ancient history 8
At least one elective from the remaining program offerings 4
(ANTH 178 may be included)
Two semesters of elementary Latin or Greek 8

Total Credits 36

MAJOR IN CLASSICS
This major allows the student to concentrate in ancient Greek, Latin or both. Specific programs for this major are worked out for each student with due consideration for the individual’s particular previous study of the language(s). Thus a student may begin ancient Greek or Latin at Lehigh and successfully complete a major in it. A minimum of 36 credits is expected, but adjustments may be made for prior language study. Students need to consult the Program Director to determine appropriate adjustments to the guidelines for major requirements.

Required Major Courses
Select one of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAT 001</td>
<td>Elementary Latin I</td>
</tr>
<tr>
<td>&amp; LAT 002</td>
<td>and Elementary Latin II</td>
</tr>
<tr>
<td>GRK 001</td>
<td>Elementary Ancient Greek I</td>
</tr>
<tr>
<td>&amp; GRK 002</td>
<td>and Elementary Ancient Greek II</td>
</tr>
</tbody>
</table>

Select one of the following:

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<tbody>
<tr>
<td>LAT 011</td>
<td>Intermediate Latin</td>
</tr>
<tr>
<td>&amp; LAT 012</td>
<td>and Intermediate Latin</td>
</tr>
<tr>
<td>GRK 011</td>
<td>Intermediate Ancient Greek</td>
</tr>
<tr>
<td>&amp; GRK 012</td>
<td>and Intermediate Ancient Greek</td>
</tr>
</tbody>
</table>

Three advanced courses in the major language minimum. 12

Environmental Biology Requirement, list of approved courses are available from CEE department.

At least four of the EES electives must be at the 300 level. Up to 8 credits of EES internship (EES 093, EES 293) and EES research (EES 393) may be used as major electives (no more than 4 of which can be EES 093/EES 293).

For more information on the EES field requirement see the EES catalog entry (http://catalog.lehigh.edu/coursesprogramsandcurricula/artsandsciences/requiredmajors/EnvironmentalBiologyRequirement.pdf).
Any two ancient history courses. 8
At least one elective from the remaining program offerings. 4

Total Credits 40

1 Depending on prior preparation.
2 Depending on prior preparation and on the extent of coursework in the second Classical language. Students entering with significant previous language study in their major language (Latin or Greek) will be expected to take four or more advanced courses. The specific number of credits for language study will be determined in consultation with the Program Director.

Departmental Honors
A student may be recommended for program honors by vote of the program based on the student's course work.

Minor Programs
The program has three minors: Classics, Latin, and Classical Civilization. The minor in Classics combines language study and civilization courses (with a minimum of two courses in the languages). The minor in Latin focuses exclusively on the study of Latin. For the minor in Classical Civilization, students may take any combination of courses in Classical Civilization (any courses designated CLSS). All the minors require a minimum of 16 credits. The program can arrange individual courses of study. Classical Studies Minor Declaration Form (http://catalog.lehigh.edu/coursesprogramsandcurricula/artsandsciences/classicalstudies/Classic_studies_Minor_Declaration_Form_2015.pdf).

- Classics Minor 16 credits
- Latin Minor 16 credits
- Classical Civilizations Minor 16 credits

Study Abroad
Lehigh University is a cooperating institution of the Intercollegiate Center for Classical Studies at Rome. Lehigh students are eligible for tuition grants at the ICCS in Rome.

Classics Courses
- CLSS 021 (HIST 021) Greek History 4 Credits
  The development of civilization from palaeolithic times to the world empire of Alexander the Great. The social, economic, religious, philosophic, artistic and literary development of the ancient world; the origin of political institutions. Attribute/Distribution: SS
- CLSS 022 (HIST 022) Roman History 4 Credits
  Rome from its origins to A.D. 476. Political, social and religious developments. Transformation of the late Roman Empire to the early medieval period. Attribute/Distribution: SS
- CLSS 050 (ENGL 050) Classical Mythology 4 Credits
  Introduction to the study of the Greek-Roman myths in their social, political, and historical contexts. Emphasis on myths and their analysis as important evidence for studying classical antiquity. Attribute/Distribution: HU
- CLSS 052 (ENGL 052) Classical Epic 4 Credits
  Study of major epic poems from Greece and Rome. Works include Homer's Iliad and Odyssey, Apollonius' Argonautica, Vergil's Aeneid, and Ovid's Metamorphoses. Attribute/Distribution: HU
- CLSS 054 (ENGL 054, THTR 054) Greek Tragedy 4 Credits
  Aspects of Greek theater and plays of Aeschylus, Sophocles, and Euripides in their social and intellectual contexts. Attribute/Distribution: HU
- CLSS 056 (ENGL 056) Topics in Greek and Roman Literature 4 Credits
  Classical literature in translation, including themes or specific periods in Greek or Roman literature. Repeat Status: Course may be repeated. Attribute/Distribution: HU

CLSS 058 (ENGL 058, THTR 058) Greek and Roman Comedy 4 Credits
  Study of comedy as a social form through plays of Aristophanes, Menander, Plautus, and Terence. Attribute/Distribution: HU
- CLSS 091 Independent Study 1-4 Credits
- CLSS 112 (ANTH 112) Doing Archaeology 4 Credits
  Principles of archaeological method and theory. Excavation and survey methods, artifact analysis, dating techniques, and cultural reconstruction. Course includes field project. Attribute/Distribution: SS
  Early Christianity from its beginnings until the end of the second century. Coverage includes the Jewish and Hellenistic matrices of Christianity, traditions about the life of Jesus and his significance, and the variety of belief and practice of early Christians. Emphasis on encountering primary texts. Attribute/Distribution: HU
- CLSS 131 (PHIL 131) Ancient Philosophy 4 Credits
  Historical survey of selected texts and issues in the classical world, from the pre-Socratics through Aristotle, with emphasis on the origins of the western philosophical traditions in ethics, metaphysics, and epistemology. Attribute/Distribution: HU
- CLSS 132 (PHIL 132) Hellenistic Philosophy 4 Credits
  Historical survey of selected texts and issues in Post-Aristotelian Greek and Roman philosophy from the fourth century B.C. to the third century A.D. Areas of focus may include epicureanism, stoicism, academic and pyrrhonian scepticism, and neoplatonism. Attribute/Distribution: HU
- CLSS 161 (HIST 161) Roman Law 4 Credits
  Examination of Roman legal systems from the Twelve Tables to the Digest of Justinian. Emphasis on development of legal concepts and their historical context. Readings in primary sources; lectures; discussion. Attribute/Distribution: SS
- CLSS 171 Independent Study 1-4 Credits
- CLSS 174 (ANTH 174, ARCH 174, ART 174) Greek Archaeology 4 Credits
  Ancient Greek culture from the neolithic to Hellenistic periods. Reconstructions of Greek social dynamics from the study of artifacts. Attribute/Distribution: SS
- CLSS 176 (ANTH 176, ARCH 176, ART 176) Roman Archaeology 4 Credits
  Cultures of the Roman Empire. Reconstructions of social, political, and economic dynamics of the imperial system from the study of artifacts. Attribute/Distribution: SS
- CLSS 191 Special Topics 1-4 Credits
- CLSS 213 (HIST 213, REL 213) Ancient Roman Religion 4 Credits
CLSS 231 (PHIL 231) Figures and Themes in Ancient Philosophy 4 Credits
This seminar course will involve in-depth focus upon a major ancient thinker (e.g. Plato, Aristotle, Sextus Empiricus, Plotinus, etc.) or the classical treatment of a particular theme (e.g., “human nature,” “the good life,” ethical or political theory, etc.). Content varies. May be repeated for credit if content differs from previous. Must have completed one HU designated course in Philosophy.
Repeat Status: Course may be repeated.
Prerequisites: PHIL 105 or PHIL 116 or PHIL 117 or PHIL 120 or PHIL 121 or PHIL 122 or PHIL 123 or PHIL 124 or PHIL 125 or PHIL 127 or PHIL 128 or PHIL 129 or PHIL 131 or PHIL 132 or PHIL 133 or PHIL 135 or PHIL 137 or PHIL 139 or PHIL 140 or PHIL 141 or PHIL 142 or PHIL 145 or PHIL 146 or PHIL 150
Attribute/Distribution: HU

CLSS 232 (PHIL 232) Figures/Themes in Hellenistic Philosophy 4 Credits
This seminar course will involve an in-depth focus upon a major movement in Hellenistic Philosophy (roughly 4th century B.C.E. to the 2nd Century C.E.) such as Epicureanism, Stoicism, Ancient Scepticism, or Neoplatonism, or the Hellenistic treatment of a particular theme (e.g. freedom from anxiety, the nature of the Cosmos and our place within it, or human nature). Content varies. Must have completed one HU designated course in Philosophy at 100-level or higher.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

CLSS 251 (REL 251) Classical Mythology 4 Credits
Attribute/Distribution: SS

CLSS 281 Readings 4 Credits
Advanced study of a historical period or theme. Emphasis on primary sources. Consent of program head required.
Prerequisites: CLSS 021 or CLSS 022
Attribute/Distribution: ND

CLSS 282 Readings 4 Credits
Advanced study of a historical period or theme. Emphasis on primary sources. Consent of program head required.
Prerequisites: CLSS 021 or CLSS 022
Attribute/Distribution: ND

CLSS 291 Independent Study 1-4 Credits
CLSS 300 Apprentice Teaching 3 Credits
CLSS 311 (HIST 311) Twins and Sins: The Rise of Rome 4 Credits
Rome from its origins to the mid-third century B.C. Emphasis on foundation legends, the power of the monarchy, and development of Roman political and religious institutions. Papers, quizzes, discussions.
Attribute/Distribution: SS

CLSS 312 (HIST 312) Decline and Fall of the Roman Empire 4 Credits
Political, social, and economic history of the Roman Empire, A.D. 117- A.D. 565. Romanization of the provinces, diffusion of Christianity, and special attention to transformation to medieval period. Includes readings in translation of primary sources.
Attribute/Distribution: SS

CLSS 314 (HIST 314) Age of Caesar and Christ 4 Credits
Roman history of the first century A.D. Political, cultural, and socio-economic changes; special attention to the evolution of absolute power. Lectures, discussions, papers.
Attribute/Distribution: SS

CLSS 389 Honors Project 1-8 Credits
Greek Courses
GRK 001 Elementary Ancient Greek I 4 Credits
Attribute/Distribution: HU
GRK 002 Elementary Ancient Greek II 4 Credits
Continued work in Greek vocabulary, forms, and syntax. Selected readings in Greek. Students should have completed one semester of elementary ancient Greek or the equivalent.
Prerequisites: GRK 001
Attribute/Distribution: HU
GRK 011 Intermediate Ancient Greek 4 Credits
Readings in Herodotus, Homer, or Xenophon. Grammar review. Students should have completed two semesters of elementary ancient Greek or the equivalent.
Attribute/Distribution: HU
GRK 012 Intermediate Ancient Greek 4 Credits
May include Plato: Euthyphro, Apology and Crito, or other dialogues. Students should have completed two semesters of elementary Greek or the equivalent.
Attribute/Distribution: HU
GRK 091 Independent Study 1-4 Credits
Repeat Status: Course may be repeated.
Attribute/Distribution: HU
GRK 111 Greek Drama 4 Credits
Representative plays of Sophocles, Euripides and Aristophanes. Literary study of the drama. Students should have completed four semesters of ancient Greek or the equivalent.
Prerequisites: GRK 012
Attribute/Distribution: HU
GRK 112 Readings in Ancient Greek 4 Credits
Readings of Greek prose and poetry, authors will vary. Students should have completed four semesters of ancient Greek or the equivalent.
Repeat Status: Course may be repeated.
Prerequisites: GRK 012
Attribute/Distribution: HU
GRK 113 Greek Historians 4 Credits
Selections from Herodotus, Thucydides or Xenophon. Study of Greek historiography. Students should have completed four semesters of ancient Greek or the equivalent.
Attribute/Distribution: HU
GRK 171 Independent Study 1-4 Credits
Attribute/Distribution: HU
GRK 271 Readings 4 Credits
Intensive readings in one author or in a selected genre. Must have completed eight hours of courses at the 100 level and consent of the program head.
Attribute/Distribution: HU
GRK 272 Readings 4 Credits
Intensive readings in one author or in a selected genre. Must have completed eight hours of courses at the 100 level. Consent of the program head required.
Attribute/Distribution: HU
GRK 291 Independent Study 1-4 Credits
Latin Courses
LAT 001 Elementary Latin I 4 Credits
Attribute/Distribution: HU
LAT 002 Elementary Latin II 4 Credits
Continuation of grammar, easy Latin prose and poetry. Students should have completed one semester of elementary Latin or the equivalent.
Attribute/Distribution: HU
LAT 011 Intermediate Latin 4 Credits
Readings in Latin prose or poetry. Consolidation of reading ability; introduction to literary analysis. Students should have completed two semesters of elementary Latin or the equivalent.
Attribute/Distribution: HU
LAT 012 Intermediate Latin 4 Credits
Readings in Latin prose or poetry. Consolidation of reading ability; introduction to literary analysis. Students should have completed two semesters of elementary Latin or the equivalent.
Attribute/Distribution: HU

LAT 091 Independent Study 1-4 Credits

LAT 111 Catullus and Horace 4 Credits
Translation and analysis of selected lyrics, focusing on imagery systems. Introduction to metrics. Students should have completed four semesters of Latin or the equivalent.
Repeat Status: Course may be repeated.
Prerequisites: LAT 012
Attributes/Distribution: HU

LAT 112 Latin Prose 4 Credits
Readings from Latin prose literature of the late republic and early empire; selections may include Cicero’s letters, Sallust, Pliny’s letters. Students should have completed four semesters of Latin or the equivalent.
Repeat Status: Course may be repeated.
Prerequisites: LAT 012
Attributes/Distribution: HU

LAT 113 Vergil 4 Credits
Selections from the Aeneid. Vergil’s creation of a Latin epic and its complex perspective. Metrics. Students should have completed four semesters of Latin or the equivalent.
Repeat Status: Course may be repeated.
Prerequisites: LAT 012
Attributes/Distribution: HU

LAT 114 Livy 4 Credits
Selections from the early books of Livy's histories focusing on his creation of a Roman mythos. Students should have completed four semesters of Latin or the equivalent.
Prerequisites: LAT 012
Attributes/Distribution: HU

LAT 115 Ovid 4 Credits
May include selections from the Ars Amatoria, Fasti, and the Metamorphoses, with attention to the problem of the ideology of Augustan Rome. Students should have completed four semesters of Latin or the equivalent.
Repeat Status: Course may be repeated.
Prerequisites: LAT 012
Attributes/Distribution: HU

LAT 116 Petronius 4 Credits
Selections from the Satyricon, focusing on language usage and epic parody. Students should have completed four semesters of Latin or the equivalent.
Prerequisites: LAT 012
Attributes/Distribution: HU

LAT 171 Independent Study 1-4 Credits
Repeat Status: Course may be repeated.
Attributes/Distribution: HU

LAT 211 Readings 4 Credits
Intensive readings in one author or in a selected genre. Must have completed eight hours of courses at the 100 level. Consent of the program head required.
Attributes/Distribution: HU

LAT 212 Readings 4 Credits
Intensive reading in one author or in a selected genre. Must have completed eight hours of courses at the 100 level. Consent of the program head required.
Attributes/Distribution: HU

LAT 291 Independent Study 1-4 Credits
Attributes/Distribution: HU

LAT 300 Apprentice Teaching 3 Credits

Cognitive Science
Program Director: Barbara Malt, Ph.D. (Stanford) (https://psychology.cas2.lehigh.edu/content/bcm0)
Email: bcm0@lehigh.edu # Phone: 610-758-4797
Website: http://cogsci.cas2.lehigh.edu/
Supported by the Office of Interdisciplinary Programs 610-758-3996; incasip@lehigh.edu
Williams Hall, 31 Williams Drive

Core Faculty
Kate Arrington, Ph.D. (Psychology); Mark Bickhard, Ph.D. (Philosophy and Psychology); Amanda Brandone, Ph.D. (Psychology); Nancy Carlisle, Ph.D. (Psychology); John Gatewood, Ph.D. (Sociology and Anthropology); Jeffrey Hefflin, Ph.D. (Computer Science and Engineering); Almut Hupbach, Ph.D. (Psychology); Kiri Lee, Ph.D. (Modern Languages and Literatures); Barbara Malt, Ph.D. (Psychology); Jessecae Marsh, Ph.D. (Psychology); Hector Munoz-Avila, Ph.D. (Computer Science and Engineering); Padraig O’Séaghdha, Ph.D. (Psychology); Dominic Packer, Ph.D. (Psychology); and Aladdin Yaqub, Ph.D. (Philosophy)

The mission of the Cognitive Science Program is to advance the study of minds and brains, real or artificial, in all their aspects, through research and teaching. This interdisciplinary field, encompassing the fields of psychology, linguistics, computer science, philosophy, anthropology, and neuroscience, provides excellent preparation for life in the age of information. The program aims to instill in students a solid grasp of the intellectual problems, frameworks, and methodologies currently available; to provide experience exploring these through guided research; and to foster the desire to create and disseminate new knowledge. With this foundation, students are well prepared for a wide variety of careers in technology, human thought and behavior, or their interaction, or for graduate studies in Cognitive Science or any of the contributing disciplines.

We offer an undergraduate major in Cognitive Science, an undergraduate minor, a graduate minor, and a graduate certificate. A Cognitive Science major is easy to combine with a second major in the humanities, natural sciences, social sciences, or computer science.

Associate Professor. Padraig G O’Séaghdha, PhD (University of Toronto)

B.A. IN COGNITIVE SCIENCE
The B.A. with a major in Cognitive Science requires a minimum of 13 courses. All majors take COGS 007, an introduction to cognitive science, core courses in cognitive psychology, philosophy, artificial intelligence, and cognitive neuroscience, and collaterals in computer science and math. In a second tier, students pursue their individual interests in their selections of major electives by completing at least five electives from three tracks. A capstone integration occurs in the required two-semester senior thesis (COGS 301 and COGS 399), in which students focus on a topic of their choice spanning at least two cognitive science sub-disciplines.

Additional coursework in affiliated disciplines is recommended, to be selected in consultation with the major adviser and dependent upon anticipated career path. These courses may fulfill college distribution requirements. Note: A number of courses have pre-requisites. Students considering this major should check pre-requisites and plan accordingly. A preliminary meeting with the program director may be useful.

Collateral Requirements
CSE 001 Breathing of Computing
CSE 002 Fundamentals of Programming
MATH 021 Calculus I
or MATH 051 Survey of Calculus I

Introductory Course
COGS 007 Introduction to Cognitive Science

Disciplinary Core Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSE 001</td>
<td>Breathing of Computing</td>
<td>2</td>
</tr>
<tr>
<td>CSE 002</td>
<td>Fundamentals of Programming</td>
<td>2</td>
</tr>
<tr>
<td>MATH 021</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>or MATH 051</td>
<td>Survey of Calculus I</td>
<td>4</td>
</tr>
</tbody>
</table>

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MAJOR ELECTIVES

Artificial Intelligence and Formal Models
- CSE 017 Programming and Data Structures
- CSE 042/MATH 261 Game Design
- CSE 261 Discrete Structures
- CSE 262 Programming Languages
- CSE 318 Introduction to the Theory of Computation
- CSE 326 Pattern Recognition
- CSE 335 Topics on Intelligent Decision Support Systems
- CSE 337 Reinforcement Learning
- CSE 348 AI Game Programming
- CSE 360 Introduction to Mobile Robotics
- CSE 431 Intelligent Agents
- PHIL/MATH 114 Symbolic Logic
- PHIL/MATH 214 Topics in Philosophical Logic
- PHIL 265 Philosophy of Mathematics
- PHIL/MATH 303 Mathematical Logic
- MATH 304 Axiomatic Set Theory
- MATH 329 Computability Theory

Language, Culture, and Meaning
- ANTH 376 Culture and the Individual
- COGS/ANTH/MLL 140 Introduction to Linguistics
- PHIL 139 Contemporary Philosophy
- PHIL 220 Ways of Knowing
- PHIL 260 Making Sense of Words
- PSYC 307 Higher Order Cognition
- PSYC 313 Person Perception
- PSYC 314 Social Cognition
- PSYC 320 Psychology of Language
- PSYC 321 Language Development
- PSYC/HMS 344 Health Care Reasoning and Decision Making
- PSYC 351 Children's Thinking
- PSYC 362 Cognition in Practice & Policy
- PSYC/GS 365 Human Development in Cross-Cultural Perspective
- PSYC 384 Self and Identity
- SOC/JOUR 135 Human Communication

Cognition and Neuroscience
- BIOS 121 Biology Core III: Integrative & Comparative Biology
- BIOS 276 Central Nervous System and Behavior
- BIOS 277 Experimental Neuroscience Laboratory
- BIOS 365 Neurobiology of Sensory Systems
- BIOS 366 Diseases of the Nervous System
- BIOS 382 Endocrinology of Behavior
- BIOS 385 Synapses, Plasticity and Learning
- PSYC 347 Cognitive Neuroscience of Memory
- PSYC 358 Inside the Infant Mind
- PSYC 369 Memory Under Construction
- PSYC 377 Attention and Attentional Failures

MINOR IN COGNITIVE SCIENCE
The undergraduate minor in Cognitive Science requires five courses:
- COGS 007 Introduction to Cognitive Science
- Four additional courses selected from among the major's core courses and major electives, with at least two of these being Disciplinary Core Courses

Program Honors
- Majors seeking to graduate with honors in cognitive science must have a 3.30 GPA in the major, a 3.30 GPA overall, and complete a high quality senior thesis. Theses submitted for honors will be evaluated by a committee of at least three cognitive science faculty.

FOR GRADUATE STUDENTS
There are two concentrations in Cognitive Science available for post-baccalaureate students: a Graduate Minor and a Graduate Certificate. The minor is intended for students currently enrolled in a degree-granting graduate program at Lehigh University. The certificate is intended for non-degree students.

Graduate Minor in Cognitive Science
The minor gives graduate students who are enrolled in Lehigh University degree programs, such as computer science or psychology, an opportunity to develop expertise at the intersection of information processing by humans and intelligent machines. Graduate students investigating mental processes or applications such as artificial intelligence or educational technology are encouraged to participate, with the approval of an adviser in their major program, by contacting the Director of the Cognitive Science Program. On completion of the program, the Director of the Cognitive Science Program will issue a letter to the student certifying that he or she has met the requirements of the minor.

The Graduate Minor requires five graduate level courses: the core course COGS/PSYC 423 and four electives. At least two of the four electives must be taken outside the student's home department. Special topics courses with a cognitive science emphasis may also count towards the minor, with the approval of the Cognitive Science Program Director. Courses taken towards the minor may also fulfill requirements of the student's major program, with the approval of the major department.

The Graduate Minor requires five graduate level courses.
- COGS/PSYC 423 Foundations of Cognitive Science
- Four electives from the list below (or approved substitutions)

Computer Science
- CSE 348 AI Game Programming
- CSE 426 Pattern Recognition
- CSE 428 Semantic Web Topics
- CSE 431 Intelligent Agents
- CSE 435 Topics on Intelligent Decision Support Systems
- CSE 447 Data Mining
- CSE 460 Mobile Robotics

Psychology
- PSYC 402 Developmental Psychology
- PSYC 403 Cognitive Psychology
- PSYC 406 Social Cognition
- PSYC 443 Seminar In Language Acquisition
- PSYC 448 Seminar in Psychology of Language
- PSYC 464 Naive Realism in Social Judgement
- PSYC 476 Seminar In Cognition
### Graduation Certificate in Cognitive Science

This concentration is intended for people working in technology-related businesses and other qualified individuals with an interest in cognitive science. It provides non-degree post-baccalaureate students with an interdisciplinary perspective on human and machine intelligence.

The Graduate Certificate requires four graduate level courses: the core course COGS/PSYC 423 and three electives. At least two of the tree electives must be at the 400-level, and the three electives must be spread over at least two departments.

- **COGS 423** Foundations of Cognitive Science 3 credits
- **Three electives from the list below.** 9-12 credits

#### Computer Science
- CSE 327 Artificial Intelligence Theory and Practice
- CSE 331 User Interface Systems and Techniques
- CSE 332 Multimedia Design and Development
- CSE 335 Topics on Intelligent Decision Support Systems
- CSE 348 AI Game Programming
- CSE 426 Pattern Recognition
- CSE 428 Semantic Web Topics
- CSE 431 Intelligent Agents
- CSE 435 Topics on Intelligent Decision Support Systems
- CSE 437 Reinforcement Learning and Markov Decision Processes
- CSE 447 Data Mining
- CSE 460 Mobile Robotics

#### Psychology
- PSYC 307 Higher Order Cognition
- PSYC 313 Person Perception
- PSYC 314 Social Cognition
- PSYC 317 Psychology of Emotion
- PSYC 320 Psychology of Language
- PSYC 321 Language Development
- PSYC 347 Cognitive Neuroscience of Memory
- PSYC 351 Children's Thinking
- PSYC 358 Inside the Infant Mind
- PSYC 362 Cognition in Practice & Policy
- PSYC 365 Human Development in Cross-Cultural Perspective
- PSYC 369 Memory Under Construction
- PSYC 377 Attention and Attentional Failures
- PSYC 402 Developmental Psychology
- PSYC 403 Cognitive Psychology
- PSYC 406 Social Cognition
- PSYC 443 Seminar In Language Acquisition
- PSYC 448 Seminar in Psychology of Language
- PSYC 464 Naive Realism in Social Judgement
- PSYC 476 Seminar In Cognition
- PSYC/COGS 478 Ontological Psychology
- PSYC 480 Seminar in Cognitive Development

### Courses

#### PSYC 001 or COGS 007 Introduction to Cognitive Science 4 Credits

**Description:**
Introduction to the field of cognitive science: Problem solving, knowledge representation, reasoning, planning and machine learning. Use of AI systems or languages. Advanced topics such as natural language processing, vision, robotics, and uncertainty. CSE 261 is recommended.

**Prerequisites:** (CSE 001 and CSE 002) or CSE 017

#### PSYC 117 (PSYC 176) Cognitive Neuroscience 4 Credits

**Description:**
Perception and cognitive neuroscience as the link between mental processes and their biological bases. Visual and auditory perception; the control of action; neuropsychological syndromes of perception, language, memory, and thought; neural network (connectionist) models of mental processes. May not be taken pass/fail.

**Prerequisites:** PSYC 001 or COGS 007

#### PSYC 140 (ANTH 140, MLL 140) Introduction to Linguistics 4 Credits

**Description:**
Relationship between language and mind; formal properties of language; language and society; how languages change over time. May not be taken pass/fail.

**Prerequisites:** PSYC 001 or COGS 007

#### PSYL 250 (PHIL 250) Philosophy of Mind 4 Credits

**Description:**
An exploration of the mind-body problem. Are the body and mind distinct substances (dualism); or is there only body (materialism); or only mind (idealism)? Other views to be considered include behaviorism (the view that behavior can be explained without recourse to mental states), and the view that the mind is a complex computer. Must have completed one HU-designated course in Philosophy at 100-level or higher.

**Attribute/Distribution:** HU

#### PSYL 260 Making Sense of Words 3 Credits

**Description:**
What is a word? How do we comprehend words? How do we learn words? What is the relationship between language, memory, and thought? How are words constructed? How are they learned? How are they used? How do language and thought interact? And what role does language play in the development of children? May not be taken pass/fail.

**Prerequisites:** PSYC 001 or COGS 007

**Attribute/Distribution:** SS

**Total Credits:** 12-15

---

1 Note: These particular 200-level courses may be taken by graduate students.
COGS 361 Independent Research 2-4 Credits
Independent research in cognitive science with a faculty advisor. Students must arrange the particular project with a faculty advisor before enrolling. Consent of program director required.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

COGS 399 Senior Project in Cognitive Science: Thesis 1-3 Credits
Research during senior year culminating in senior thesis advised by a member of the Cognitive Science faculty. Execution and written report of project proposed and approved in COGS 301. Students must enroll for a total of three credits which may be split between the sections of a primary and secondary adviser. Theses submitted for honors will be evaluated by a committee of at least three cognitive science faculty. Prerequisite: COGS 301 and consent of the program director.
Repeat Status: Course may be repeated.
Prerequisites: COGS 301

COGS 405 Individual Study in Cognitive Science 1-6 Credits
Study of a topic not covered in regular course offerings. By arrangement with a consulting faculty member. Consent of program director required.
Repeat Status: Course may be repeated.

COGS 423 (PSYC 423) Foundations of Cognitive Science 3 Credits
Survey of fundamental theory and methodologies from artificial intelligence, linguistics, cognitive psychology, philosophy, and neuroscience, as well as salient research problems such as knowledge acquisition and representation, natural language processing, skill acquisition, perception and action, and the philosophical question of intentionality.

COGS 478 (PSYC 478) Ontological Psychology 3 Credits
Principles and constraints for modeling psychological phenomena. Representation; perception; memory; knowing; learning; emotions; consciousness; language; rationality.

Comparative and International Education

The Comparative and International Education (CIE) Program offers three degrees: An M.Ed. in Globalization and Educational Change, a M.A. in Comparative and International Education, and a Ph.D. in Comparative and International Education. The CIE program also offers a Lehigh graduate certificate program in International Education for Development.

Graduates completing their degree in the CIE program may move into positions as government officials and education policy makers, research/policy institute scientists, development program officers, or work in various non-governmental and educational organizations either in the United States or in countries around the world.

The Comparative and International Education (CIE) program provides a unique blend of global community, content, interaction, context, perspective and purpose. Highlights of these innovative qualities include:

• An international learning community. The CIE Program is a vibrant learning community where internationalization thrives in formal classroom instruction, as well as in daily socialization of students and faculty in academic, professional, and personal realms. CIE students have a unique opportunity to engage in a myriad of international experiences as a part of their graduate education experience, including conducting education research and evaluation worldwide, engaging in international education development consultancy, internships at the United Nations, and assisting in journal/book editing in comparative and international education.

• Multiple opportunities for student/faculty interaction. CIE faculty have extensive experience in the field as teachers and leaders, as well as a theoretical and methodological grounding in a discipline, which is relevant to global research and comparative educational issues. We recognize that students bring a wealth of expertise and knowledge that complements the faculty's expertise and knowledge. Therefore, the CIE program provides a framework through which students and faculty can build professional relationships that extend beyond the classroom, including collaborative projects, directed study, and intellectual discourse.

• Interdisciplinary perspectives. Given that education is the product of many converging forces from politics to society to economics to history to business and philosophy, education and schooling issues are too complex and diverse to be addressed by just one disciplinary perspective. Unless we understand the various factors impacting decisions, we cannot understand why schools in countries halfway around the world are structured the way they are, or why educational policies in our own communities deal with the topics they do. Working closely with the graduate programs of Lehigh’s College of Arts and Sciences, the CIE degree programs breach the boundaries of disciplines, thus creating an opportunity for students to examine education-related issues from multiple perspectives.

There are several projects that exemplify the CIE Program's signature and distinctive properties. They are:

• International Education and Research. CIE faculty and students participate in research and academic exchange with colleagues around the world. One example is through the CIE Program-based Tübingen-Lehigh International Partnership (TüLIP). Through TüLIP, Lehigh students have the option to take either full-term or short schedule courses taught in English at the University of Tübingen (Germany). Research or field-work may also be taken for Lehigh academic credit and is collaboratively supervised by both Lehigh and Tübingen professors. One recent project connected to TüLIP through the CIE Program is the Mountaintop Experience called “Transitions for Refugees through Empowerment and Education” (TREE). The TREE project unites Lehigh students, refugee advocates and education experts in both the U.S. and Germany to investigate the dynamic factors facing resettled refugee youth.

• Scholarly Publication and Editing. The CIE Program is home to two professional academic publications in the field: The Annual Review of Comparative and International Education (ARCIE) and the FIRE: Forum for International Research in Education. ARCIE is the flagship academic review in the field of comparative and international education, and is published annually. FIRE is an international, peer-reviewed, open-source, online journal promoting interdisciplinary scholarship on the use of internationally comparative data for evidence-based and innovative change in education worldwide. CIE faculty serve as senior editor for both publications and CIE students serve as both editorial assistants and frequent co-authors for these prestigious publications.

• International Development and Consulting. CIE Program faculty and students engage in short-term development and program-related consultancy projects on a regular basis. For example, a CIE faculty and student team has worked with a youth village for orphaned and vulnerable youth in post-genocide Rwanda to develop a village-wide monitoring and evaluation system. This consultancy project, developed with the support of a CIE degree program graduate working with the Rwandan village, involved both Lehigh-based and Rwanda-based planning, research, workshops, and other consultancy-related activities, and complemented graduate-level coursework in the CIE program.

For additional information about the program, please visit: http://coe.lehigh.edu/academics/disciplines/cie

Associate Professor. Alexander W. Wiseman, PhD (The Pennsylvania State University)
Assistant Professor. Peggy A Kong, PhD (Harvard University)
Professors Of Practice. Lisa Mareike Damaschke-Deitrick, MSC (Free University); Sothy Eng, PhD (Texas Tech University)
Doctor of Philosophy in Comparative and International Education
***You currently have no program requirements listed in the catalog.***

Master of Arts In Comparative and International Education

REQUIRED COURSES (15 CREDITS)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIE 400</td>
<td>Comparative and International Education (REQUIRED COURSES (15 CREDITS))</td>
<td>3</td>
</tr>
<tr>
<td>CIE 401</td>
<td>Globalization &amp; Contextualization</td>
<td>3</td>
</tr>
<tr>
<td>CIE 408</td>
<td>Master's Thesis/Capstone</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 471</td>
<td>Diversity and Multicultural Perspectives</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 403</td>
<td>Research</td>
<td>3</td>
</tr>
</tbody>
</table>
**ELECTIVE COURSES (6 CREDITS, select 2 courses from below)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDUC 408</td>
<td>Introduction to Statistics</td>
<td>3</td>
</tr>
<tr>
<td>CIE 402</td>
<td>Development and Evaluation of International Educational Projects</td>
<td>3</td>
</tr>
<tr>
<td>CIE 403</td>
<td>Globalization and Curriculum Implications</td>
<td>3</td>
</tr>
<tr>
<td>CIE 404</td>
<td>Issues and Institutions in International Educational Development</td>
<td>3</td>
</tr>
<tr>
<td>CIE 405</td>
<td>Experiencing the United Nations: Gender and Education in International Development</td>
<td>3</td>
</tr>
<tr>
<td>CIE 406</td>
<td>International Education Policy</td>
<td>3</td>
</tr>
<tr>
<td>CIE 407</td>
<td>Grant Writing and Fund Raising in International Education Development</td>
<td>3</td>
</tr>
</tbody>
</table>

**SELECT A DISCIPLINARY FOCUS:**

**Focus 1: SOCIOLOGY & ANTHROPOLOGY (12 CREDITS, select 4 courses from below)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ANTH 325</td>
<td>Economic Anthropology</td>
<td>4</td>
</tr>
<tr>
<td>AAS 313</td>
<td>Social Movements</td>
<td>4</td>
</tr>
<tr>
<td>GS 322</td>
<td>Global Health Issues</td>
<td>4</td>
</tr>
<tr>
<td>SOC 323</td>
<td>The Child In Family and Society</td>
<td>4</td>
</tr>
<tr>
<td>SOC 329</td>
<td>Global Migration</td>
<td>4</td>
</tr>
<tr>
<td>SOC 341</td>
<td>Gender and Health</td>
<td>4</td>
</tr>
<tr>
<td>SOC 345</td>
<td>Colonialism and the Black Radical Tradition</td>
<td>4</td>
</tr>
<tr>
<td>SOC 351</td>
<td>Gender and Social Change</td>
<td>4</td>
</tr>
<tr>
<td>SOC 355</td>
<td>Sociology Of Education</td>
<td>4</td>
</tr>
<tr>
<td>SOC 364</td>
<td>Sociology of the Family</td>
<td>3,4</td>
</tr>
<tr>
<td>SOC 402</td>
<td>Sociology of Cyberspace</td>
<td>3</td>
</tr>
<tr>
<td>SOC 415</td>
<td>Case Studies Of Social Control</td>
<td>3</td>
</tr>
<tr>
<td>SOC 418</td>
<td>Gendered Experience of Globalization</td>
<td>3</td>
</tr>
<tr>
<td>SOC 419</td>
<td>Global Food Systems</td>
<td>3</td>
</tr>
<tr>
<td>SOC 420</td>
<td>Global Migration</td>
<td>3</td>
</tr>
<tr>
<td>SOC 441</td>
<td>Gender and Health</td>
<td>3</td>
</tr>
<tr>
<td>SOC 454</td>
<td>Urban Education: Inequality and Public Policy</td>
<td>1-4</td>
</tr>
<tr>
<td>SOC 465</td>
<td>Inequalities at Work</td>
<td>3</td>
</tr>
<tr>
<td>SOC 473</td>
<td>Social Basis Of Human Behavior</td>
<td>3</td>
</tr>
<tr>
<td>SOC 476</td>
<td>Issues In Health Policy Analysis</td>
<td>3</td>
</tr>
</tbody>
</table>

**OTHER SSP 400+ AND ANTH 400+ courses with advisor approval**

**Focus 2: POLITICAL SCIENCE & INTERNATIONAL RELATIONS (12 CREDITS, select 4 courses from below)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>POLS 413</td>
<td>Modern Political Philosophy</td>
<td>3</td>
</tr>
<tr>
<td>POLS 451</td>
<td>Comparative Politics Core</td>
<td>3</td>
</tr>
<tr>
<td>POLS 425</td>
<td>Nationalism in Comparative Perspective</td>
<td>3</td>
</tr>
<tr>
<td>IR 322</td>
<td>Poverty and Development</td>
<td>4</td>
</tr>
<tr>
<td>IR 323</td>
<td>Political Economy of Industrialization and Development</td>
<td>4</td>
</tr>
<tr>
<td>IR 340</td>
<td>International Environmental and Science Policy</td>
<td>4</td>
</tr>
<tr>
<td>IR 344</td>
<td>International Politics of Oil</td>
<td>4</td>
</tr>
<tr>
<td>IR 345</td>
<td>Democratization</td>
<td>4</td>
</tr>
<tr>
<td>IR 346</td>
<td>Contemporary Ethical Dilemmas in World Politics</td>
<td>4</td>
</tr>
<tr>
<td>IR 347</td>
<td>Non-State Actors in a Globalized World</td>
<td>4</td>
</tr>
</tbody>
</table>

**OTHER POL 400+ and IR 300+ courses with advisor approval**

**Focus 3: ECONOMICS (12 CREDITS, select 4 courses from below)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECO 303</td>
<td>Economic Development</td>
<td>3</td>
</tr>
<tr>
<td>ECO 339</td>
<td>International Trade</td>
<td>3</td>
</tr>
<tr>
<td>ECO 340</td>
<td>International Finance</td>
<td>3</td>
</tr>
<tr>
<td>ECO 342</td>
<td>Economic Development in China</td>
<td>3</td>
</tr>
<tr>
<td>ECO 343</td>
<td>European Economic Integration</td>
<td>3</td>
</tr>
<tr>
<td>ECO 472</td>
<td>International Trade Theory</td>
<td>3</td>
</tr>
<tr>
<td>ECO 473</td>
<td>International Monetary Economics</td>
<td>3</td>
</tr>
</tbody>
</table>

**OTHER ECO 400+ with advisor approval**

**Focus 4: HISTORY (12 CREDITS, select 4 courses from below)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIST 401</td>
<td>Historical Research</td>
<td>3</td>
</tr>
<tr>
<td>HIST 404</td>
<td>Readings in the History of the Atlantic World, 1500-1900</td>
<td>3</td>
</tr>
<tr>
<td>HIST 443</td>
<td>Readings in English History</td>
<td>3</td>
</tr>
<tr>
<td>HIST 444</td>
<td>Readings in Latin American History</td>
<td>3</td>
</tr>
<tr>
<td>HIST 447</td>
<td>Readings in European History</td>
<td>3</td>
</tr>
<tr>
<td>HIST 453</td>
<td>Research in English History</td>
<td>3</td>
</tr>
<tr>
<td>HIST 454</td>
<td>Research in Latin American History</td>
<td>3</td>
</tr>
<tr>
<td>HIST 457</td>
<td>Research in European History</td>
<td>3</td>
</tr>
</tbody>
</table>

**OTHER HIST 400+ courses with advisor approval**

The M.A. in Comparative and International Education (CIE) guides students in the examination of educational policy and theory on an international level, taking into consideration the impact of global economic, political, social, and historical factors on educational systems. A focus on interdisciplinary approaches to comparative and international education provides students a foundation for examining both educational research and policy. Graduates are prepared to work in educational research and policy organizations, government offices, ministries of education, and international development organizations.

The M.A. in CIE is a 36 credit hour program comprised of 18 credit hours of required (core) courses, 6 credit hours of electives, 12 credit hours of disciplinary-focused courses, and 3 thesis/capstone credit hours.

The core includes foundational courses in comparative and international education, statistics, and research. 6 credit hours of electives provide students the opportunity to specialize in a particular area of the field of comparative and international education. The 12 credits of disciplinary-focused coursework requires students to choose among the following social science disciplines: sociology/anthropology, political science/international relations, history, and economics. This disciplinary focus builds a theoretical and methodological foundation in a social science, which is a valued characteristic of professionals in the field of comparative and international education. Finally, the master's thesis is prepared under the direction of one of the core CIE faculty.

**Master of Education in Globalization and Educational Change**

- **CIE 400** Comparative and International Education
- **CIE 401** Globalization & Contextualization
- **CIE 402** Development and Evaluation of International Educational Projects
- **CIE 403** Globalization and Curriculum Implications
- **CIE 471** Globalization and Education Equity
- **EDUC 403** Research

In addition, students take a minimum of 12 credits in a Concentration area. Concentration coursework is designed by each student and faculty advisor in close collaboration to fit the interests and situation of the student's current and/or potential needs. In addition, students may choose to concentrate in one of the following areas exclusively, which then leads to concurrent receipt of the M.Ed. in Globalization and Educational Change plus a Post-Baccalaureate Certificate in the specified area: 1) International Counseling (12 credit minimum), 2) International Development in Education (12 credit minimum), 3) Special Education (12 credit minimum), 4) Teaching English to Second Language Learners (12 credit minimum), 5) Technology Use in the Schools (12 credit minimum), 6) Women, Gender, and Sexuality Studies (12 credit minimum)

The M.Ed. is a 30-credit-hour program, which is designed to equip graduates to understand, participate in, and make data-driven decisions in and about schools and education institutions — both in the U.S. and internationally. It is a practitioner-oriented program with concentrations
in education-related areas (e.g., international counseling, international development education, TESOL, special education, and technology use in schools). Program curriculum explores how education is related to economic, political, and social globalization, as well as examines how education policies, structures, and practices are contextualized in different geopolitical contexts.

**International Development in Education Certificate**

The post-baccalaureate certificate program in International Development in Education (IDE) provides a foundation in the theoretical concepts of, and practical skills in, education and international development. Certificate holders are prepared to assess and solve education problems in international development, understanding different socioeconomic and political contexts in the global milieu, and work towards educational equity. From examining the work of international development agencies to learning the skills of program evaluation and proposal writing, certificate holders are prepared to work in NGOs, international development agencies, and multilateral organizations.

**CIE 404 Issues and Institutions in International Educational Development**

3 Credits

**CIE 405 Experiencing the United Nations: Gender and Education in International Development**

3 Credits

**CIE 406 International Education Policy**

3 Credits

**CIE 407 Grant Writing and Fund Raising in International Education Development**

3 Credits

**Courses**

**CIE 400 Comparative and International Education 3 Credits**

The goal of this course is to introduce students to the origins and development of the field of international and comparative education and to explore how both scholars and educational policymakers have engaged some of the debates that characterize policy and research in education around the world. Special attention is devoted to similarities and differences in educational policy and practice between advanced and developing capitalist, socialist and “transitional” societies. At the end of this course, students should be able to think about their school or educational system within a global context, and have some idea how to make meaningful comparisons.

**CIE 401 Globalization & Contextualization 3 Credits**

The goal of the course is to clarify what globalization is and to consider the impact of globalizing ideas, structures, and cultures on education, and how educators and other stakeholders respond given their school’s or system’s unique global context. Through case studies and discussions with real-world school leaders, students explore ways that policies are “borrowed” and both educational cultures and structures are “institutionalized.”

**CIE 402 Development and Evaluation of International Educational Projects 3 Credits**

This course is an introductory exercise for students new to educational research, program evaluation and related areas (e.g., quality improvement, enhancing organizational performance, methods of social change, management training). Students will develop and conduct a professional on-site project evaluation of existing national and international projects, including initiatives undertaken by different international organizations (e.g., UNICEF, UNESCO, USAID), educational institutions, and schools (both public and private). Students will be accompanied and supervised throughout all stages of the research and evaluation process. No previous experience with evaluation research and empirical or qualitative data analysis is required.

**CIE 403 Globalization and Curriculum Implications 3 Credits**

This course investigates the impact of globalization on curriculum. In particular, it discusses how curriculum has historically been utilized in nation building; how tensions between the global and the local are inherent in curriculum; and how curriculum is a site of construction of national as well as global/cosmopolitan identities. Global citizenship is one of the major curricula themes spanning this dynamic interaction between the global and the local. This course will present several theoretical perspectives on this phenomenon and compare curricula across nations to understand how globalizing the curricula differs according to culture and language.

**CIE 404 Issues and Institutions in International Educational Development 3 Credits**

Explores theoretical approaches to understanding the role of education in international development by introducing students to institutions involved in international educational development in diverse global settings (e.g., United Nations, World Bank, NGOs, and state agencies). Discussions are framed by current debates in the fields of international and comparative education.

**CIE 405 (WGSS 405) Experiencing the United Nations: Gender and Education in International Development 3 Credits**

Building on the Lehigh University/United Nations partnership initiative, this course provides a structured practical experience for students to learn about the dynamics of UN and civil society relationships, focusing on the issues of gender and education in international development. Class activities include trips to the UN to attend NGO briefings and other events. Students develop experiences and skills in international development such as policy blogging, brief writing, and education sector analysis.

**CIE 406 International Education Policy 3 Credits**

Focuses on how policy is created, implemented, and evaluated in schools and educational systems from a comparative and international perspective. Provides a framework for a comprehensive analysis of the education “sector” in order to inform regional, national, or multinational educational policymaking. Students will apply this understanding to an analysis of education policy in a specific region or district (e.g., Pennsylvania) from a global policymaking perspective.

**CIE 407 Grant Writing and Fund Raising in International Education Development 3 Credits**

Addresses NGO issues and needs and will develop leadership, problem solving, and practical grant writing skills focused on international education development. The course is designed for individuals working in international NGOs and schools and is designed to work in conjunction with a local or international NGO. Teams of students will develop a project proposal related to the agency’s primary service mission, articulate a fund-raising strategy, and raise capital on the basis of proposals developed in class.

**CIE 408 Master’s Thesis/Capstone 3 Credits**

Master’s-level course requiring an original research or a capstone (project, paper, presentation, or a co-authored publication) related to a relevant topic in the field of comparative and international education. Thesis/capstone is conducted with the supervision of Comparative & International Education program faculty.

**CIE 410 Research in Comparative and International Education 3 Credits**

(Two-semester-course taught in consecutive semesters with CIE 411.) This course provides an overview of research methodologies used in comparative and international education research. The course will introduce doctoral students to both qualitative and quantitative research methodologies, including participant observation, interviews, ethnography, narrative analysis, survey data collection, and large-scale, cross-national data analysis. The relationship between each methodology and the field of comparative and international education will be discussed using both research and policy examples from a variety of developed and developing country contexts.
CIE 411 Research in Comparative and International Education II 3 Credits
(Two-semester-course taught in consecutive semesters with CIE 410)
This course provides an overview of research methodologies used in comparative and international education research. The course will introduce doctoral students to both qualitative and quantitative research methodologies, including participant observation, interviews, ethnography, narrative analysis, survey data collection, and large-scale, cross-national data analysis. The relationship between each methodology and the field of comparative and international education will be discussed using both research and policy examples from a variety of developed and developing country contexts.

CIE 412 Sociocultural Issues in Comparative and International Education 3 Credits
This course examines social and cultural contexts of teaching and learning in developed and developing country contexts. The course combines theoretical and empirical readings to highlight the dynamic factors that shape the lives of learners inside and outside the classroom. The course is divided into two modules. The first module presents theoretical readings on the social and cultural context of schooling. The second module draws from empirical studies of social and cultural issues in developed and developing country contexts.

CIE 414 Globalization and Post-Colonialism in Education 3 Credits
This course focuses on some of the central discussions in the field of comparative and international education and addresses the specific questions about the meaning of education and post-colonialism. Readings examine specific instances of the intersection of European colonialism, global capitalism, and international development in a variety of geographic settings, including Eastern/Central Europe, Africa, and Asia. Assignments focus on post-colonialism in specific countries to develop a historical perspective on the topic and to provide the basis for international comparison.

CIE 450 Doctoral Seminar in Comparative and International Education I 3 Credits
[Two-semester sequence] This seminar is a year-long course divided into several modules, each taught by different faculty within the comparative and international education program. The goal is to provide new doctoral students with a strong foundation in comparative education theory and initiate them into the professional and academic field. Students will study a variety of established and evolving theoretical frameworks and explore major research areas in comparative and international education and its sub-disciplines, with an emphasis on Lehigh-specific expertise in the field.

CIE 451 Doctoral Seminar in Comparative and International Education II 3 Credits
[Two-semester sequence] This seminar is a year-long course divided into several modules, each taught by different faculty within the comparative and international education program. The goal is to provide new doctoral students with a strong foundation in comparative education theory and initiate them into the professional and academic field. Students will study a variety of established and evolving theoretical frameworks and explore major research areas in comparative and international education and its sub-disciplines, with an emphasis on Lehigh-specific expertise in the field.

CIE 460 Advanced Research Practicum in Comparative and International Education 3 Credits
The goal of this course is to provide an opportunity for doctoral students to learn advanced techniques of comparative education research or measurement applied to international and/or cross-national comparative study of education phenomena. Advanced Research Practicum will be closely supervised by a CIE faculty member and will involve elements of collaborative academic research and professional mentoring.

CIE 470 Doctoral Proposal Seminar in Comparative and International Education 3 Credits
This course guides students through the initial stages of the dissertation proposal writing. Must have official standing as a doctoral student in comparative and international education.

CIE 471 Globalization and Education Equity 3 Credits
This course investigates how globalization affects education equity by examining group differences that result from race, ethnicity, culture, language, class, and gender. It critically analyzes existing systems of power and privilege that maintain the social constructions of cultural differences in the United States and globally. Through readings and class discussion, students are empowered to clarify and ground their own beliefs about education equity, while articulating a vision for equitable educational development as thoughtful, critical, and humane education researchers and practitioners.

CIE 482 Practicum in University Teaching: Comparative & International Ed 1-4 Credits
Mentored and guided co-teaching focused on the design, organization, pedagogy and assessment of university courses in Comparative and International Education. Students in this course will work with a faculty member to apply best practices in university teaching with feedback while co-teaching students in a course in the College of Education. Students taking the course must meet the college standards for participation and be approved by the program director and department chair.
Repeat Status: Course may be repeated.

CIE 491 Special Topics in Comparative and International Education 3 Credits
Intensive study and discussion of a specialized area in comparative and international education. Subtitle will vary.
Repeat Status: Course may be repeated.

CIE 499 Dissertation 1-15 Credits

Computer Engineering

Computer Engineering deals with the design and analysis of intelligent systems that have become indispensable in today's world. Because it requires expertise in both hardware and software areas, the Computer Engineering program is offered jointly by the department of Computer Science and Engineering (CSE) and the department of Electrical and Computer Engineering (ECE).

UNDERGRADUATE PROGRAMS

Mission Statement
The mission of the computer engineering program is to prepare computer engineers to meet the challenges of the future; to promote a sense of scholarship, leadership and service among our graduates; to instill in the students the desire to create, develop, and disseminate new knowledge; and to provide international leadership to the computer engineering profession. The mission is attained through the following program educational objectives.

Program Educational Objectives in Computer Engineering
The objective of the Computer Engineering program is to produce students who within 5-10 years after graduation will:

• Meet expectations of the employers of computer engineers.
• Pursue diverse career paths if they so desire.
• Become leaders in their chosen careers.

BACHELOR OF SCIENCE IN COMPUTER ENGINEERING
The required courses for this degree include the fundamentals of electronic circuits, signal theory, logic design, computer architecture, digital systems, structured programming, data structures, software engineering, operating systems and discrete mathematics. A strong foundation in the physical sciences and in mathematics is required. Approved technical electives, chosen with the advisor’s consent, are selected in preparation for graduate study or entry into industry according to individual interests.

The program totals 133 credit hours. The Computer Engineering program is accredited by the Engineering Commission of ABET, www.ABET.org.

The recommended sequence of courses follows:

First Year

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<thead>
<tr>
<th>First Semester</th>
<th>Credits</th>
<th>Second Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 001</td>
<td>3</td>
<td>ENGL 002</td>
<td>3</td>
</tr>
<tr>
<td>MATH 021</td>
<td>4</td>
<td>MATH 022</td>
<td>4</td>
</tr>
</tbody>
</table>
### Graduate Programs

Graduate programs of study provide a balance between formal classroom instruction and research and are tailored to the individual student’s professional goals. The programs appeal to individuals with backgrounds in computer or information science, in computer engineering, in electrical engineering, in mathematics, or in the physical science. Research is an essential part of the graduate program. The research topics are listed in the departmental descriptions for Computer Science and Engineering (CSE) and Electrical and Computer Engineering (ECE) which jointly administer the computer engineering program. Individual courses are listed in the catalog descriptions of the CSE and ECE departments.

The Master of Science degree requires the completion of 30 credit hours of work and may include a six credit hour thesis for Computer Engineering degree. A program of study must be submitted in compliance with the graduate school regulations. An oral presentation of the thesis is required.

The Master of Engineering degree requires the completion of 30 credit hours of work, which includes design-oriented courses and an engineering project. A program of study must be submitted in compliance with the college rules. An oral presentation of the project is required.

The Ph.D. degree in computer engineering requires the completion of 42 credit hours of work (including the dissertation) beyond the master's degree (48 hours if the master's degree is not from Lehigh), the passing of a departmental qualifying examination appropriate to each degree within one year after entrance into the degree program, the passing of a general examination in the candidate’s area of specialization, the admission into candidacy, and the writing and defense of a dissertation. Competence in a foreign language is not required.

The program has a core curriculum requirement for graduate students. The purpose of this requirement is to guarantee that all students pursuing graduate studies in the program acquire an appropriate breadth of knowledge of their discipline. To satisfy the core curriculum requirements in Computer Engineering, students need to complete at least two courses in the computer hardware/architecture area, at least two courses in a second area, and at least one course in a third area. In each of the three areas at least one course must be at the 400 level. The areas are: computer software systems, signal processing and communications, computer software applications, and circuits and systems. See www.compe.lehigh.edu for details about these areas.

Courses from other universities or undergraduate studies may be used to satisfy these requirements, by petition, at the discretion of the program faculty. Additional graduate program information may be obtained from the program’s graduate coordinator.

Most courses in the Computer Engineering curriculum are listed in the Computer Science and Engineering (p. 172) (CSE) and Electrical and Computer Engineering (p. 203) (ECE) departments.

### Courses

**CREG 257 Senior Lab Project I 3 Credits**
With CREG 258, a complete design experience for Computer Engineers. Research, planning, and completion of the initial design for a capstone project that integrates the many facets of the undergraduate Computer Engineering program. The project, carried forward to completion in CREG 258, must involve the integration of hardware and software within a single system. Technical writing, product development, ethics and professional engineering, and presentation of design and research.

**CREG 258 Senior Lab Project II 2 Credits**
Continuation of CREG 257 Complete design, construction, and testing of projects selected and developed in CREG 257. Final design reviews and project presentations; final written report; development issues, including manufacturability, patents, and ethics. Department approval.  
**Prerequisites:** CREG 257

### Computer Science and Business Program

The College of Business and Economics and the Computer Science and Engineering department in the P.C. Rossin College of Engineering and Applied Science jointly offer the Computer Science and Business (CSB) program. The mission of the program is to provide rigorous computer science education integrated with in-depth business training that prepares high quality undergraduate students with diverse backgrounds for lifelong learning and to assume positions of leadership in the business community. This carefully crafted 136 credit hour degree integrates technology skills in software development with a solid background in business and economics. Deep immersion in both of these areas distinguishes CSB from programs offered by other universities. At the same time it is well balanced with approximately one
third of the courses in liberal arts, one-third in computer science, and one-third in business.

After four years the program leads to a degree in Computer Science and in Business, which is jointly awarded by the College of Business and Economics and the P.C. Rossin College of Engineering and Applied Science. Graduates of the program will be ideal candidates for placement within public accounting firms, consulting companies, and startup companies. This program provides students with the background needed to become the CIO’s, decision makers, and general managers of information age corporations.

While honors-like in quality and rigor, the CSB program is open to any student wishing to accept the challenges it offers. Students may matriculate at Lehigh specifically into CSB or enter the program at a later point. Transferring into CSB after freshman year, however, may require students to take additional credits to graduate. The CSB program is accredited in Business (AACSB International) and is accredited by The Computer Accreditation Commission of ABET, www.abet.org.

The co-directors of the CSB program are James A. Hall, Peter E. Bennett Chair in Business and Economics (jah0@lehigh.edu) and Henry Korth, Professor of Computer Science and Engineering (hfk2@lehigh.edu).

For additional information visit the CSB web site at: www.cse.lehigh.edu/csb

MISSION FOR PROGRAM
The Computer Science and Business program’s mission is to provide its students with a strong education in mathematics, science, business, and computer science fundamentals and to prepare them to be able to adapt to future changes in the practice of Computer Science.

PROGRAM EDUCATIONAL OBJECTIVES
Graduates of the Bachelor of Science in Computer Science and Business Program will:

• Apply their education in computer science to the analysis and solution of business and industrial problems.

• Account for ethical and social issues when solving business and industrial problems.

• Function effectively in a collaborative team and effectively communicate with members of the team.

• Engage in continued education in their field of expertise.

• Attain positions of leadership in their chosen field.

• Apply their training to problems where information technologies and business processes converge.

DEGREE REQUIREMENTS
The required courses for the CSB degree constitute the fundamentals of structured programming, discrete mathematics, algorithms, computer architecture, programming languages, software engineering, accounting, finance, marketing, management, and economics. None of the program requirements for the CSB major may be taken pass/fail.

The requirements are stated below. To view a number of suggested sequences of courses for satisfying these requirements see Suggested Sequences of Courses (p. 167) below.

Required Computer Science courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSE 001</td>
<td>Breadth of Computing</td>
<td>2</td>
</tr>
<tr>
<td>CSE 002</td>
<td>Fundamentals of Programming</td>
<td>2</td>
</tr>
<tr>
<td>CSE 017</td>
<td>Programming and Data Structures</td>
<td>3</td>
</tr>
<tr>
<td>CSE 109</td>
<td>Systems Software</td>
<td>4</td>
</tr>
<tr>
<td>CSE 202</td>
<td>Computer Organization and Architecture</td>
<td>3</td>
</tr>
<tr>
<td>CSE 216</td>
<td>Software Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CSE 241</td>
<td>Database Systems and Applications</td>
<td>3</td>
</tr>
<tr>
<td>or CSE 341</td>
<td>Database Systems, Algorithms, and Applications</td>
<td>3</td>
</tr>
<tr>
<td>CSE 261</td>
<td>Discrete Structures</td>
<td>3</td>
</tr>
<tr>
<td>CSE 262</td>
<td>Programming Languages</td>
<td>3</td>
</tr>
<tr>
<td>CSE 303</td>
<td>Operating System Design</td>
<td>3</td>
</tr>
<tr>
<td>CSE 340</td>
<td>Design and Analysis of Algorithms</td>
<td>3</td>
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</table>

One 300-level course

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>MATH 202</td>
<td>Calculus II (or MATH 075 followed by MATH 076)</td>
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</tr>
<tr>
<td>MATH 231</td>
<td>Probability and Statistics</td>
<td>3</td>
</tr>
<tr>
<td>or ECO 045</td>
<td>Statistical Methods</td>
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Natural science courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CSE 311</td>
<td>Computer Applications in Business</td>
<td>3</td>
</tr>
<tr>
<td>CSE 312</td>
<td>Design of Integrated Business Application I</td>
<td>3</td>
</tr>
<tr>
<td>CSE 313</td>
<td>Design of Integrated Business Application II</td>
<td>3</td>
</tr>
</tbody>
</table>

Required CSB courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 001</td>
<td>Composition and Literature</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 002</td>
<td>Composition and Literature II</td>
<td>3</td>
</tr>
<tr>
<td>CSE 252</td>
<td>Computers, the Internet, and Society</td>
<td>3</td>
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</tbody>
</table>

Humanities and Social Science requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 001</td>
<td>Composition and Literature</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 002</td>
<td>Composition and Literature II</td>
<td>3</td>
</tr>
<tr>
<td>CSE 252</td>
<td>Computers, the Internet, and Society</td>
<td>3</td>
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</tbody>
</table>

Humanities (HU) electives

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
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<td>Social Sciences (SS) electives</td>
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<td>3</td>
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</table>

Free electives

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSE 252</td>
<td>Computer Applications in Business</td>
<td>3</td>
</tr>
<tr>
<td>CSE 312</td>
<td>Design of Integrated Business Application I</td>
<td>3</td>
</tr>
<tr>
<td>CSE 313</td>
<td>Design of Integrated Business Application II</td>
<td>3</td>
</tr>
</tbody>
</table>

Required CSB electives

Courses approved by the student’s advisor.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 001</td>
<td>Composition and Literature</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 002</td>
<td>Composition and Literature II</td>
<td>3</td>
</tr>
<tr>
<td>CSE 252</td>
<td>Computers, the Internet, and Society</td>
<td>3</td>
</tr>
</tbody>
</table>

Humanities (HU) electives

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Sciences (SS) electives</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

Free electives

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSE 252</td>
<td>Computer Applications in Business</td>
<td>3</td>
</tr>
<tr>
<td>CSE 312</td>
<td>Design of Integrated Business Application I</td>
<td>3</td>
</tr>
<tr>
<td>CSE 313</td>
<td>Design of Integrated Business Application II</td>
<td>3</td>
</tr>
</tbody>
</table>

Required Business courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUS 001</td>
<td>Introduction to Business in a Global Environment</td>
<td>3</td>
</tr>
<tr>
<td>ACCT 151</td>
<td>Introduction to Financial Accounting</td>
<td>3</td>
</tr>
<tr>
<td>ACCT 152</td>
<td>Introduction to Managerial Accounting</td>
<td>3</td>
</tr>
<tr>
<td>ECO 001</td>
<td>Principles of Economics</td>
<td>4</td>
</tr>
<tr>
<td>ECO 029</td>
<td>Money, Banking, and Financial Markets</td>
<td>3</td>
</tr>
<tr>
<td>ECO 146</td>
<td>Applied Microeconomic Analysis</td>
<td>3</td>
</tr>
<tr>
<td>FIN 125</td>
<td>Introduction to Finance</td>
<td>3</td>
</tr>
<tr>
<td>LAW 201</td>
<td>Legal Environment of Business</td>
<td>3</td>
</tr>
<tr>
<td>SCM 186</td>
<td>Supply Chain Operations Management</td>
<td>3</td>
</tr>
<tr>
<td>MKT 111</td>
<td>Principles of Marketing</td>
<td>3</td>
</tr>
<tr>
<td>MGT 301</td>
<td>Strategic Management in a Global Environment</td>
<td>3</td>
</tr>
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Total Credits

<table>
<thead>
<tr>
<th>Credits</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>135-137</td>
<td></td>
</tr>
</tbody>
</table>

1. Such that one course has an attached laboratory and such that two courses are in a laboratory science with the first course a prerequisite to the second course. Note that there are some NS courses that, though in a laboratory science, do not include a laboratory; instead the “attached lab” has a separate course number. See Suggested Sequences of Natural Science Courses (http://www.cse.lehigh.edu/academics/undergraduate-computer-science/bs-in-computer-science-and-business/2-uncategorised/174-natural-science-course-sequence).


CSB TRACKS
Students may choose to use their CSB professional electives to develop areas of concentrations or tracks from courses offered within the CSE department or CBE. In certain cases, the program co-directors may also approve courses from other departments. See some examples of CSB tracks (http://www.cse.lehigh.edu/academics/undergraduate-computer-science/bs-in-computer-science-and-business/2-uncategorised/122-csb-choice) list.

SAMPLE SEQUENCES OF COURSES
Below are several sample course sequences that fulfill the CSB degree requirements. These are only examples and nothing here is intended to suggest implicit requirements. It should be clear in particular that electives can easily be rearranged. All sample sequences assume a
non-Physics science sequence; the first Physics course in the Physics sequence is 5 credits (4-credit course plus 1-credit lab).

None of these samples assume AP credit. Generally, students with AP move courses in the sequence earlier to leave room for more electives in the junior and/or senior years.

Samples A and B are shown in two versions: Samples A1 and B1 assume MATH 021 in the fall of freshman year. Samples A2 and B2 assume that MATH 021 is replaced by the sequence of MATH 075 in the fall and MATH 076 in the spring with MATH 022 deferred until sophomore year.

Students contemplating the Lehigh in Prague Program during the summer following their sophomore year should complete ACCT 151 and ACCT 152, CSB 311, and CSE 241 (or CSE 341) by the end of sophomore year. (See Samples B1 and B2). It is necessary to request an override to be allowed to take ACCT 152 concurrent with CSB 311.

Students not planning to go to Prague, or who plan to go in the summer following their junior year should take CSB 311 in the spring of junior year.

Students contemplating graduate study in computer science or employment at major computing software firms (e.g. Microsoft, Google, Oracle, IBM) should consider taking CSE 340 prior to senior year. (See Sample C).

Sample D shows how a student entering CSB as a sophomore from the P.C. Rossin College of Engineering and Applied Science could complete the CSB major in 4 years with overloads in senior year. The overloads can be avoided via AP credit, a summer course, or the Lehigh in Prague program. It is important that students considering a transfer into CSB contact Professor James Hall or Professor Hank Korth prior to course registration.

Sample E shows how a student entering CSB as a sophomore from the College of Business and Economics could complete the CSB major in 4 years without overloads (but see note regarding Math). It is important that students considering a transfer into CSB contact Professor James Hall or Professor Hank Korth prior to course registration.

**Computer Science and Business - SAMPLE A1 (MATH 021)**

This is not compatible with participating in the Lehigh in Prague Program during the summer after sophomore year, though it is compatible with participation during the summer after junior year.

<table>
<thead>
<tr>
<th>First Year</th>
<th>First Semester CR</th>
<th>Second Semester CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUS 001</td>
<td>3</td>
<td>CSE 017</td>
</tr>
<tr>
<td>CSE 001</td>
<td>2</td>
<td>ECO 029</td>
</tr>
<tr>
<td>CSE 002</td>
<td>2</td>
<td>ENGL 002</td>
</tr>
<tr>
<td>ECO 001</td>
<td>4</td>
<td>MATH 022</td>
</tr>
<tr>
<td>ENGL 001</td>
<td>3</td>
<td>Science elective</td>
</tr>
<tr>
<td>MATH 021</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CBE Excel Competency Exam</td>
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</table>

**Second Year**

<table>
<thead>
<tr>
<th>First Semester CR</th>
<th>Second Semester CR</th>
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</thead>
<tbody>
<tr>
<td>ACCT 151</td>
<td>3</td>
</tr>
<tr>
<td>CSE 109</td>
<td>4</td>
</tr>
<tr>
<td>MATH 231 or ECO 045</td>
<td>3</td>
</tr>
<tr>
<td>MKT 111</td>
<td>3</td>
</tr>
<tr>
<td>Science elective</td>
<td>4</td>
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**Third Year**

<table>
<thead>
<tr>
<th>First Semester CR</th>
<th>Second Semester CR</th>
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<tbody>
<tr>
<td>CSE 303</td>
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<tr>
<td>CSE 216</td>
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<td>FIN 125</td>
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**Fourth Year**

<table>
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<td>CSE 262</td>
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<td>CSB professional elective</td>
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</tbody>
</table>

**Total Credits: 136**

**Computer Science and Business - SAMPLE A2 (MATH 075/076)**

This is not compatible with participating in the Lehigh in Prague Program during the summer after sophomore year, though it is compatible with participation during the summer after junior year.

<table>
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<tr>
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<th>Second Semester CR</th>
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<tbody>
<tr>
<td>BUS 001</td>
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<td>CSE 017</td>
</tr>
<tr>
<td>CSE 001</td>
<td>2</td>
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</tr>
<tr>
<td>CSE 002</td>
<td>2</td>
<td>ENGL 002</td>
</tr>
<tr>
<td>ECO 001</td>
<td>4</td>
<td>MATH 022</td>
</tr>
<tr>
<td>ENGL 001</td>
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<td>Science elective</td>
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<td>MATH 075</td>
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**Second Year**

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**Third Year**

<table>
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<th>Second Semester CR</th>
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<tbody>
<tr>
<td>CSE 303</td>
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<tr>
<td>CSE 216</td>
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<td>SCM 186</td>
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**Fourth Year**

<table>
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<td>CSE 340</td>
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<tr>
<td>CSE 262</td>
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<tr>
<td>CSB professional elective</td>
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</table>
## Computer Science and Business - SAMPLE B1 (Math 021)
Targeted towards students thinking about spending the summer after sophomore year in the Lehigh in Prague Program. Students not going to Prague need to fit CSE 252 and 3 professional elective credits into the regular semesters.

<table>
<thead>
<tr>
<th>First Year</th>
<th>First Semester CR</th>
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<td>ECO 001</td>
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<td>MATH 022</td>
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<td>ENGL 001</td>
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<td>MATH 021</td>
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<tr>
<td>CBE Excel</td>
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**Total Credits: 136**

<table>
<thead>
<tr>
<th>Second Year</th>
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<tbody>
<tr>
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<td>CSB 314</td>
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<tr>
<td>CSE 252</td>
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</table>

<table>
<thead>
<tr>
<th>Third Year</th>
<th>CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Semester CR</td>
<td>Second Semester CR</td>
</tr>
<tr>
<td>BUS 001</td>
<td>3</td>
</tr>
<tr>
<td>CSE 252</td>
<td>3</td>
</tr>
<tr>
<td>CSE 303</td>
<td>3</td>
</tr>
<tr>
<td>HU elective</td>
<td>4</td>
</tr>
</tbody>
</table>

**Total Credits: 136**

## Computer Science and Business - SAMPLE B2 (Math 075/076)
Targeted towards students thinking about spending the summer after sophomore year in the Lehigh in Prague Program. Students not going to Prague need to fit CSE 252 and 3 professional elective credits into the regular semesters.

<table>
<thead>
<tr>
<th>First Year</th>
<th>First Semester CR</th>
<th>Second Semester CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUS 001</td>
<td>3</td>
<td>CSE 017</td>
</tr>
<tr>
<td>CSE 001</td>
<td>2</td>
<td>ECO 029</td>
</tr>
<tr>
<td>CSE 002</td>
<td>2</td>
<td>ENGL 002</td>
</tr>
<tr>
<td>ECO 001</td>
<td>4</td>
<td>MATH 076</td>
</tr>
<tr>
<td>ENGL 001</td>
<td>3</td>
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<tr>
<td>MATH 075</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>CBE Excel</td>
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<td></td>
</tr>
</tbody>
</table>

**Total Credits: 136**

## Computer Science and Business - SAMPLE C
Designed for students thinking of graduate study in Computer Science. This sample is compatible with the Lehigh in Prague Program, but assumes the students chooses not to do it. This sample includes some specific choices of course options and CSE electives that are not recommended as preparations for graduate study.

<table>
<thead>
<tr>
<th>First Year</th>
<th>First Semester CR</th>
<th>Second Semester CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUS 001</td>
<td>3</td>
<td>CSE 017</td>
</tr>
<tr>
<td>CSE 001</td>
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<td>ECO 029</td>
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**Total Credits: 136**
Computer Science and Business Program

<table>
<thead>
<tr>
<th>CSE 002</th>
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<th>ENGL 002</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 001</td>
<td>3</td>
<td>MATH 022</td>
<td>4</td>
</tr>
<tr>
<td>ECO 001</td>
<td>4</td>
<td>Science elective</td>
<td>4</td>
</tr>
<tr>
<td>MATH 021</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBE Excel Competency Exam</td>
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</table>

**Second Year**

<table>
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<th>CR</th>
<th>Second Semester</th>
<th>CR</th>
</tr>
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<tbody>
<tr>
<td>ACCT 151</td>
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<td>ACCT 152</td>
<td>3</td>
</tr>
<tr>
<td>ECO 001</td>
<td>4</td>
<td>CSE 261</td>
<td>3</td>
</tr>
<tr>
<td>ECO 029</td>
<td>3</td>
<td>CSE 109</td>
<td>4</td>
</tr>
<tr>
<td>Science Elective (must be PHY or CHM)</td>
<td>4</td>
<td>CSE 241 or 341</td>
<td>3</td>
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**Third Year**

<table>
<thead>
<tr>
<th>First Semester</th>
<th>CR</th>
<th>Second Semester</th>
<th>CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSE 216</td>
<td>3</td>
<td>CSB 311</td>
<td>3</td>
</tr>
<tr>
<td>CSE 262</td>
<td>3</td>
<td>CSB 312</td>
<td>3</td>
</tr>
<tr>
<td>ECO 146</td>
<td>3</td>
<td>CSE 202</td>
<td>3</td>
</tr>
<tr>
<td>FIN 125</td>
<td>3</td>
<td>CSE elective (See Computer Science &amp; Business Electives below)</td>
<td>3</td>
</tr>
<tr>
<td>MATH 205</td>
<td>3</td>
<td>LAW 201</td>
<td>3</td>
</tr>
<tr>
<td>MKT 111</td>
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**Fourth Year**

<table>
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<tr>
<th>First Semester</th>
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<th>Second Semester</th>
<th>CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSB 313</td>
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<td>CSB professional elective</td>
<td>3</td>
</tr>
<tr>
<td>CSE 303</td>
<td>3</td>
<td>CSB professional elective</td>
<td>3</td>
</tr>
<tr>
<td>CSE 340</td>
<td>3</td>
<td>MGT 301</td>
<td>3</td>
</tr>
<tr>
<td>CSE 252</td>
<td>3</td>
<td>SS elective</td>
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</tr>
<tr>
<td>CSB professional elective</td>
<td>3</td>
<td>HU elective</td>
<td>3</td>
</tr>
<tr>
<td>CSE elective</td>
<td>4</td>
<td>Free elective</td>
<td>5</td>
</tr>
<tr>
<td>HU elective</td>
<td>4</td>
<td>Free elective</td>
<td>5</td>
</tr>
<tr>
<td>Science elective</td>
<td>4</td>
<td>Free elective</td>
<td>5</td>
</tr>
<tr>
<td>Plus 2 other computer science courses</td>
<td>6</td>
<td></td>
<td></td>
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</tbody>
</table>

**Total Credits: 139**

**Computer Science and Business - SAMPLE D**

Designed for students entering CSB after first-year in the P.C. Rossin College of Engineering and Applied Science. Ideally, students will take ECO 001 in freshman year. Students interested in Prague after sophomore year need CSB 311 in spring of sophomore year as an overload, or should wait until after junior year.

**First Year**

<table>
<thead>
<tr>
<th>First Semester</th>
<th>CR</th>
<th>Second Semester</th>
<th>CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 001</td>
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<td>ENGL 002</td>
<td>3</td>
</tr>
<tr>
<td>MATH 021</td>
<td>4</td>
<td>MATH 022</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 005</td>
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<td>ENGR 010 (or in fall term)</td>
<td>2</td>
</tr>
<tr>
<td>ENGR 010 (or in spring term)</td>
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<td>Select one of the following</td>
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<tr>
<td>Select one of the following</td>
<td>4-5</td>
<td>CHM 030</td>
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</tr>
<tr>
<td>CHM 030</td>
<td>4</td>
<td>PHY 011 &amp; PHY 012</td>
<td>5</td>
</tr>
<tr>
<td>PHY 011 &amp; PHY 012</td>
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<td>CSB Required Courses</td>
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<tr>
<td>CSE 002</td>
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<td>CBE Excel Competency Exam</td>
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<table>
<thead>
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<th>Second Semester</th>
<th>CR</th>
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<tbody>
<tr>
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<tr>
<td>ECO 001</td>
<td>4</td>
<td>CSE 261</td>
<td>3</td>
</tr>
<tr>
<td>ECO 029</td>
<td>3</td>
<td>CSE 109</td>
<td>4</td>
</tr>
<tr>
<td>Science Elective (must be PHY or CHM)</td>
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<td>CSE 241 or 341</td>
<td>3</td>
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</table>

<table>
<thead>
<tr>
<th>Third Year</th>
<th>CR</th>
<th>Second Semester</th>
<th>CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSE 216</td>
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<td>CSB 311</td>
<td>3</td>
</tr>
<tr>
<td>CSE 262</td>
<td>3</td>
<td>CSB 312</td>
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<tr>
<td>ECO 146</td>
<td>3</td>
<td>CSE 202</td>
<td>3</td>
</tr>
<tr>
<td>FIN 125</td>
<td>3</td>
<td>CSE elective (See Computer Science &amp; Business Electives below)</td>
<td>3</td>
</tr>
<tr>
<td>MATH 205</td>
<td>3</td>
<td>LAW 201</td>
<td>3</td>
</tr>
<tr>
<td>MKT 111</td>
<td>3</td>
<td>SCM 186</td>
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<table>
<thead>
<tr>
<th>Fourth Year</th>
<th>CR</th>
<th>Second Semester</th>
<th>CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSB 313</td>
<td>3</td>
<td>CSB professional elective</td>
<td>3</td>
</tr>
<tr>
<td>CSE 303</td>
<td>3</td>
<td>CSB professional elective</td>
<td>3</td>
</tr>
<tr>
<td>CSE 340</td>
<td>3</td>
<td>MGT 301</td>
<td>3</td>
</tr>
<tr>
<td>CSE 252</td>
<td>3</td>
<td>SS elective</td>
<td>3</td>
</tr>
<tr>
<td>CSB professional elective</td>
<td>3</td>
<td>HU elective</td>
<td>3</td>
</tr>
<tr>
<td>CSE elective</td>
<td>4</td>
<td>Free elective</td>
<td>5</td>
</tr>
<tr>
<td>HU elective</td>
<td>4</td>
<td>Free elective</td>
<td>5</td>
</tr>
<tr>
<td>Science elective</td>
<td>4</td>
<td>Free elective</td>
<td>5</td>
</tr>
<tr>
<td>Plus 2 other computer science courses</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Total Credits: 157-159 |

**Computer Science and Business - SAMPLE E**

Designed for students entering CSB after first-year in the College of Business and Economics, assuming a typical first-year set of courses. This sample is not compatible with the Lehigh in Prague Program until after junior year.

**First Year**

<table>
<thead>
<tr>
<th>First Semester</th>
<th>CR</th>
<th>Second Semester</th>
<th>CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUS 001</td>
<td>3</td>
<td>ECO 029</td>
<td>3</td>
</tr>
<tr>
<td>ECO 001</td>
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<td>ENGL 002</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 001</td>
<td>3</td>
<td>BUS 005</td>
<td>1</td>
</tr>
<tr>
<td>MATH 081</td>
<td>4</td>
<td>ECO 045</td>
<td>3</td>
</tr>
<tr>
<td>Elective</td>
<td>1-3</td>
<td>HU or SS elective</td>
<td>4</td>
</tr>
<tr>
<td>CBE Excel Competency Exam</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second Year</th>
<th>CR</th>
<th>Second Semester</th>
<th>CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCT 151</td>
<td>3</td>
<td>ACCT 152</td>
<td>3</td>
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<tr>
<td>CSE 001</td>
<td>2</td>
<td>CSE 017</td>
<td>3</td>
</tr>
<tr>
<td>CSE 002</td>
<td>2</td>
<td>MATH 205</td>
<td>3</td>
</tr>
</tbody>
</table>
MATH 022  6  4  CSE 261  3  
MKT 111  3  SCM 186  3  
Science elective  4  ECO 146  3  

**Total Credits: 134-136**

1. Note that most HU courses are 4 credits and the credits beyond the total of 6 needed contribute towards satisfying the free elective.
2. The ECO 045 alternative is not recommended for students targeting CS graduate study.
3. CSE 341 is a better choice for students targeting CS graduate study than CSE 241.
4. Free elective, but this covered by any HU credits beyond the 2 listed above.
5. 400-level CSE courses not needed for an undergraduate program can be applied to a Lehigh graduate program via petition.
6. CSB requires MATH 021 rather than MATH 081. However, if you earned at least a B in MATH 081 you may (if you wish) request permission from the Math Department to go directly into MATH 022. If the Math Department grants that permission, and you complete MATH 022 with at least a C-, the CSB program will accept your MATH 081 course in place of MATH 021. The sample sequence assumes you get permission to go directly to MATH 022. Without that permission, unless you have AP credits, you will need to overload at least one semester or get course credits during the summer.

**COMPUTER SCIENCE & BUSINESS ELECTIVES**

In addition to the CSB electives, students are required to take one Computer Science course from the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSE 271</td>
<td>3</td>
</tr>
<tr>
<td>CSE 302</td>
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</tr>
<tr>
<td>CSE 313</td>
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<tr>
<td>CSE 318</td>
<td>3</td>
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<tr>
<td>CSE 326</td>
<td>3</td>
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<td>CSE 327</td>
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<td>CSE 331</td>
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</tr>
<tr>
<td>CSE 336</td>
<td>3</td>
</tr>
<tr>
<td>CSE 342</td>
<td>4</td>
</tr>
</tbody>
</table>

**SUGGESTED SEQUENCES OF NATURAL SCIENCE COURSES**

The following is an incomplete list of course sequences that satisfy the requirement: "two courses are in a laboratory science with the first course prerequisite to the second course." The exact set of courses depends on what each science department offers each semester.

Any course used for the science requirement must have an "NS" designation in the catalog (and there are some CHM, BIOS, and EES courses that are not "NS" but rather "ND", meaning "not designated"). The sum of all the NS-designated science credits must be at least 12.

We list here only courses that contribute to a prerequisite sequence. These sequences add up to between 7 and 9 credits. The remaining credits to reach a total of 12 may consist of any NS-designated courses.

**Biology Sequence**

CHM 030 & BIOS 041 Introduction to Chemical Principles and Biology Core I: Cellular and Molecular

**Chemistry Sequences**

CHM 030 & CHM 031 Introduction to Chemical Principles and Chemical Equilibria in Aqueous Systems

CHM 030 & CHM 110 Introduction to Chemical Principles and Organic Chemistry I (includes lab, CHM 111 optional 1-credit lab) 1

CHM 030 & BIOS 041 Introduction to Chemical Principles and Biology Core I: Cellular and Molecular

CHM 040 & CHM 041 Honors General Chemistry I and Honors General Chemistry II (both courses include lab)

CHM 040 & CHM 110 Honors General Chemistry I and Organic Chemistry I (includes lab, CHM 111 optional 1-credit lab) 1

CHM 040 & BIOS 041 Honors General Chemistry I and Biology Core I: Cellular and Molecular (includes lab)

**Physics Sequences**

PHY 011 & PHY 021 Introductory Physics I and Introductory Physics II 2

PHY 010 & PHY 013 General Physics I and General Physics II 2

PHY 011 & PHY 013 Introductory Physics I and General Physics II 2

**Earth and Environmental Science Sequence**

EES 021 Introduction to Planet Earth & EES 022 and Exploring Earth

EES 021 & EES 131 and Introduction to Rocks and Minerals

EES 025 The Environment and Living Systems & EES 022 and Exploring Earth

EES 025 & EES 152 and Ecology

EES 028 Conservation and Biodiversity & EES 022 and Exploring Earth

EES 028 & EES 152 and Ecology

1. May also take optional 1-credit lab: CHM 111
2. May also take optional 1-credit lab: PHY 012
Computer Science and Engineering

The department of computer science and engineering (CSE) offers undergraduate and graduate programs of study in computer science, computer science and business, and computer engineering, along with research opportunities in these fields. Computer science is the study of computer algorithms, software systems, and the effective use of computers to solve real-world problems and to develop new applications. Computer engineering is the study of how to develop new computer systems and how to integrate computers with electronic devices. Lehigh’s majors prepare students for graduate school or for any of the different careers in computer science, computer engineering or computer systems analysis. Computer science and computer engineering and their related careers represent, in the US workplace, the largest field of engineering larger than all others, including electrical engineering, combined. More discussion on the career potential, as well as the most up to date course offerings can be found on our departmental web site, www.cse.lehigh.edu.

Lehigh University offers a bachelor of science degree in computer science from the P. C. Rossin College of Engineering and Applied Science; the bachelor of science degree in computer science, and the bachelor of arts degree with a major in computer science, from the College of Arts and Sciences; and a bachelor of science and management degree in Computer Science and Business, jointly supported by the P. C. Rossin College of Engineering and Applied Science and the College of Business and Economics. A minor in computer science is available except to students majoring in computer engineering, computer science or computer science and business. Graduate study in the department leads to the degrees of master of science and doctor of philosophy (Ph.D.) in computer science. In conjunction with the department of Electrical and Computer Engineering (ECE), a bachelor of science degree in computer engineering and the master of science and Ph.D. degrees in computer engineering are also offered in the P.C. Rossin College of Engineering and Applied Science. In conjunction with the College of Business and Economics, the CSE department also takes part in the masters of business and engineering (MB&E) program and in the integrated business and engineering major. Except for the Bachelor of Arts degree, each of the above programs is accredited by the Computer Accreditation Commission of ABET, Inc., www.ABET.org.

The undergraduate programs emphasize the fundamental aspects of their respective areas, with extensive hands-on experiences for the students. Electives permit students to tailor their programs according to their interests and goals, whether they be in preparation for graduate study or entry into industry. The department highly recommends that students give focus to their electives by following one of the tracks listed in the department website at www.cse.lehigh.edu/TRACKS. Students have the opportunity to synthesize and apply their knowledge in a senior design project. Students are encouraged to become involved in the many research projects within the department, and may use independent study courses and their senior project as a way to participate while receiving course credit.

The graduate programs enable students to deepen their professional knowledge, understanding, and capability within their subspecialties. Each graduate student develops a program of study in consultation with his or her graduate advisor. Key thrust areas in the department include:

Computer Systems Engineering: computer architecture, sensor networks, robotics, mobile and wearable computing, and networking.

Software Systems Engineering: software architectures, parallel and distributed computing, object-oriented soft ware, middleware, Web-based systems and networked software systems.

Information Systems Engineering: database, data mining, bioinformatics, computer graphics, optimization, multimedia systems, expert systems, artificial intelligence, and computer vision.

Both graduate and undergraduate research are encouraged. The department maintains a number of computer laboratories in support of computer science and computer engineering. The department has research laboratories in robotics, networking, image processing, artificial intelligence, security, and web mining. These laboratories and their associated research activities are described more completely in the
Computer laboratory usage is an essential part of the student's education. The primary department resources include a network of more than 60 workstations, file servers, and compute servers running the Unix operating system. These systems provide an array of software tools for our students and researchers including programming languages (C, C++, Java, Perl, Python, Ruby, Matlab, etc.), software development tools, software and hardware simulators, and computer-aided design packages. One of our teaching labs contains workstations specifically designed for flexibility in running different operating systems so that students can become system administrators, network defenders, or designers of high-performance code utilizing graphical processing units (GPUs) within a controlled environment.

The department’s computers are connected via gigabit Ethernet to the university’s backbone network. The university is connected through multiple high-capacity connections to the Internet as well as a connection to Internet2. Neither the department nor the university requires a student to own a personal computer. In addition to the departmental resources, the university provides campus-wide wireless network access, public sites containing hundreds of PCs and Macintoshes, multiple large-capacity compute servers, and most classrooms are equipped with a PC and a video projection system.

Professors. Mooi Choo Chuah, PhD (University of California San Diego); Henry F. Korth, PhD (Princeton University); Daniel P. Lopresti, PhD (Princeton University); Hector Munoz-Avila, PhD (Technische Universität Kaiserslautern)

Associate Professors. Brian Y Chen, PhD (Rice University); Liang Cheng, PhD (Rutgers University); Brian D. Davison, PhD (Rutgers University); Jeffrey D. Helllin, PhD (University of Maryland College Park); Sharon Xiaohei Huang, PhD (Rutgers University); Michael F. Spear, PhD (University of Rochester); John R. Splutzer, PhD (University of Pennsylvania) 

Assistant Professors. Yinzhi Cao, PhD (Northwestern University); Ting Wang, PhD (Georgia Institute of Technology); Sihong Xie, MENG (Sun Yat-sen University)

Professors Of Practice. James A Femister, PhD (Lehigh University); Eric Fouh Mbindi, PhD (Virginia Tech); Sharon M. Kalafut, MS (The Pennsylvania State University); Jason Loew, PhD (State University of NY, Binghamton University)

Emeriti. Henry S. Baird, PhD (Princeton University); Glenn D. Blank, PhD (University Wisconsin at Madison); Donald J. Hillman, PhD (University of Cambridge); Edwin J Kay, PhD (Lehigh University); Roger N. Nagel, PhD (University of MaryLand)

UNDERGRADUATE PROGRAMS

Mission Statement for the Computer Science and Engineering Programs

The mission of the computer science, computer engineering and computer science and business programs is to prepare computer scientists and computer engineers to meet the challenges of the future; to promote a sense of scholarship, leadership and service among our graduates; to instill in the students the desire to create, develop, and disseminate new knowledge; and to provide international leadership to the computer science and engineering professions.

Program Educational Objectives in Computer Science

Graduates of the Bachelor of Science in Computer Science Programs will:

- Apply their education in computer science to the analysis and solution of scientific, business, and industrial problems.
- Account for ethical and social issues when solving scientific, business, and industrial problems.
- Function effectively in a collaborative team and effectively communicate with members of the team.
- Engage in continued education in their field of expertise.
- Attain positions of leadership in their chosen field.

BACHELOR OF SCIENCE IN COMPUTER ENGINEERING

See catalog entry for Computer Engineering (p. 165).

BACHELOR OF SCIENCE IN COMPUTER SCIENCE AND BUSINESS

See catalog entry for Computer Science and Business (p. 166).

BACHELOR OF SCIENCE IN COMPUTER SCIENCE

Bachelor of Science in Computer Science degree programs are available to students through either the College of Arts and Sciences or the P. C. Rossin College of Engineering and Applied Science. Both programs are accredited by the Computing Accreditation Commission of ABET (http://www.abet.org). The two programs are identical in the fundamental requirements in mathematics and computer science, and the programs are appropriate for entry into management or industrial positions. They are also appropriate for continued graduate study, though students considering graduate study are strongly encouraged to consider taking part in a research project during their junior year. The two BS programs differ in their non-computer science content in that the students must fulfill the distribution requirements of the respective college.

The required courses for the degrees contain the fundamentals of discrete mathematics, structured programming, algorithms, computer architecture, compiler design, operating systems, and programming languages. A strong foundation in mathematics is required. Because many courses are frequently offered, there are many sequences in which courses may be taken to satisfy the requirements. Below are the requirements for the B.S. degrees. See www.cse.lehigh.edu/COURSES for links to sample sequences and for a list of all CSE courses, their prerequisites, and when they are offered.

P. C. ROSSIN COLLEGE OF ENGINEERING AND APPLIED SCIENCE

Bachelor of Science in Computer Science

Total required credit hours: 128

Required Computer Science courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit</th>
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<tbody>
<tr>
<td>CSE 002</td>
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<tr>
<td>CSE 017</td>
<td>Programming and Data Structures</td>
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<td>CSE 109</td>
<td>Systems Software</td>
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<td>CSE 202</td>
<td>Computer Organization and</td>
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<td></td>
<td>Architecture</td>
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<td>CSE 216</td>
<td>Software Engineering</td>
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<td>CSE 261</td>
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<td>CSE 262</td>
<td>Programming Languages</td>
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<td>CSE 280</td>
<td>Capstone Project I</td>
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<td>CSE 281</td>
<td>Capstone Project II</td>
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<td>CSE 303</td>
<td>Operating System Design</td>
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<tr>
<td>CSE 318</td>
<td>Introduction to the Theory of</td>
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<tr>
<td></td>
<td>Computation</td>
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<tr>
<td>CSE 340</td>
<td>Design and Analysis of Algorithms</td>
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Required Math and Science courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit</th>
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<tbody>
<tr>
<td>CHM 030</td>
<td>Introduction to Chemical Principles</td>
<td>4</td>
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<tr>
<td>ENGR 010</td>
<td>Applied Engineering Computer Methods</td>
<td>2</td>
</tr>
<tr>
<td>ENGR 005</td>
<td>Introduction to Engineering Practice</td>
<td>2</td>
</tr>
<tr>
<td>MATH 021</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 022</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 023</td>
<td>Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>MATH 205</td>
<td>Linear Methods</td>
<td>3</td>
</tr>
<tr>
<td>MATH 231</td>
<td>Probability and Statistics</td>
<td>3</td>
</tr>
<tr>
<td>PHY 011</td>
<td>Introductory Physics I</td>
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</tr>
<tr>
<td>&amp; PHY 012</td>
<td>and Introductory Physics Laboratory I</td>
<td>5</td>
</tr>
<tr>
<td>PHY 021</td>
<td>Introductory Physics II</td>
<td>5</td>
</tr>
<tr>
<td>&amp; PHY 022</td>
<td>and Introductory Physics Laboratory II</td>
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Required approved electives

CSE courses, not including CSE 042: 12
Science and technology courses, chosen by the student with the approval of the student’s advisor: 6

Humanities and Social Science (HSS) requirements

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<thead>
<tr>
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<th>Credit</th>
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<td>ENGL 001</td>
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<tr>
<td>ENGL 002</td>
<td>Composition and Literature II</td>
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<tr>
<td>ECO 001</td>
<td>Principles of Economics</td>
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### Required Computer Science courses

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<th>Credits</th>
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<tr>
<td>CSE 001</td>
<td>Breadth of Computing</td>
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</tr>
<tr>
<td>CSE 002</td>
<td>Fundamentals of Programming</td>
<td>2</td>
</tr>
<tr>
<td>CSE 017</td>
<td>Programming and Data Structures</td>
<td>3</td>
</tr>
<tr>
<td>CSE 097</td>
<td>Discrete Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>CSE 282</td>
<td>Operating System Design</td>
<td>3</td>
</tr>
<tr>
<td>CSE 318</td>
<td>Introduction to the Theory of Computation</td>
<td>3</td>
</tr>
<tr>
<td>CSE 340</td>
<td>Design and Analysis of Algorithms</td>
<td>3</td>
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### Required Math and Science courses

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<tr>
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<tbody>
<tr>
<td>MATH 021</td>
<td>Calculus I</td>
<td>4</td>
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<tr>
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<td>Calculus II</td>
<td>4</td>
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<tr>
<td>MATH 023</td>
<td>Calculus III</td>
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<tr>
<td>MATH 025</td>
<td>Linear Methods</td>
<td>3</td>
</tr>
<tr>
<td>MATH 231</td>
<td>Probability and Statistics</td>
<td>3</td>
</tr>
</tbody>
</table>

### Required approved electives

- CSE courses, not including CSE 042: 12
- Science and technology courses, chosen by the student with the approval of the student's advisor: 6
- Humanities and Social Science (HSS) requirements:
  - ENGL 001: Composition and Literature: 3
  - ENGL 002: Composition and Literature II: 3
  - CSE 252: Computers, the Internet, and Society: 3
  - HSS courses that satisfy the Arts and Sciences College distribution requirements: 21

### Electives

- Free Electives: 12

### Total Credits

- 127

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### Graduate Programs

#### P. C. ROSSIN COLLEGE OF ENGINEERING AND APPLIED SCIENCE

**Note:** For information about graduate degrees in Computer Engineering, see the catalog entry for Computer Engineering (p. 165).

Graduate programs of study provide a balance between formal classroom instruction and research and are tailored to the individual student's professional goals. The programs appeal to individuals with backgrounds in computer or information science, in computer engineering, in electrical engineering, in mathematics, or in the physical sciences. Research is an essential part of the graduate program. The research topics were listed earlier in the departmental description.

The Master of Science degree requires the completion of 30 credit hours of work and may include a three credit hour thesis. A program of study must be submitted in compliance with the graduate school regulations. An oral presentation of the thesis is required.

The Master of Engineering degree requires the completion of 30 credit hours of work, which includes design-oriented courses and an engineering project. A program of study must be submitted in compliance with the college rules. An oral presentation of the program is required.

The Ph.D. degree in computer science requires the completion of 42 credit hours of work (including the dissertation) beyond the master's degree (48 hours if the master's degree is not from Lehigh), the passing of departmental qualifying requirements appropriate to each degree within one year after entrance into the degree program, the admission into candidacy, the passing of a general examination in the candidate's
area of specialization, and the writing and defense of a dissertation. Competence in a foreign language is not required.

The CSE department has a core curriculum requirement for graduate students in each of the degree programs. The purpose of this requirement is to guarantee that all students pursuing graduate studies in the department acquire an appropriate breadth of knowledge of their discipline.

Computer Science: PhD students in the CS program must satisfy a “Graduate Breadth” requirement which involves taking, in addition to the four mandated first-year courses, another four regular graduate-level courses in Computer Science and Engineering or a closely related subject. Courses appropriate to the student's educational objectives should be selected in consultation with the student’s advisor. The plan must be approved by the advisor, the Director of Graduate Studies for CSE, and the Chair of the CSE Department. To satisfy the requirement, courses must be at the 400-level and may not be research, independent study, experimental, or special topics courses (for example, courses numbered CSE 450 or CSE 49X will not satisfy the requirement).

This new requirement applies to CS students entering the Ph.D. program in Fall 2010 or later (i.e., those who fall under the new rules regarding the first-year curriculum). For details on these requirements, see the department’s web site www.cse.lehigh.edu.

Courses from other universities or undergraduate studies may be used to satisfy these requirements, by petition, at the discretion of the department faculty. Additional graduate program information may be obtained from the department's graduate coordinator.

Courses

CSE 001 Breadth of Computing 2 Credits

Broad overview of computer science, computer systems, and computer applications. Interactive Web page development. Includes laboratory. Not available to students who have taken CSE 012 or ENGR 010.

CSE 002 Fundamentals of Programming 2 Credits

Problem-solving and object-oriented programming using Java. Includes laboratory. No prior programming experience needed.

CSE 012 Survey of Computer Science 3 Credits

Fundamental concepts of computing and "computational thinking": problem analysis, abstraction, algorithms, digital representation of information, and networks. Applications of computing and communication that have changed the world. Impact of computing on society. Concepts of software development using a scripting language such as Python, Perl, or Ruby. Not available to students who have taken CSE 015 or CSE 001.

CSE 017 Programming and Data Structures 3 Credits

Algorithmic design and implementation in a high level, object oriented language, such as Java. Classes, subclasses, recursion, searching, sorting, linked lists, trees, stacks, queues.

Prerequisites: CSE 002 and (CSE 001 or CSE 012 or (ENGR 010) or ENGR 097)

Attribute/Distribution: MA

CSE 042 (EMC 042) Game Design 3 Credits

Modern topics in game design: Finite State Machines, iterative design process, systems and interactivity, designing rules for digital games, emergence in games, games as Examples of Uncertainty, games as Information Theory Schemes, games as Information Systems, games as Cybernetic Systems. The course does not count as a technical elective for majors in Computer Science, Computer Science and Business, or Computer Engineering.

CSE 109 Systems Software 4 Credits

Advanced programming and data structures, including dynamic structures, memory allocation, data organization, symbol tables, hash tables, B-trees, data files. Object-oriented design and implementation of simple assemblers, loaders, interpreters, compilers, and translators. Practical methods for implementing medium-scale programs.

Prerequisites: CSE 017 or CSE 018

CSE 130 Technical Presentation 1 Credit

Oral and written communication of information in computer science. Technical writing; structure, style, and delivery of oral presentations; use of visual aids.

Prerequisites: CSE 017 or CSE 018

Can be taken Concurrently: CSE 017, CSE 018

CSE 190 Special Topics 1-3 Credits

Supervised reading and research. Consent of department required.

CSE 202 Computer Organization and Architecture 3 Credits

Interaction between low-level computer architectural properties and high-level program behaviors: instruction set design; digital logic and assembly language; processor organization; the memory hierarchy; multicore and GPU architectures; and processor interrupt/exception models. Credit will not be given for both CSE 201 and CSE 202.

Prerequisites: CSE 017 or CSE 018

CSE 216 Software Engineering 3 Credits

The software lifecycle; lifecycle models; software planning; testing; specification methods; maintenance. Emphasis on team work and large-scale software systems, including oral presentations and written reports.

Prerequisites: CSE 109

CSE 241 Database Systems and Applications 3 Credits

Design of large databases: Integration of databases and applications using SQL and JDBC; transaction processing; performance tuning; data mining and data warehouses. Not available to students who have credit for CSE 341 or IE 224.

Prerequisites: CSE 017 or CSE 018

CSE 252 Computers, the Internet, and Society 3 Credits

An interactive exploration of the current and future role of computers, the Internet, and related technologies in changing the standard of living, work environments, society and its ethical values. Privacy, security, depersonalization, responsibility, and professional ethics; the role of computer and Internet technologies in changing education, business modalities, collaboration mechanisms, and everyday life.

Attribute/Distribution: SS

CSE 261 (MATH 261) Discrete Structures 3 Credits

Topics in discrete structures chosen for their applicability to computer science and engineering. Sets, propositions, induction, recursion; combinatorics; binary relations and functions; ordering, lattices and Boolean algebra; graphs and trees; groups and homomorphisms. Various applications.

Prerequisites: (MATH 021 or MATH 031 or MATH 051 or MATH 076)

Attribute/Distribution: MA

CSE 262 Programming Languages 3 Credits

Use, structure and implementation of several programming languages.

Prerequisites: CSE 017 or CSE 018

CSE 264 Web Systems Programming 3 Credits

Practical experience in designing and implementing modern Web applications. Concepts, tools, and techniques, including: HTTP, HTML, CSS, DOM, JavaScript, Ajax, PHP, graphic design principles, mobile web development. Not available to students who have credit for IE 275.

Prerequisites: CSE 017

Attribute/Distribution: ND

CSE 265 System and Network Administration 3 Credits

Overview of systems and network administration in a networked UNIX-like environment. System installation, configuration, administration, and maintenance; security principles; ethics; network, host, and user management; standard services such as electronic mail, DNS, and WWW; file systems; backups and disaster recovery planning; troubleshooting and support services; automation, scripting; infrastructure planning.

Prerequisites: CSE 017 or CSE 018

CSE 271 Programming in C and the Unix Environment 3 Credits

C language syntax and structure. C programming techniques. Emphasis on structured design for medium to large programs. Unix operating system fundamentals. Unix utilities for program development, text processing, and communications.

Prerequisites: CSE 109
CSE 280 Capstone Project I 3 Credits
First of a two semester capstone course sequence that involves the design, implementation, and evaluation of a computer science software project. Conducted by small student teams working from project definition to final documentation. Each student team has a CSE faculty member serving as its advisor. The first semester emphasis is on project definition, planning and implementation. Communication skills such as technical writing, oral presentations, and use of visual aids are also emphasized. Project work is supplemented by weekly seminars.
Prerequisites: CSE 216
Can be taken Concurrently: CSE 216

CSE 281 2 Credits
Second of a two semester capstone course sequence that involves the design, implementation, and evaluation of a computer science software project; conducted by small student teams working from project definition to final documentation; each student team has a CSE faculty member serving as its advisor; The second semester emphasis is on project implementation, verification & validation, and documentation requirements. It culminates in a public presentation and live demonstration to external judges as well as CSE faculty and students.
Prerequisites: CSE 280

CSE 300 Apprentice Teaching 1-4 Credits

CSE 302 Compiler Design 3 Credits
Principles of artificial language description and design. Sentence parsing techniques, including operator precedence, bounded-context, and syntax-directed recognizer schemes. The semantic problem as it relates to interpreters and compilers. Dynamic storage allocation, table grammars, code optimization, compiler-writing languages.
Prerequisites: (CSE 109)

CSE 303 Operating System Design 3 Credits
Process and thread programming models, management, and scheduling. Resource sharing and deadlocks. Memory management, including virtual memory and page replacement strategies. I/O issues in the operating system. File system implementation. Multiprocessing. Computer security as it impacts the operating system.
Prerequisites: ECE 201 or (CSE 201 or CSE 202) and CSE 109

CSE 307 (BIOE 307) Structural Bioinformatics 3 Credits
Computational techniques and principles of structural biology used to examine molecular structure, function, and evolution. Topics include: protein structure alignment and prediction; molecular surface analysis; statistical modeling; QSAR; computational drug design; influences on binding specificity; protein-ligand, -protein, and -DNA interactions; molecular simulation, electrostatics. Tutorials on UNIX systems and research software support an interdisciplinary collaborative project in computational structural biology. Credit will not be given for both CSE 307 and CSE 407. Must have junior standing or higher.
Prerequisites: BIOS 120 or CSE 109 or CHM 113 or MATH 231

CSE 308 (BIOE 308) Bioinformatics: Issues and Algorithms 3 Credits
Computational problems and their associated algorithms arising from the creation, analysis, and management of bioinformatics data. Genetic sequence comparison and alignment, physical mapping, genome sequencing and assembly, clustering of DNA microarray results in gene expression studies, computation of genomic rearrangements and evolutionary trees. Credit will not be given for both CSE 308 (BIOE 308) and CSE 408 (BIOE 408). No prior background in biology is assumed.
Prerequisites: CSE 017 or CSE 018

CSE 313 Computer Graphics 3 Credits
Computer graphics for animation, visualization, and production of special effects: displays, methods of interaction, images, image processing, color, transformations, modeling (primitives, hierarchies, polygon meshes, curves and surfaces, procedural), animation (keyframing, dynamic simulation), rendering and realism (shading, texturing, shadows, visibility, ray tracing), and programmable graphics hardware.
Prerequisites: CSE 109 and (MATH 043 or MATH 205 or MATH 242)

CSE 318 Introduction to the Theory of Computation 3 Credits
Formal study of theoretical computational models: finite automata, pushdown automata, and Turing machines. Study of formal languages: regular, context-free, and decidable languages.
Prerequisites: CSE 261 or MATH 261

CSE 319 Image Analysis and Graphics 3 Credits
State-of-the-art techniques for fundamental image analysis tasks: feature extraction, segmentation, registration, tracking, recognition, search (indexing and retrieval). Related computer graphics techniques: modeling (geometry, physically-based, statistical), simulation (data-driven, interactive), animation, 3D image visualization, and rendering. Credit will not be given for both CSE 319 and CSE 419.
Prerequisites: CSE 313

CSE 320 (BIOE 320) Biomedical Image Computing and Modeling 3 Credits
Biomedical image modalities, image computing techniques, and imaging informatics systems. Understanding, using, and developing algorithms and software to analyze biomedical image data and extract useful quantitative information: Biomedical image modalities and formats; image processing and analysis; geometric and statistical modeling; image informatics systems in biomedicine. Credit will not be given for both CSE 320 and CSE 420.
Prerequisites: (MATH 205 or MATH 043) and CSE 017
Attribute/Distribution: ND

CSE 326 Pattern Recognition 3 Credits
Bayesian decision theory and the design of parametric and nonparametric classifiers: linear (perceptrons), quadratic, nearest-neighbors, neural nets. Machine learning techniques: boosting, bagging. High-performance machine vision systems: segmentation, contextual analysis, adaptation. Students carry out projects, e.g. on digital libraries and vision-based Turing tests. Credit will not be given for both CSE 326 and CSE 426.
Prerequisites: CSE 109 and CSE 340 and MATH 205 and (MATH 231 or ECO 045)

CSE 327 (COGS 327) Artificial Intelligence Theory and Practice 3 Credits
Introduction to the field of artificial intelligence: Problem solving, knowledge representation, reasoning, planning and machine learning. Use of AI systems or languages. Advanced topics such as natural language processing, vision, robotics, and uncertainty. CSE 261 is recommended.
Prerequisites: (CSE 001 and CSE 002) or CSE 017

CSE 331 User Interface Systems and Techniques 3 Credits
Principles and practice of creating effective human-computer interfaces. Design and user evaluation of user interfaces; design and use of interface building tools. Programming projects using a variety of interface building tools to construct and evaluate interfaces.
Prerequisites: CSE 017

CSE 332 Multimedia Design and Development 3 Credits
Analysis, design and implementation of multimedia software, primarily for e-learning courses or training. Projects emphaize user interface design, content design with storyboards or scripts, creation of graphics, animation, audio and video materials, software development using high level authoring tools. Consent of instructor.
Prerequisites: CSE 012 or CSE 015 or ENGR 001

CSE 334 Software System Security 3 Credits
Survey of common software vulnerabilities: buffer overflows, format string attacks, cross-site scripting, and botnets. Discussion of common defense mechanisms: static code analysis, reference monitors, language-based security, secure information flow, and others. Credit will not be given for both CSE 334 and CSE 434.
Prerequisites: CSE 109 and CSE 262

CSE 335 Topics on Intelligent Decision Support Systems 3 Credits
Intelligent decision support systems (IDSS). AI techniques that are used to build IDSSs: case-based reasoning, decision trees and knowledge representation. Applications of these techniques: help-desk systems, e-commerce, and knowledge management. Credit will not be given for both CSE 335 and CSE 435.
Prerequisites: CSE 327 or CSE 109
CSE 336 (ECE 336) Embedded Systems 3 Credits
Prerequisites: CSE 017 or CSE 018

CSE 337 Reinforcement Learning 3 Credits
Algorithms for automated learning from interactions with the environment to optimize long-term performance. Markov decision processes, dynamic programming, temporal-difference learning, Monte Carlo reinforcement learning methods. Credit will not be given for both CSE 337 and CSE 437.
Prerequisites: MATH 231 and CSE 109

CSE 340 (MATH 340) Design and Analysis of Algorithms 3 Credits
Algorithms for searching, sorting, manipulating graphs and trees, finding shortest paths and minimum spanning trees, scheduling tasks, etc.: proofs of their correctness and analysis of their asymptotic runtime and memory demands. Designing algorithms: recursion, divide-and-conquer, greediness, dynamic programming. Limits on algorithm efficiency using elementary NP-completeness theory. Credit will not be given for both CSE 340 (Math 340) and CSE 441 (Math 441).
Prerequisites: MATH 022 or MATH 096 or MATH 032 and (CSE 261 or MATH 261)

CSE 341 Database Systems, Algorithms, and Applications 3 Credits
Design of large databases; normalization; query languages (including SQL); Transaction-processing protocols; Query optimization; performance tuning; distributed systems. Not available to students who have credit for CSE 241.
Prerequisites: CSE 017

CSE 342 Fundamentals of Internetworking 4 Credits
Architecture and protocols of computer networks. Protocol layers; network topology; data-communication principles, including circuit switching, packet switching and error control techniques; sliding window protocols, protocol analysis and verification; routing and flow control; local and wide area networks; network interconnection; client-server interaction; emerging networking trends and technologies; topics in security and privacy.
Prerequisites: CSE 109

CSE 343 Network Security 3 Credits
Overview of network security threats and vulnerabilities. Techniques and tools for detecting, responding to and recovering from security incidents. Fundamentals of cryptography. Hands-on experience with programming techniques for security protocols. Credit will not be given for both CSE 343 and CSE 443.
Prerequisites: CSE 265 or CSE 303 or CSE 342

CSE 345 WWW Search Engines 3 Credits
Study of algorithms, architectures, and implementations of WWW search engines; Information retrieval (IR) models; performance evaluation; properties of hypertext crawling, indexing, searching and ranking; link analysis; parallel and distributed IR; user interfaces. Credit will not be given for both CSE 345 and CSE 445.
Prerequisites: CSE 109

CSE 347 Data Mining 3 Credits
Overview of modern data mining techniques: data cleaning; attribute and subset selection; model construction, evaluation and application. Fundamental mathematics and algorithms for decision trees, covering algorithms, association mining, statistical modeling, linear models, neural networks, instance-based learning and clustering covered. Practical design, implementation, application, and evaluation of data mining techniques in class projects. Credit will not be given for both CSE 347 and CSE 447.
Prerequisites: (CSE 017 or CSE 018) and (MATH 231 or ECO 045)
Can be taken Concurrently: ECO 045

CSE 348 AI Game Programming 3 Credits
Contemporary computer games: techniques for implementing the program controlling the computer component; using Artificial Intelligence in contemporary computer games to enhance the gaming experience: pathfinding and navigation systems; group movement and tactics; adaptive games, game genres, machine scripting language for game designers, and player modeling. Credit will not be given for both CSE 348 and CSE 448.
Prerequisites: CSE 327 or CSE 109

CSE 350 Special Topics 3 Credits
Selected topics in the field of computer science not included in other courses.
Repeat Status: Course may be repeated.
Prerequisites: MATH 205

CSE 360 Introduction to Mobile Robotics 3 Credits
Algorithms employed in mobile robotics for navigation, sensing, and estimation. Common sensor systems, motion planning, robust estimation, bayesian estimation techniques, Kalman and Particle filters, localization and mapping. Credit will not be given for both CSE 360 and CSE 460.
Prerequisites: MATH 205 or MATH 023 or MATH 231

CSE 363 Network Systems Design 3 Credits
Design principles and issues of network systems. Traditional protocol processing systems and latest network processor/processing technologies. Packet processing, protocol processing, classification and forwarding, switching fabrics, network processors, and network systems design tradeoffs.
Prerequisites: CSE 342

CSE 375 Principles of Practice of Parallel Computing 3 Credits
Parallel computer architectures, parallel languages, parallelizing compilers and operating systems. Design, implementation, and analysis of parallel algorithms for scientific and data-intensive computing. Credit is not given for both CSE 375 and CSE 475.
Prerequisites: (ECE 201 or CSE 201) or CSE 303 or CSE 202
Can be taken Concurrently: ECE 201, CSE 201, CSE 303, CSE 202

CSE 379 Senior Project 3 Credits
Design, implementation, and evaluation of a computer science capstone project conducted by student teams working from problem definition to testing and implementation; written progress reports supplemented by oral presentations. Must have senior standing.

CSE 389 Honors Project 1-8 Credits

CSE 392 Independent Study 1-3 Credits
An intensive study, with report, of a topic in computer science which is not treated in other courses. Consent of instructor required.
Repeat Status: Course may be repeated.

CSE 401 (ECE 401) Advanced Computer Architecture 3 Credits
Design, analysis and performance of computer architectures; high-speed memory systems; cache design and analysis; modeling cache performance; principle of pipeline processing, performance of pipelined computers; scheduling and control of a pipeline; classification of parallel architectures; systolic and data flow architectures; multiprocessor performance; multiprocessor interconnections and cache coherence.

CSE 403 Advanced Operating Systems 3 Credits
Principles of operating systems with emphasis on hardware and software requirements and design methodologies for multiprogramming systems. Global topics include the related areas of process management, resource management, and file systems.
Prerequisites: CSE 303

CSE 404 (ECE 404) Computer Networks 3 Credits
Study of architecture and protocols of computer networks. The ISO model; network topology; data-communication principles, including circuit switching, packet switching and error control techniques; sliding window protocols, protocol analysis and verification; routing and flow control; local area networks; network interconnection; topics in security and privacy.
CSE 405 Advanced Programming Languages 3 Credits
Basic ideas behind modern programming language design, with a focus on functional languages: type systems, modularity, operational semantics, and others. Students need to have some mathematical maturity, including familiarity with proof techniques such as induction.

Prerequisites: CSE 307 or CSE 407

CSE 406 Research Methods 3 Credits
Technical writing, reading the literature critically, analyzing and presenting data, conducting research, making effective presentations, and understanding social and ethical responsibilities. Topics drawn from probability and statistics, use of scripting languages, and conducting large-scale experiments. Must have first-year status in either the CS or CompE Ph. D. program.

CSE 407 (BIOE 407) Structural Bioinformatics 3 Credits
Computational techniques and principles of structural biology used to examine molecular structure, function, and evolution. Topics include: protein structure alignment and prediction; molecular surface analysis; statistical modeling; QSAR; computational drug design; influences on binding specificity; protein-ligand, -protein, and –DNA interactions; molecular simulation, electrostatics. This course, a version of 307 for graduate students, requires advanced assignments and a collaborative project. Credit will not be given for both CSE 307 and 407. Consent of instructor required.

Prerequisites: CSE 017 or CSE 018

CSE 408 (BIOE 408) Bioinformatics: Issues and Algorithms 3 Credits
Computational problems and their associated algorithms arising from the creation, analysis, and management of bioinformatics data. Genetic sequence comparison and alignment, physical mapping, genome sequencing and assembly, clustering of DNA microarray results in gene expression studies, computation of genomic rearrangements and evolutionary trees. This course, a version of 308 for graduate students requires advanced assignments. Credit will not be given for both BIOE 308 (CSE 308) and BIOE 408 (CSE 408). No prior background in biology is assumed.

Prerequisites: CSE 318 or CSC 318

CSE 411 Advanced Programming Techniques 3 Credits
Deeper study of programming and software engineering techniques. The majority of assignments involve programming in contemporary programming languages. Topics include memory management, GUI design, testing, refactoring, and writing secure code.

CSE 419 Image Analysis and Graphics 3 Credits
State-of-the-art techniques for fundamental image analysis tasks; feature extraction, segmentation, registration, tracking, recognition, search (indexing and retrieval). Related computer graphics techniques: modeling (geometry, physically-based, statistical), simulation (data-driven, interactive), animation, 3D image visualization, and rendering. This course, a graduate version of CSE 319, requires additional advanced assignments. Credit will not be given for both CSE 319 and CSE 419.

CSE 420 (BIOE 420) Biomedical Image Computing and Modeling 3 Credits
Biomedical image modalities, image computing techniques, and imaging informatics systems. Understanding, using, and developing algorithms and software to analyze biomedical image data and extract useful quantitative information: Biomedical image modalities and formats; image processing and analysis; geometric and statistical modeling; image informatics systems in biomedicine. This course, a graduate version of BIOE 320, requires additional advanced assignments. Credit will not be given for both BIOE 320 and BIOE 420.

Prerequisites: MATH 205 and CSE 109
Attribute/Distribution: ND

CSE 424 Advanced Communication Networks 3 Credits
Current and emerging research topics in communication networks: network protocols, network measurement, internet routing, network security, adhoc and sensor networks, disruption tolerant networks. Lecture, readings, and discussion, plus a project.

Prerequisites: CSE 342 or CSE 303 or CSE 404

CSE 426 Pattern Recognition 3 Credits
Bayesian decision theory and the design of parametric and nonparametric classifiers: linear (perceptrons), quadratic, nearest-neighbors, neural nets. Machine learning techniques: boosting, bagging. High-performance machine vision systems: segmentation, contextual analysis, adaptation. Students carry out projects, e.g. on digital libraries and vision-based Turing tests. This course, a version of CSE 326 for graduate students requires advanced assignments. Credit will not be given for both CSE 326 and CSE 426.

CSE 428 Semantic Web Topics 3 Credits
Theory, architecture and applications of the Semantic Web. Issues in designing distributed knowledge representation languages, ontology development, knowledge acquisition, scalable reasoning, integrating heterogeneous data sources, and web-based agents.

CSE 431 Intelligent Agents 3 Credits
Principles of rational autonomous software systems. Agent theory; agent architectures, including logic-based, utility-based, practical reasoning, and reactive; multi-agent systems; communication languages; coordination methods including negotiation and distributed problem solving; applications.

CSE 432 Object-Oriented Software Engineering 3 Credits
Design and construction of modular, reusable, extensible and portable software using statically typed object-oriented programming languages (Eiffel, C++, Objective C). Abstract data types; genericity, multiple inheritance; use and design of software libraries; persistence, and object-oriented databases; impact of object-oriented programming on the software life cycle.

CSE 434 Software System Security 3 Credits
Survey of common software vulnerabilities: buffer overflows, format string attacks, cross-site scripting, and botnets. Discussion of common defense mechanisms: static code analysis, reference monitors, language-based security, secure information flow, and others. The graduate version differs from the undergraduate version by requiring advanced assignments and projects. Credit will not be given for both CSE 334 and CSE 434. Must have graduate standing in Computer Science or consent of instructor.

CSE 435 Topics on Intelligent Decision Support Systems 3 Credits
AI techniques used to build IDSSs: case-based reasoning, decision trees and knowledge representation. Applications: helpdesk systems, e-commerce, and knowledge management. This course, a version of CSE 335 for graduate students, requires research projects and advanced assignments. Credit will not be given for both CSE 335 and CSE 435.

CSE 437 Reinforcement Learning and Markov Decision Processes 3 Credits
Formal model based on Markov decision processes for automated learning from interactions with stochastic, incompletely known environments. Markov decision processes, dynamic programming, temporal-difference learning, Monte Carlo reinforcement learning methods. Credit will not be given for both CSE 337 and CSE 437. Must have graduate standing in Computer Science or have consent of instructor.

CSE 441 (MATH 441) Advanced Algorithms 3 Credits
Algorithms for searching, sorting, manipulating graphs and trees, scheduling tasks, finding shortest path, matching patterns in strings, cryptography, matroid theory, linear programming, max-flow, etc., and their correctness proofs and analysis of their time and space complexity. Strategies for designing algorithms, e.g. recursion, divide-and-conquer, greediness, dynamic programming. Limits on algorithm efficiency are explored through NP completeness theory. Quantum computing is briefly introduced. Credit will not be given for both CSE 340 (MATH 340) and CSE 441 (MATH 441).
CSE 443 Network Security 3 Credits
Overview of network security threats and vulnerabilities. Techniques and tools for detecting, responding to and recovering from security incidents. Fundamentals of cryptography. Hands-on experience with programming techniques for security protocols. This course, a version of CSE 343 for graduate students, requires research projects and advanced assignments. Credit will not be given for both CSE 343 and CSE 443.
Prerequisites: (CSE 404 or ECE 404) or CSE 265 or CSE 303 or CSE 342

CSE 445 WWW Search Engines 3 Credits
Study of algorithms, architectures, and implementations of WWW search engines. Information retrieval (IR) models; performance evaluation; properties of hypertext crawling, indexing, searching and ranking; link analysis; parallel and distributed IR; user interfaces. This course, a version of CSE 345 for graduate students, requires research projects and advanced assignments. Credit will not be given for both CSE 345 and CSE 445.

CSE 447 Data Mining 3 Credits
Modern data mining techniques: data cleaning; attribute and subset selection; model construction, evaluation and application. Algorithms for decision trees, covering algorithms, association rule mining, statistical modeling, model and regression trees, neural networks, instance-based learning and clustering covered. This course, a version of CSE 347 for graduate students, requires research projects and advanced assignments. Credit will not be given for both CSE 347 and CSE 447.
Prerequisites: MATH 023 and MATH 205 and MATH 231
Can be taken Concurrently: MATH 231

CSE 475 Principles and Practice of Parallel Computing 3 Credits
Parallel computer architectures, parallel languages, parallelizing compilers and operating systems. Design, implementation, and analysis of parallel algorithms for scientific and data-intensive computing. This is a graduate version of CSE 375. As such, it will require additional assignments. Credit is not given for both CSE 375 and CSE 475.

CSE 490 Thesis 1-6 Credits
Thesis. Repeat Status: Course may be repeated.

CSE 491 Research Seminar 1-3 Credits
Regular meetings focused on specific topics related to the research interests of department faculty. Credit is based on presentation and review of relevant publications. Students may be required to present and review relevant publications. Consent of instructor required.
Repeat Status: Course may be repeated.

CSE 492 Independent Study 1-3 Credits
An intensive study, with report of a topic in computer science that is not treated in other courses. Consent of instructor required.
Repeat Status: Course may be repeated.

CSE 499 Dissertation 1-15 Credits
Counseling Psychology

The Counseling Psychology program offers 4 degrees: M.Ed. (and certification) in School Counseling (48 credits); M.Ed. in Counseling and Human Services (60 credits); M.Ed. in International Counseling (30 credits); and Ph.D. in Counseling Psychology. The program also offers a Lehigh graduate certificate in International Counseling.

The M.Ed. in School Counseling is approved for certification (pre-K-12) by the Pennsylvania Department of Education (PDE); the M.Ed. program in Counseling and Human Services is accredited by the Master’s in Psychology and Counseling Accreditation Council (MPCAC), and the Ph.D. program is accredited by the American Psychological Association (APA).

Our counseling psychology programs (Ph.D. and M.Ed. in Counseling and Human Services) adhere to The Benchmark Competencies for Professional Psychology (Campbell, Fouad, Grus, Hatcher, Leahy, & McCutcheon, 2013). The M.Ed. Program in School Counseling adheres to the PDE competencies for pre-K-12 School Counselors.

Counseling Psychology prepares students as competent and effective scientist-practitioners who demonstrate and strive for self-awareness, knowledge, and skills, undergirded by an attentiveness and responsiveness to multiculturalism and social justice.

Students who complete the M.Ed. in School or International Counseling typically seek positions in public, private, and international educational settings as school counselors. Students who complete the M.Ed. in Counseling and Human Services seek a variety of positions, including community and agency counseling, independent practice, doctoral-level work, business and industry, and they often seek LPC licensure.

Students completing the Ph.D. in Counseling Psychology typically seek positions as professional psychologists in hospitals and mental health centers, university counseling centers, independent practice, government positions (for example, Veterans Administration, public health) or as university professors.

Students and faculty are active in local communities, doing research in a major NIH-funded project on maternal child attachment and emotional regulation, and in working with inner city adolescents in the Lehigh Valley. The Counseling Psychology program also runs a summer institute on international counseling and conducts training of counselors globally. In addition, the Community Voices Clinic (CVC) is a school-based integrated mental health clinic, located at Broughal Middle and Donegan Elementary Schools, that provides mental health services to uninsured and underinsured families and communities in Southside Bethlehem. Many of our students co-publish and co-present nationally with faculty members.

For additional information about the program, please visit:
http://coe.lehigh.edu/academics/disciplines/cp

Questions regarding APA Accreditation may be addressed to the APA Office of Accreditation at:
Office of Program Consultation and Accreditation
750 First St, NE, Washington, DC 20002-4242
Telephone: (202) 336-5979
TDD/TTY: (202) 336-6123
Fax: (202) 336-5978
Email (apaaccred@apa.org) (General Questions) (apaacccred@apa.org)
Email (aro@apa.org) (Annual Report Online only)

Professors. Arpana Govindan Inman, PhD (Temple University); Arnold R. Spokane, PhD (Ohio State University)

Associate Professors. Grace Caskie, PhD (University of North Carolina); Christopher T H Liang, PhD (University of Maryland College Park); Susan S. Woodhouse, PhD (University of Maryland College Park)

Assistant Professors. Nicole Johnson Quay, PhD (University of Akron); Julia Lechuga, PhD (University Texas El Paso)

Professor Of Practice. Jerome A Farrell, PhD (University at Albany)

Doctor of Philosophy in Counseling Psychology

Currently, the doctoral program requires a total of 103 credits, which are composed of 30 master’s level credits plus 70 doctoral level credits. A student who enters the counseling psychology doctoral program already holding a master’s degree, regardless of where the degree was obtained, may be exempted by her or his advisor from taking up to a total of the 30 credits of required master's level coursework, with the exemption granted based on a review of the student’s transcript and/ or course syllabi to ensure that the course or courses were of similar content to the course offered by Lehigh. These exempted credits do not count toward the total needed for the doctoral degree (currently 103), but will not appear on the student’s Lehigh transcript. After conferring with his or her advisor, the student will complete an internal petition to have these credits exempted, and this petition must be approved by the program director.
### Required Master's Level Coursework

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>EDUC 403</td>
<td>Research</td>
<td>3</td>
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<tr>
<td>EDUC 408</td>
<td>Introduction to Statistics</td>
<td>3</td>
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<tr>
<td>CPSY 427</td>
<td>Assessment and Appraisal in Counseling</td>
<td>3</td>
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<tr>
<td>CPSY 439</td>
<td>Theory and Practice of Group Counseling</td>
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<td>Counseling and Therapeutic Approaches</td>
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<td>Professional Seminar</td>
<td>3</td>
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<tr>
<td>CPSY 451</td>
<td>Helping Skills</td>
<td>3</td>
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<tr>
<td>CPSY 455</td>
<td>Counseling Issues and Skills: Advanced Techniques in Counseling</td>
<td>3</td>
</tr>
<tr>
<td>CPSY 471</td>
<td>Diversity and Multicultural Perspectives</td>
<td>3</td>
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</tbody>
</table>

**Doctoral Coursework**

**General Psychology Core**

- (3) Biological Bases of Behavior (e.g., physiological psychology, comparative psychology, neuropsychology, sensation, psychopharmacology)
- BIOS 404 Behavioral Neuroscience 3
- or EDUC 491 Advanced Seminars: (with subtitle) 3
- (3) Cognitive-Affective Bases of Behavior (e.g., learning, memory, perception, cognition, thinking, motivation, emotion)
- EDUC 451 Applied Principles of Cognitive Psychology 3
- (3) Social Bases of Behavior (e.g., social psychology; cultural, ethnic and group processes; sex roles; organizational systems and theory)
- EDUC 473 Social Basis of Human Behavior 3
- (3) Individual Behavior (e.g., personality theory, human development, individual differences, abnormal psychology)
- CPSY 472 Human Development Across the Lifespan 3
- (3) History and Systems of Psychology
- CPSY 484 History and Systems of Psychology 3

**Counseling Psychology Core**

- CPSY 460 Foundations of Counseling Psychology 3
- CPSY 436 Culture-Centered Career Intervention 3
- CPSY 473 Advanced Research Methods in Applied Psychology 3
- CPSY 481 Advanced Multicultural Counseling 3

**Assessment Core**

- EDUC 412 Advanced Applications of Psychometric Principles 3
- CPSY 461 Assessment of Adult Intellectual Functioning 3
- or SCHP 422 Assessment of Intelligence 3
- CPSY 462 Assessment of Personality 3
- CPSY 466 Current Issues in Counseling and Therapy (Projective Techniques - Optional) 3

**Advanced Applications in Counseling**

- CPSY 476 Supervision and Consultation in Counseling 4
- EDL 488 Program Evaluation 3

**Advanced Seminar**

- CPSY 466 Current Issues in Counseling and Therapy 3
- or CPSY 467 Doctoral Seminar In Counseling Psychology 3

**Apprenticeship**

- CPSY 470 Independent Study and Research (College Teaching Apprenticeship) 1
- CPSY 477 Independent Study and Research (Research Apprenticeship) 1
- CPSY 478 Advanced Doctoral Practicum I 3
- CPSY 488 Advanced Doctoral Practicum II 3
- CPSY 489 Advanced Doctoral Practicum III 1
- CPSY 491 Advanced Doctoral Practicum IV 1
- CPSY 492 Advanced Field Placement (if not taken as part of master's [course can be repeated]) 1

**Internship**

- CPSY 498 Counseling Psychology Doctoral Internship (2 semesters full-time, or four semesters half-time) 2
- CPSY 499 Dissertation (Note credit requirement explained in dissertation section) 4

**Total Credits**: 103

*After the student has completed the first 15 hours of graduate work, the student is specifically reviewed for full admission. This review is completed during the annual review process for any student who has completed 15 hours. The student's coursework and performance and progress in the doctoral program are reviewed by the faculty. Any questions about the student's progress and plans are raised and discussed, and a vote is then taken to admit the student. The College of Education then writes a letter of admittance to the student specifying the time line for completion of all degree requirements. Students entering with a bachelor's degree have 10 years to complete all degree requirements. Students entering with a master's degree have 7 years to complete all degree requirements.

1 Prior to, and including the semester in which a proposal is approved, students must register for 3 dissertation credits each fall and spring semester. Similarly, for the semester(s) following the approval of the dissertation proposal, students must take 1 maintenance of candidacy credit each fall and spring semester. The only exception to this policy is during the time the student is on internship, during which only internship credits need to be taken. The matter of taking these dissertation credits should be taken seriously. Students who do not follow this procedure, and take fewer credits than required, will find that they will not be able to graduate until back-credits are paid for.

**Master of Education in Counseling and Human Services**

This professional preparation program reflects the increasing level of skills and competencies required for certification as a counselor in the Commonwealth of Pennsylvania, as well as new regulations governing Professional Counselor Licensure in Pennsylvania. The M.Ed. program is designed to provide the basic coursework as well as the specialized counseling "common core" coursework, and practical experience and professional concentration for certification as a school counselor in the Commonwealth of Pennsylvania; as preparation for further graduate study (i.e., doctoral study [see Ph.D. program manual]).

**Shared Core Courses**

- CPSY 427 Assessment and Appraisal in Counseling 3
- CPSY 436 Culture-Centered Career Intervention 3
Counseling and Therapeutic Approaches 3
CPSY 471 Diversity and Multicultural Perspectives 3
CPSY 451 Helping Skills 3
CPSY 472 Human Development Across the Lifespan 3
EDUC 403 Research 3
Counseling and Human Services Track
CPSY 430 Professional Seminar 3
CPSY 439 Theory and Practice of Group Counseling 3
CPSY 440 Introduction to Family Counseling 3
CPSY 455 Counseling Issues and Skills: Advanced Techniques in Counseling 3
EDUC 408 Introduction to Statistics 3
Clinical Training
CPSY 479 Master’s Counseling Practicum 2 3
CPSY 480 Master’s Internship I 3
CPSY 483 Master’s Internship II 3
Specialty
At least one advisor approved 3 credit elective from each of three areas (9)
- Biological and Neuropsychological bases of behavior (3)
- Social Justice, Diversity, Trauma and Loss (3)
- Abnormal Behavior and Psychopathology (3)
Six additional credits of advisor approved electives (6) 2
Total Credits 60
1 CPSY 479: Practicum is taken for 3 credits
2 CPSY 466: Current Issues in Counseling and Therapy is an option for electives
• Total Credits for Proposed Program are 60, consistent with MPCAAC Accreditation recommendations and PA Licensure Standard.

Master of Education in International Counseling
The Master’s program in International Counseling is designed to prepare professional counselors for practice in school and community settings. This program provides students with an understanding of the counselor’s role within the context of a global third culture community in overseas schools and communities. Coursework addresses fundamental counseling and intervention skills for use in schools, community, work, and family settings. The International Counseling program is developmental/contextual in nature and presumes that counselors must work in an increasingly diverse cultural and economic environment, and that school/community counselors must understand and be prepared to adapt to changing societal condition and demands placed upon individuals and families in home and work settings.

Summer Institute I - Summer Session I *
CPSY 452 Counseling Issues and Skills: Facilitating Healthy Adjustment 3
CPSY 453 Counseling Issues and Skills: Building Healthy Communities 3
Advisor Approved Elective (on-site) 3
Year I Fall Semester
CPSY 436 Culture-Centered Career Intervention (online) 3
Spring Semester
CPSY 442 Counseling and Therapeutic Approaches (online) 3
Summer Institute II - Summer Session II *
CPSY 471 Diversity and Multicultural Perspectives 3
CPSY 440 Introduction to Family Counseling 3
CPSY 430 Professional Seminar 3
Year 2 Fall Semester
CPSY 480 Master’s Internship I (online) 3
Spring Semester
CPSY 483 Master’s Internship II (online) 3
Advisor Approved Elective (online) **
Total Credits 30
• NOTE: 4 of the above courses will be offered online. Online courses may be offered in a variety of formats, including synchronous (i.e., everyone online at the same time), asynchronous (i.e., each student goes online at different times based on his/her schedule), or a combination of these formats.

International Counseling Certificate
***You currently have no program requirements listed in the catalog.***

Master of Education in School Counseling & Pennsylvania State Certification
The curricula and PDE standards for our school counseling program are detailed in this section.

M.Ed. in School Counseling Curriculum
Shared Core Courses (21 cr.)
CPSY 427 Assessment and Appraisal in Counseling 3
CPSY 436 Culture-Centered Career Intervention 3
CPSY 442 Counseling and Therapeutic Approaches (*) 3
CPSY 471 Diversity and Multicultural Perspectives (**) 3
CPSY 472 Human Development Across the Lifespan 3
EDUC 403 Research (*** 3
CPSY 451 Helping Skills (*) 3
School Counseling Track (17 cr.)
CPSY 445 School Counseling I (*) 4
CPSY 448 School Counseling II (*) 3
CPSY 449 School Counseling III (*) 4
SPED 332 Education and Inclusion of Individuals with Special Needs in K-12 3
SPED 465 Advanced Inclusionary Practices in K-12 (**** 3
Clinical Training (7 cr.)
CPSY 479 Master’s Counseling Practicum 1
CPSY 480 Master’s Internship I 3
CPSY 483 Master’s Internship II 3
Specialty and Technology Requirement
1 Advisor Approved Elective 3
Electronic Portfolio Completion Form Signed Off
Technology Requirement (An Electronic Portfolio is required, student must post it to Web space), complete online registration each semester, receive orientation from LTS staff on use of the portal, use Course Site for at least one course, and take at least one Information Resources Mini Course as well as participate in the LU CP Listserv
NOTE: Students seeking LPC status should also register for CPSY 439 and CPSY 430 as two of their additional courses for licensure beyond the 48 credits required for the degree.
CPSY 427 (SCHP 427) Assessment and Appraisal in Counseling 3 Credits
Principles of psychological measurement (e.g., tests construction, technology, validity, reliability, functional utility). Ethical, legal, and cultural issues in the administration and interpretation of psychological tests. Case conceptualization, reporting and presentation.

CPSY 430 Professional Seminar 3 Credits
Professional, ethical, and legal issues in counseling. Management and delivery of counseling services in a culturally diverse society. Professional development, certification, licensure, and role identification.

CPSY 436 Culture-Centered Career Intervention 3 Credits
Examination of the career development process and interventions for children, adolescents, and adults with a culture-centered perspective. Study of theorists, vocational assessment process, and occupational and psychological information systems.

CPSY 439 Theory and Practice of Group Counseling 3 Credits
Introduction to the process of group counseling and therapy. Selection of group members; group rules; group procedures with children, adolescents and adults; ethical considerations with groups. Study of research on group processes, group therapy, and group leadership. Consent of program director required.

CPSY 440 Introduction to Family Counseling 3 Credits
Research and current trends in the practice of family counseling. Overview and analysis of major theoretical approaches of family therapy.

CPSY 442 Counseling and Therapeutic Approaches 3 Credits
Theory, research, and technique of counseling within a cultural context. Must have admission to CPSY master’s program or consent of counseling psychology program director.

CPSY 445 School Counseling I 4 Credits
Overview of the history, philosophy and current trends in school counseling. Emphasis is placed on (a) professional, ethical, and legal issues in counseling; (b) management and delivery of counseling services in a school setting and culturally diverse society; (c) professional development, certification and role identification; (d) collaboration and consultation with teachers, parents, and administrators. Students will be involved in a pre-practicum observation of school counselors in a K-12 setting.

CPSY 448 School Counseling II 3 Credits
Emphasis on the social and cultural context of school counseling. Includes ethical, legal, and cultural issues in the administration and interpretation of psychological tests used in K-12 settings. Focus on a special topic such as school violence or substance abuse prevention, school and community interaction, and the social and cultural context of school counseling, etc. The course will also include observations in schools.

CPSY 449 School Counseling III 4 Credits
Theory and methods of consultation; development and implementation of student assistance programs; intra-and inter-agency collaborations. The course will also include observations in schools.

CPSY 451 Helping Skills 3 Credits
Helping Skills is a course designed to provide counselor trainees with didactic and experiential learning opportunities to facilitate and enhance beginning counseling skills. Counselor trainees will begin to develop an understanding of the counselor’s role in assisting or inhibiting client change. This course utilizes such techniques as modeling, role-playing, audiotape feedback, as well as other learning modalities. Particular emphasis is given to theoretical frameworks, cultural competency, and self-understanding.

CPSY 452 Counseling Issues and Skills: Facilitating Healthy Adjustment 3 Credits
Assists counselors in developing proficiency in helping skills and an understanding of the counselor’s role in facilitating or inhibiting client change. Focus is on gaining knowledge related to mental health issues for third culture children and adolescents that include (a) cultural adjustment, (b) eating disorders, (c) depression and suicidality, (d) substance abuse, (e) anxiety, (f) family dysfunction, and (h) career development.

CPSY 453 Counseling Issues and Skills: Building Healthy Communities 3 Credits
The objectives of this course are for students to develop proficiency in counseling skills and gaining knowledge related to constructing prevention programs for children and adolescents that include (a) substance abuse, (b) sexually transmitted disease and teen pregnancy, (c) eating disorders, (d) violence prevention, and (e) resiliency and competency promotion programs. Special focus will be paid to understanding the components of an effective crisis management plan.

CPSY 455 Counseling Issues and Skills: Advanced Techniques in Counseling 3 Credits
The objectives of this course are to help students expand knowledge of traditional counseling theories and facilitate the development of basic counseling and assessment skills. Specifically, the course is designed to: (1) Enhance students’ understanding of the intersection of characteristics of effective helping, stages of the helping relationship, and the uses of counseling techniques; (2) Expand students’ understanding of the differences between foundational skills, commonly used helping skills and techniques that require specialized training; and (3) Provide students with training experiences that expand conceptual understanding of the counseling process from a multicultural perspective (i.e., from initial intake interviews to integrating assessment information to formulating and carrying out intervention plans to termination).

CPSY 460 Foundations of Counseling Psychology 3 Credits
Knowledge in the core foundations of Counseling Psychology, including the history of Counseling Psychology, multicultural issues, career and vocational counseling, counseling/psychotherapy process and outcome, ethics, prevention and health promotion, social justice and disaster intervention. Must have admission to the Ph.D. program in counseling psychology or consent of the counseling psychology program director.

CPSY 461 Assessment of Adult Intellectual Functioning 3 Credits
Administration and interpretation of individual tests/batteries of adult intelligence and neuropsychological functioning. Consideration of psychological and cross-cultural issues in intellectual assessment. Preparation of psychological reports. Consent of instructor required.

CPSY 462 Assessment of Personality 3 Credits
Consideration of issues and methods of personality assessment, including ethical and legal issues, and cross-cultural issues. Practice in the administration of instruments used for personality assessment. Supervised experience and report writing. Must have admission to the Ph.D. program in counseling psychology.

CPSY 466 Current Issues in Counseling and Therapy 1-6 Credits
Examination of an area of counseling or therapy that is of topical interest to students and faculty.

Repeat Status: Course may be repeated.

Credits
Total Credits 48

Courses
CPSY 407 (SCHP 407) Crisis Management in the Schools 3 Credits
This course is designed to provide students with knowledge and skills related to crisis preparedness and intervention in the schools. Relevant theories and research literature will be explored as well as practical elements of crisis response that are applicable to all school systems. In addition, intervention strategies and protocols will be examined and discussed.

CPSY 427 (SCHP 427) Assessment and Appraisal in Counseling 3 Credits
In addition, intervention strategies and protocols will be examined and discussed.

Consent of program director required.

Repeat Status: Course may be repeated.

Credits
Total Credits 48

Courses
CPSY 407 (SCHP 407) Crisis Management in the Schools 3 Credits
This course is designed to provide students with knowledge and skills related to crisis preparedness and intervention in the schools. Relevant theories and research literature will be explored as well as practical elements of crisis response that are applicable to all school systems. In addition, intervention strategies and protocols will be examined and discussed.

CPSY 427 (SCHP 427) Assessment and Appraisal in Counseling 3 Credits
In addition, intervention strategies and protocols will be examined and discussed.

Consent of program director required.

Repeat Status: Course may be repeated.

Credits
Total Credits 48

Courses
CPSY 407 (SCHP 407) Crisis Management in the Schools 3 Credits
This course is designed to provide students with knowledge and skills related to crisis preparedness and intervention in the schools. Relevant theories and research literature will be explored as well as practical elements of crisis response that are applicable to all school systems. In addition, intervention strategies and protocols will be examined and discussed.

CPSY 427 (SCHP 427) Assessment and Appraisal in Counseling 3 Credits
In addition, intervention strategies and protocols will be examined and discussed.

Consent of program director required.

Repeat Status: Course may be repeated.

Credits
Total Credits 48

Courses
CPSY 407 (SCHP 407) Crisis Management in the Schools 3 Credits
This course is designed to provide students with knowledge and skills related to crisis preparedness and intervention in the schools. Relevant theories and research literature will be explored as well as practical elements of crisis response that are applicable to all school systems. In addition, intervention strategies and protocols will be examined and discussed.

CPSY 427 (SCHP 427) Assessment and Appraisal in Counseling 3 Credits
In addition, intervention strategies and protocols will be examined and discussed.

Consent of program director required.

Repeat Status: Course may be repeated.

Credits
Total Credits 48

Courses
CPSY 407 (SCHP 407) Crisis Management in the Schools 3 Credits
This course is designed to provide students with knowledge and skills related to crisis preparedness and intervention in the schools. Relevant theories and research literature will be explored as well as practical elements of crisis response that are applicable to all school systems. In addition, intervention strategies and protocols will be examined and discussed.

CPSY 427 (SCHP 427) Assessment and Appraisal in Counseling 3 Credits
In addition, intervention strategies and protocols will be examined and discussed.

Consent of program director required.

Repeat Status: Course may be repeated.

Credits
Total Credits 48

Courses
CPSY 407 (SCHP 407) Crisis Management in the Schools 3 Credits
This course is designed to provide students with knowledge and skills related to crisis preparedness and intervention in the schools. Relevant theories and research literature will be explored as well as practical elements of crisis response that are applicable to all school systems. In addition, intervention strategies and protocols will be examined and discussed.

CPSY 427 (SCHP 427) Assessment and Appraisal in Counseling 3 Credits
In addition, intervention strategies and protocols will be examined and discussed.

Consent of program director required.

Repeat Status: Course may be repeated.

Credits
Total Credits 48

Courses
CPSY 407 (SCHP 407) Crisis Management in the Schools 3 Credits
This course is designed to provide students with knowledge and skills related to crisis preparedness and intervention in the schools. Relevant theories and research literature will be explored as well as practical elements of crisis response that are applicable to all school systems. In addition, intervention strategies and protocols will be examined and discussed.

CPSY 427 (SCHP 427) Assessment and Appraisal in Counseling 3 Credits
In addition, intervention strategies and protocols will be examined and discussed.

Consent of program director required.

Repeat Status: Course may be repeated.
CPSY 467 Doctoral Seminar In Counseling Psychology 1-6 Credits
Research and writing-intensive seminar on current issues and topics in professional psychology directed to doctoral students in counseling psychology. Permission of CP Training Director.
Repeat Status: Course may be repeated.

CPSY 470 Independent Study and Research 1-6 Credits
Individual or small group study in the field of counseling. Approved and supervised by the major adviser.
Repeat Status: Course may be repeated.

CPSY 471 (EDUC 471) Diversity and Multicultural Perspectives 3 Credits
Examination of the influence of culture, gender, and disabilities on behavior and attitudes. Historical and current perspectives on race, culture, gender, and Lehigh minority group issues in education and psychology. Lecture/small group discussion. is restricted to graduate students in the College of Education only.

CPSY 472 Human Development Across the Lifespan 3 Credits
An examination of prevailing theories of human growth and development across the lifespan. Examination of the interactive effect of various age groups upon one another. Particular emphasis on the helping relationships.

CPSY 473 (SCHIP 473) Advanced Research Methods in Applied Psychology 3 Credits
For doctoral students in applied psychology. Issues and methods of research design, data collection and data analysis. Advanced discussion of quantitative, qualitative and single-case research design. Admission to the Ph.D. program in counseling psychology or school psychology or permission of the instructor.

CPSY 476 Supervision and Consultation in Counseling 3 Credits
Examination of supervision and consultation theory, research and practice within a multicultural framework. Observation and supervision of counseling practicum students. Consultation in clinical settings. For candidates for supervisor's certificate or doctorate in counseling. Consent of instructor required.
Prerequisites: CPSY 488

CPSY 477 Supervision Apprenticeship 3 Credits
The Supervision Apprenticeship normally follows completion of the supervision course CPSY 476 and ensures a full academic year of supervision experience working with master's level trainees under the supervision of a faculty member. Doctoral standing and permission of training director required.
Repeat Status: Course may be repeated.

CPSY 479 Master's Counseling Practicum 3 Credits
CPSY 479 Master's Counseling Practicum 3 Credits Practicum field experience in professional practice settings with accompanying seminar meetings. Minimum of 100 documented hours on site.

CPSY 480 Master's Internship I 3 Credits
Twenty hours of weekly supervised practicum training for advanced graduate students in individual, group, and family counseling and therapy.
Repeat Status: Course may be repeated.
Prerequisites: CPSY 442 or CPSY 451 or CPSY 479

CPSY 481 Advanced Multicultural Counseling 3 Credits
This seminar covers models and theories of multicultural counseling and intervention. Students should be actively engaging in practice with multicultural clients in a practicum or field site, and these cases will form part of the basis of course discussions. Must have admission to the doctoral program in counseling psychology. Consent of counseling psychology program director required.
Prerequisites: CPSY 471

CPSY 482 Practicum in University Teaching: Counseling Psychology 1-4 Credits
Mentored and guided co-teaching focused on the design, organization, pedagogy and assessment of university courses in Counseling Psychology. Students in this course will work with a faculty member to apply best practices in university teaching with feedback while co-teaching students in a course in the College of Education. Students taking the course must meet the college standards for participation and be approved by the program director and department chair.
Repeat Status: Course may be repeated.

CPSY 483 Master's Internship II 3-6 Credits
Twenty hours of weekly supervised professional practice in a school or agency setting as an extension of CPSY 480, Practicum. Onsite supervision, audio and/or video recordings and case presentations required. Consent of counseling psychology practicum coordinator required.
Prerequisites: CPSY 480

CPSY 484 (SCHIP 484) History and Systems of Psychology 3 Credits
This doctoral level course is designed as an overview of the history of psychology in the Western world. The historical approaches to this task will include a historical developmental approach to the origins and changes of ideas over time, the study of great persons and schools of thought, and a look at the Zeitgeist of each. This course will examine the nature of psychology as a whole, and the influence of philosophical worldviews in areas such as epistemology, ontology, teleology, and axiology. Part of this study regards the nature of science, and its power and limitations as applied to the understanding of human beings.

CPSY 485 Advanced Psychopathology 3 Credits
This class will cover etiology, assessment, interviewing techniques, establishing a therapeutic alliance, and treatment planning in adult mental disorders. In depth coverage will be given to Axis II disorders. The diagnosis and classification of abnormal behavior using DSM-IV-R medical model will be emphasized. Alternate theories of abnormal psychology will also be discussed.

CPSY 486 Family Counseling Clinic 3-6 Credits
Supervised practicum training for advanced graduate students in family counseling and therapy. Techniques and methods of conducting family counseling and therapy.
Prerequisites: CPSY 480 and CPSY 440

CPSY 487 Advanced Doctoral Practicum I 3 Credits
Supervised clinical experience for entry-level doctoral students with emphasis on the development of intake skills, assessment procedures and intervention skills. Audio and video recording, individual and group supervision. Must have admission to the doctoral program in counseling psychology. Consent of the counseling psychology practicum coordinator required.

CPSY 488 Advanced Doctoral Practicum II 3 Credits
Supervised clinical experience with emphasis on advanced skills in interpretation, case conceptualization from a theoretical perspective, termination and referral, and in the broad array of professional activities normally conducted by a counseling psychologist. Audio and video recording, individual and group supervision. Consent of counseling psychology practicum coordinator required.
Prerequisites: CPSY 487

CPSY 489 Advanced Doctoral Practicum III 1 Credit
Supervised field experience in counseling and therapeutic settings for doctoral students with specific populations. In consultation with on-site supervisor, the student will develop an area of focus for this practicum that will include therapy experience, training, and additional assessment skills as needed. Consent of counseling psychology practicum coordinator required.
Prerequisites: CPSY 488
CPSY 491 Advanced Doctoral Practicum IV 1 Credit
Supervised field experience in counseling and therapeutic settings for doctoral students with specific populations. In consultation with on-site supervisor, the student will develop an area of focus for this practicum that will include therapy experience, training and additional assessment skills as needed. Consent of counseling psychology practicum coordinator required.
Repeat Status: Course may be repeated.
Prerequisites: CPSY 489

CPSY 492 Advanced Field Placement 1-3 Credits
Students perform counseling in university and community agencies under the supervision of the Ph.D. psychologists at the field placement. Open only to students in counseling psychology. Consent of counseling psychology practicum coordinator required.
Repeat Status: Course may be repeated.
Prerequisites: CPSY 491

CPSY 498 Counseling Psychology Doctoral Internship 1 Credit
A one year full-time or two year half-time supervised internship in professional psychology. Student functions as regular staff member. Regular contact with academic advisor required in addition to end-of-semester evaluation by the internship site and the student. Consent of program director required.
Repeat Status: Course may be repeated.
Prerequisites: CPSY 491

CPSY 499 Dissertation 1-15 Credits
Repeat Status: Course may be repeated.

Cooperative Graduate Education

The P.C. Rossin College of Engineering and Applied Science permits graduate students to spend part of their research experience in industry, business, or a government agency. In general, the external research experience should be complementary to their graduate studies at Lehigh University and can count towards their degree program through ENGR 400 Engineering Co-op for Graduate Students (see Graduate tab). Permission of the department chair is required in order to participate in this program.

Subject to university/federal regulations, when enrolled in courses at Lehigh University, a student can work for a maximum of 20 hours at the company/laboratory (co-op partner). If not enrolled in courses other than ENGR 400, a student will be permitted to work full time at the co-op partner. Full time employment over the summer will also be permitted. Maintenance of full-time status, however, requires that during the semester students must be registered for the minimum number of credit hours as listed in R&P or meet the qualifications to be certified as a full-time student.

MS/ME/ENG CO-OP PROGRAMS
- ENGR 400 can be taken for a maximum of 6 credits, with at most 3 credits in any registration period.
- Minimum of 18 course credit hours, excluding ENGR 400 and Thesis (ENGR 490) must be obtained through Lehigh University

PH.D. PROGRAM
- 9 credits of ENGR 400 can be taken throughout a student's entire graduate study at Lehigh, with at most 3 credits in any registration period.

Courses

ENGR 400 Engineering Co-op for Graduate Students 1-3 Credits
Supervised cooperative work assignment to obtain practical experience in field of study. Requires consent of department chairperson. When on a cooperative assignment, the student must register for this course to maintain continuous student status. Limit to at most three credits per registration period. No more than six credits may be applied towards a master's program and no more than nine credits may be used throughout a student's entire graduate study at Lehigh.
Repeat Status: Course may be repeated.

ENGR 401 Teaching/Presentation Skills 1 Credit
Development of teaching and presentation skills for scientific professionals. Presentation effectiveness, teaching/presentation methodologies, classroom management, course development/content preparation, lecture/presentation development and lecture/presentation delivery. Individualized undergraduate course specific modules selected by student. Enrollment limited to Rossin Doctoral Fellows.

ENGR 402 Preparing for the Professoriate 1 Credit
Overview of the job search, research program development and service skills for graduate students entering academic careers. Transition from graduate student to faculty responsibilities, the post-doctoral experience, time management, CV/resume preparation, faculty search process, tenure and promotion, research leadership and program development, research proposal preparation and research sponsorship. Enrollment limited to Rossin Doctoral Fellows.

ENGR 430 Technical Writing for Engineering and the Sciences 1 Credit
Formal composition and technical writing skills for advanced non-native English writers in Engineering and the Sciences. Instructor and peer review of writing, self-editing strategies, how to incorporate technical vocabulary and formulas, advanced sentence structure, and appropriate citation of research. Field-specific readings, which students must compile, critique, and model in their own writing. Designed for international graduate students who are writing or preparing to write publishable quality articles, theses, or dissertations.

ENGR 452 (CHE 452) Mathematical Methods in Engineering 3 Credits
Analytical techniques are developed for the solution of engineering problems described by algebraic systems, and by ordinary and partial differential equations. Topics covered include: linear vector spaces; eigenvalues, eigen-vectors, and eigenfunctions. First and higher-order linear differential equations with initial and boundary conditions; Sturm-Liouville problems; Green's functions. Special functions; Bessel, etc. Qualitative and quantitative methods for nonlinear ordinary differential equations; phase plane. Solutions of classical partial differential equations from the physical sciences; transform techniques; method of characteristics.

ENGR 490 Thesis (Moc) 1 Credit
ENGR 499 Dissertation (Moc) 1 Credit

Earth and Environmental Sciences

The Department of Earth and Environmental Sciences (EES) is Lehigh's home for teaching and research in the areas of ecology, environmental science, and geological sciences. Matters of environmental quality and natural resources will increasingly impact people and society in the years to come, and the EES department offers a range of undergraduate and graduate programs that provide students with an understanding of Earth's biosphere, atmosphere, lithosphere, and hydrosphere, with an emphasis on how these components function as an integrated Earth system. Training in Earth and Environmental Sciences can lead to technical and scientific careers in research, environmental consulting, conservation ecology, government agencies, and the petroleum industry, and can also serve as an excellent liberal arts degree that provides context and preparation for careers such as law, policy, journalism and economics.

Faculty in the EES department have a wide range of interests and strong reputations in the fields of geology, ecology, and environmental sciences. Instruction at all levels, the department emphasizes field experiences, laboratory techniques, and experiential learning, as well as the development of quantitative and communication skills. The EES department maintains a relaxed and personal atmosphere in which students can interact with faculty in many ways, including seminars, special symposia on topics of the students' choice, field research, and departmental field trips.

EES is a core department in the Environmental Initiative Program (EI), which offers students access to interdisciplinary training in Environmental Science, Engineering, and Policy.

At the undergraduate level, students may choose from a B.A. or a B.S. degree in Earth and Environmental Sciences. The flexible B.A. program provides students an opportunity to acquire breadth, design
a specialized program, or find room for a double major. A popular choice is a double major in Earth and Environmental Sciences and in Environmental Studies, a major offered through the Environmental Initiative (http://www.ei.lehigh.edu). This degree is well suited to students with career aspirations in areas such as engineering, environmental law, journalism, economics, government, among many other possibilities.

The B.S. degree, while still offering considerable flexibility, provides the more in-depth technical training required for graduate school and scientific careers, and is well suited for students seeking science graduate degrees or employment as professionals in the earth and environmental sciences.

An accessible minor program is available for students wishing to add Earth and Environmental Science insight into any number of other technical or non-technical degree programs, helping students distinguish themselves as they prepare to enter today’s fast-evolving job markets and graduate programs.

For students with strong interests in areas such as hydrology, water and soil remediation, hazards and associated geotechnical strategies, EES, in conjunction with the Department of Civil and Environmental Engineering (CEE), offers a five-year program leading to dual B.S. degrees in EES and CEE (students having these interests may also want to see the description of the B.S. in Environmental Engineering in the catalog entry for the Department of Civil and Environmental Engineering).

EES offers graduate training leading to either M.S. or Ph.D. in Earth and Environmental Sciences. The EES graduate program is marked by close faculty-student collaboration. Graduate students can take advantage of strong externally funded faculty research programs and the extensive analytical and computing facilities available in the department; these facilities and specific EES research programs are described in some detail on the EES departmental web page at www.ees.lehigh.edu.

FIELD WORK AND EXPERIENTIAL LEARNING

Field experiences are a hallmark of the EES undergraduate program. The goal of these experiences is to place students into learning environments that are distinct from the classroom or lab, where all the complexities and subtleties of the field can be appreciated in their natural setting. The Department runs a nationally recognized ~5 week long (6 credit) summer field camp in the Rocky Mountains, which offers intense field training in hydrology, geology, and field methods including computer-based mapping. As part of the Lehigh in Costa Rica Program, the Department teaches a field course in Costa Rica every winter term that focuses on tropical ecology and natural history. Students can participate in the department’s longstanding research programs in limnological and ecological research in the Poconos Lakes region and in the Lehigh River watershed. Supervised internships allow students at all levels to become engaged in projects involving cross-disciplinary research, assessment, and consulting work. Undergraduate students can also become involved in forefront research programs. In recent years, students have played a role in research in the Himalaya, Alaska, California, Idaho, Argentina, and Italy, in addition to more nearby sites in the mid-Atlantic states. We strongly encourage all EES majors to take advantage of the special field programs and opportunities made available by the department. Most EES courses also include field experiences in the form of one-day or weekend-long field trips, and several courses include weekly or bi-weekly field trips.

PROGRAMS IN EARTH AND ENVIRONMENTAL SCIENCES

The descriptions of the following programs in the Department of Earth and Environmental Sciences are organized as follows:

- Minor in Earth and Environmental Sciences
- Bachelor of Arts Degree in Earth and Environmental Sciences
- Bachelor of Sciences Degree in Earth and Environmental Sciences
- Department Honors in Earth and Environmental Sciences
- Civil and Environmental Engineering and Earth and Environmental Sciences
- Graduate Studies

Professors. David J. Anastasio, PhD (Johns Hopkins University); Gray E. Bebout, PhD (University of California Los Angeles); Edward Gray E. Bebout, PhD (University of Wisconsin); Kenneth P. Kodama, PhD (Stanford University); Anne S. Meltzer, PhD (Rice University); Frank J. Pazzaglia, PhD (The Pennsylvania State University); Dork Sahagian, PhD (University of Chicago); Zicheng Yu, PhD (University of Toronto); Peter K. Zeiliger, PhD (Dartmouth College)

Associate Professors. Robert K. Booth, PhD (University of Wyoming); Benjamin S. Felzer, PhD (Brown University); Donald P. Morris, PhD (University of Colorado Boulder); Stephen C. Peters, PhD (University of Michigan Ann Arbor); Joan Ramage Macdonald, PhD (Cornell University)

Assistant Professor. Jill McDermott, PhD (Massachusetts Institute of Technology)

Professor Of Practice. Claudio Berti, DOC (Universita G. D’Annunzio)

Emeriti. Bobb Carson, PhD (University of Washington); Bruce R. Hargreaves, PhD (University of California Berkeley); Paul B. Myers, Jr., PhD (Lehigh University); Dale R. Simpson, PhD (California Institute of Technology)

REQUIREMENTS FOR A MINOR IN EARTH AND ENVIRONMENTAL SCIENCES

A minor is designed for students wishing to explore an area of Earth or Environmental Sciences in conjunction with a major program in another field for personal development or career enhancement.

EES 022  Exploring Earth 1
EES 80 or Courses at the 100 or higher levels 8
EES Courses 6

Total Credits 15

Natural science (NS) designated EES College seminars (EES 090) may be used to meet minor requirements.

DEGREE REQUIREMENTS FOR A BACHELOR OF ARTS DEGREE IN EARTH AND ENVIRONMENTAL SCIENCES

The B.A. degree is designed with flexibility in mind and is recommended for students interested in a sound liberal arts degree that will permit them to bring a scientific perspective to a wide variety of careers. The degree also permits students to take a double major, or design a specialized program tailored to specific topics in the earth and environmental sciences. Students who choose the B.A. but are interested in attending graduate school should talk to their faculty advisor and consult the B.S. program descriptions to see the type of requirements that may be required for graduate admission.

University and College Requirements

College Seminar 3
English Composition (2 courses) 6
Distribution Requirements: at least 2 Humanities courses 8
Distribution Requirements: at least 2 Social Science courses 8

Junior Writing Requirement

EES 200  Earth History 1

MATH and Collateral Science Requirements 2

1 semester of math equivalent to MATH 012 or above for at least 4 credits
1 additional course from Chemistry, Mathematics, or Physics, approved by advisor.

Core Sequence in EES Major

EES 080  Introduction to the Earth System 4
EES 200  Earth History 4
EES 380  The Practice of Science 1

Major Electives 24
Select from EES or cross-listed offerings at the 100-300 levels 3

Free Electives

Courses chosen from anywhere in the University’s curriculum, sufficient to bring the total to a minimum of 120 credits.
The ability to express oneself clearly in writing is a critical skill for success in any chosen career. It is also integral to the learning experience. Students are encouraged to take courses that help develop written skills in their major. To help ensure this, the College of Arts and Sciences requires each student to complete at least one writing intensive course and receive certification from the instructor of that course. EES 200 Earth History is the designated writing intensive course in EES and fulfills the junior writing requirement. Students may also fulfill this requirement by taking writing intensive courses in other departments (although this is not encouraged).

Students interested in scientific careers or pursuing graduate education in the sciences are recommended to take at least two additional math and collateral science courses chosen in consultation with an advisor.

Up to 8 credits of EES internship (EES 293) and EES research (EES 393) may be used as major electives (no more than 4 of which can be EES 293).

DEPARTMENT HONORS IN EARTH AND ENVIRONMENTAL SCIENCES

Students in either the B.A. or B.S. degree programs may undertake a program that leads to graduation with department honors. To participate, the student must (1) have a minimum major GPA of 3.4 and an overall cumulative GPA of 3.0 expected at graduation, (2) complete at least four credits of EES 393 (Supervised Research in Earth and Environmental Sciences), and (3) prepare a written honors thesis on the EES 393 research project. To graduate with honors students should (1) file a written request with the EES undergraduate instruction coordinator no later than the beginning of the senior year (preferably during the junior year), (2) constitute an advisory committee of two EES faculty plus the student’s research supervisor to guide the research, (3) prepare a research proposal for committee’s approval, and (4) give an oral presentation of research results and conclusions at a department seminar on or before the last day of classes in the second semester of the senior year. The committee should approve the research proposal and the honors thesis by signing the required form and cover sheet, which will be filed with the Department.

CIVIL AND ENVIRONMENTAL ENGINEERING AND EARTH AND ENVIRONMENTAL SCIENCES

This program is designed for students interested in combining programs in two departments: Civil & Environmental Engineering and Earth & Environmental Sciences, leading to two bachelor of science degrees, a civil and environmental engineering B.S. degree and a B.S. degree in earth and environmental sciences. Both degrees would be awarded at the end of the fifth year. This program is one of the dual degree programs mentioned in the Five-Year Programs section. The student will have a primary advisor in the P.C. Rossin College of Engineering and Applied Sciences and a secondary advisor in the College of Arts and Sciences. The program provides alternatives for students who may decide not to complete the dual-degree program. Students who make this decision prior to the beginning of the fourth year may qualify at the end of that year for the bachelor of science in civil or environmental engineering, as well as a minor in earth and environmental sciences. Also, if a student decides after two years to pursue only a B.S. degree in the EES department, it is possible to complete the requirements in four years. If the decision to work toward this degree is made during the fourth year, at least one additional semester is required to qualify for either B.S. degree. Interested students should consult with the respective departmental advisors to create a schedule of courses to resolve conflicts or if a specified course is not offered that semester. Required courses and major electives for the EES B.S. degree are listed in the catalog entry for EES. Crosslisted EES/CEE courses used to satisfy Civil Engineering Approved Electives can reduce the individual semester and total program credits when chosen to satisfy EES program requirements. The dual degree, and a suggested schedule of courses, is described more fully elsewhere in the catalog (p. 154). Additional useful information can be found on the web sites (www.lehigh.edu/~incee/ and www.ees.lehigh.edu).

GRADUATE STUDIES

The Department of Earth & Environmental Sciences offers graduate programs leading to the M.S. and Ph.D. in Earth and Environmental Sciences. These degrees emphasize what we feel is an important and growing trend in ecology, environmental science, and geology, namely the blending of expertise and perspectives from many disciplines. Research is an integral component of all EES graduate programs and leads to an M.S. thesis or Ph.D. dissertation prepared under a research supervisory committee and chaired by a departmental faculty research...
The University has outlined the general academic requirements for M.S. and Ph.D. students in its Graduate Student Handbook, and EES has additional Departmental requirements that must also be fulfilled. It is the student’s responsibility to ensure that all graduation requirements are met. All graduate students work with an advisor who chairs the student’s research supervisory committee. Graduate students make annual presentations of their research to the Department. All graduate students are required to take one of the Department’s four graduate core courses (EES 411, EES 415, EES 426, and EES 484) and five additional courses (15 credits) at the 400-level. M.S. students complete 30 credits of coursework and thesis research and orally defend a written thesis that encompasses the findings and conclusions of their research. Candidates for the Ph.D. must first pass the qualification evaluation in the first year, then defend their dissertation proposal in the General Exam, and finally, orally defend a dissertation. For more details beyond this brief summary, please see the graduate handbook online at: www.ees.lehigh.edu/graduate/grad_handbook.html.

Research Facilities
Our Department is well equipped for a broad range of field and laboratory investigations in the Environmental, Ecological, and Geological Sciences. Our laboratories and equipment include:

- Petrographic microscopy facilities, rock-crusher, ball mill, rock saws, and cathodoluminescence and camera lucida digitizing capabilities;
- Laboratory for Ar-Ar, U-Th/He, and fission-track geochronology including dual UV and CO2 lasers, VG 3600 noble-gas mass spectrometer, Balzers quadrupole mass spectrometer, dedicated He and Ar extraction lines with lowblank furnaces, all under full LabVIEW automation;
- A stable isotope geochemistry laboratory equipped with a Finnigan MAT model 252 mass spectrometer (with dual-inlet and carrier gas capabilities), on-line peripherals, and off-line vacuum extraction lines, for O, H, C, and N isotope analyses of silicate minerals and rocks, carbonates, fluid inclusions, and organic matter;
- Equipment for sampling groundwater wells as well as automated samplers for surficial water systems;
- A microbial ecology laboratory (fluorescence and phase contrast microscopy, bioreactors, UV photon, walk-in controlled environment chambers);
- Field instruments to characterize solar radiation (UV bands, PAR, broadband, and high resolution spectral irradiance with automated shadowband options for diffuse and direct spectral irradiance), water quality & optical properties (Biospherical PUV profilers, YSI datasondes, SCUFA CDOM fluorometers), weather parameters, and hydrology (precise water level, precipitation, wind, humidity, atmospheric pressure, water temperature thermistor chains) plus automated ISCO rain-triggered samplers for applications in aquatic and terrestrial ecosystem studies;
- Aquatic ecology laboratory instruments to characterize water quality and optical properties (pH, specific conductance, dissolved oxygen, UV-VIS spectrophotometers, scanning fluorometer, Turner CDOM/Chlorophyll fluorometer, N & P nutrient analyzer, automated Shimadzu TOC/TN analyzer, CHN analyzer, scintillation counter, photobleaching laboratory, low-carbon water purification system);
- An aqueous geochemistry laboratory with a ThermoElectron X-Series inductively-coupled plasma mass spectrometer with collision cell, and hydride generation apparatus that can be coupled to an HPLC system for species analysis, a Dionex ion chromatograph for simultaneous analysis of anions and cations, a Mercury analyzer for analysis of gaseous and liquid samples, and a Class 100 clean room for ultra trace sample preparation; additional instruments including a Waters computer-assisted ion chromatograph, an ARL 34000 inductively-coupled plasma atomic emission spectrometer, a Netzsch DTA/TGA instrument, and a high-pressure core-holder/column reactor for flow-through experiments;
- A sedimentation and soils analysis laboratory including equipment for particle size analysis;
- A paleomagnetism laboratory with a magnetically shielded room, a 2G superconducting magnetometer and built-in af demagnetizer, Molspin spinner magnetometer, a Schonstedt AF demagnetizer modified to apply pARMs, and an ASC thermal demagnetizer, and a KLY-3S Kappabridge magnetic susceptibility system, and an ASC impulse magnetizer;
- A reflection seismology laboratory has equipment including broadband seismometer linked to global networks; computer workstations for seismic processing, Bison DIFP multi-channel seismograph, various seismic energy sources, and ground-penetrating radar;
- Field geophysical equipment includes a Worden Master gravimeter, and a Geometrics portable proton precession magnetometer;
- Geomorphology lab including a Topcon total station, flow gages, LASCII digitizer, complete airphoto analysis facility, and a flume facility in the CEE hydraulics lab. We also maintain several PC and UNIX computer labs devoted to GIS (ArcGIS) and large spatial digital topographic databases;
- Paleoeological laboratories with facilities for the analysis and photo documentation of tree rings, pollen, macrofossils, and other biological and physical parameters of environmental archives, including lake and peatland sediments.
- A sediment core laboratory with facilities for initial core preparation and core storage, including a walk-in cold room, a GeoTek MultiSensor Core Logger, a VirTis AdVantage Freezer Dryer and various corers (Livingstone, Mackereth, Glew Gravity, Russian peat Corers);
- A remote sensing laboratory with image processing software, extensive spatial data collections, as well as equipment for measuring field characteristics of important remotely sensed parameters.

Courses

EES 002 (ES 002) Introduction to Environmental Science 3 Credits
Focuses on natural and human-induced drivers and consequences of environmental change. Exploring options for mitigating and adapting to environmental change in ecosystems, physical and social systems, we will examine such topics as biogeochemical cycles, population pressure, ecosystem diversity, productivity and food security, energy, water resources, climate change, pollution, ozone, urban issues and sustainability. Stresses interactions and interrelationships, using a series of case studies. Intended for any student with an interest in the environment. May be combined with EES 022.
Attribute/Distribution: NS

EES 004 The Science of Environmental Issues 1 Credit
Analysis of current environmental issues from a scientific perspective. The focus on the course will be weekly discussions based on assigned readings.
Prerequisites: (EES 002 or EES 002 or EES 028 or GCP 002 or EES 011 or EES 012 or EES 014 or EES 015 or EES 016 or IR 016 or EES 021 or EES 024 or EES 025 or EES 026 or GCP 026 or EES 027 or GCP 027 or GCP 028 or EES 028 or EES 089 or EES 090 or EES 022)
Can be taken Concurrently: EES 002, EES 028, GCP 002, EES 011, EES 012, EES 014, EES 015, EES 016, IR 016, EES 021, EES 024, EES 025, EES 026, GCP 026, EES 027, GCP 027, GCP 028, EES 028, EES 089, EES 090, EES 022
Attribute/Distribution: NS

EES 011 Environmental Geology 3 Credits
Analysis of the dynamic interaction of geologic processes and human activities. Catastrophic geologic processes (earthquakes, volcanoes, landslides), pollution of geologic systems, and engineering case studies. May be combined with EES 022 or EES 004 for 4 credits.
Attribute/Distribution: NS

EES 012 Glaciers and Glaciation 3-4 Credits
An investigation of how cold climates and the associated processes of glaciation and periglacial activity have left their imprint on the Earth. May be combined with EES 022 or EES 004 for 4 credits.
Attribute/Distribution: NS
EES 014 Lands of the Midnight Sun 3 Credits
Investigations of polar exploration and science, the environment at high latitudes, and cultures of the Arctic, as well as discussion of issues related to understanding interactions among extreme environments, global change, pollution, and indigenous cultures. Lecture, discussion, classroom activities. May be combined with EES 022 or EES 004 for 4 credits.
Attribute/Distribution: NS

EES 015 Volcanoes and the Ring of Fire 3 Credits
Volcanoes are a tangible, often breathtaking, reminder of the inner workings of our restless planet. In this course, we consider the processes leading to volcanic eruptions, the significance of volcanism for long-term Earth evolution, and the hazards volcanoes create for humans, particularly those living in the circum-Pacific (the Ring of Fire). May be combined with EES 022 or EES 004 for 4 credits.
Attribute/Distribution: NS

EES 016 Geology of War 3 Credits
Introduction to Earth and Environmental Sciences through a study of the geologic underpinnings of human conflict, the geologic influences over the outcomes of great battles, and the long-term environmental impacts of war. Instructional format includes lectures, discussions, student projects, and a field trip to Gettysburg National Military Park. May be combined with EES 022 or EES 004 for 4 credits.
Attribute/Distribution: NS

EES 021 Introduction to Planet Earth 3 Credits
Processes within the Earth and dynamic interactions between the solid earth, the atmosphere, and the oceans. Lectures.
Attribute/Distribution: NS

EES 022 Exploring Earth 1 Credit
Laboratory course in methods, data acquisition, data analyses and scientific communication relevant to Earth and Environmental Sciences. Building on the framework of the “Earth Science Literacy Initiative” the course introduces students to the foundations of the scientific method, the basic concepts of the Earth systems, and the influence and interaction of the natural world in everyday life. Hazards, resources, anthropogenic forcing and impacts, biogeochemical cycles and sustainability are discussed and modeled among other timely topics.
Prerequisites: EES 023 or EES 021 or EES 024 or EES 025 or EES 026 or EES 027 or EES 028 or EES 002 or EES 011 or EES 012 or EES 014 or EES 015 or EES 016 or EES 090 or IR 016 or GCP 026 or GCP 027 or EES 028 or EES 004
Can be taken Concurrently: EES 023, EES 021, EES 024, EES 025, EES 026, EES 027, EES 028, EES 002, EES 011, EES 012, EES 014, EES 015, EES 016, EES 090, IR 016, GCP 026, GCP 027, EES 028, EES 004
Attribute/Distribution: NS

EES 023 Weather and Climate: Past, Present, and Future 3 Credits
Introduction to the basic principles of meteorology, as they pertain to past, present, and future climates. Earth’s energy balance; cloud formation and precipitation; winds and atmospheric circulation; regional climatologies; past warm periods and ice ages in Earth’s history; the latest ideas about future climate change and global warming. Students will maintain a weather notebook to enable them to relate theory to observations from real weather data. May be combined with EES 022 or EES 004 for 4 credits.
Attribute/Distribution: NS

EES 024 Climate Change 3 Credits
Examination and discussion of Earth’s climate history and the multiple interactions among components of the climate system, including ice, water, air, land, and vegetation; review of the causes of climate change at various time scales. Assessment of historical and future climate change and the role of humans in causing climate change, including global warming. May be combined with EES 022 or EES 004 for 4 credits.
Attribute/Distribution: NS

EES 025 The Environment and Living Systems 3 Credits
The course will provide an introduction to the role of the environment in regulating living systems at a variety of scales and levels of organization. The role of the environment in regulating and shaping populations, communities, and ecosystems will be explored. In addition, the role of the environment will be discussed as it relates to the origin, evolution, and diversity of life on earth. Whenever possible, the role of anthropogenic environmental change will be discussed as it relates to the above topics. May be combined with EES 022 or EES 004 for 4 credits.
Attribute/Distribution: NS

EES 026 (GCP 026) Energy – Origins, Impacts, and Options 3 Credits
Critical assessment of current and predicted energy resources used by humans, including their origins, distribution, environmental impacts, and feasibility. Lectures, discussion, field trips. May be combined with EES 022 or EES 004 for 4 credits.
Attribute/Distribution: NS

EES 027 Natural Hazards: Impacts and Consequences 3 Credits
Earthquakes, volcanoes, tsunamis, floods, and hurricanes are a natural part of the Earth and our environment. These events have violent consequences for our lives and significant economic implications. This course examines the causes, predictability, and risk mitigation for these events. We will also consider how natural disasters are represented by popular media and whether this helps or harms public understanding of our dynamic planet and our relationship to it. May be combined with EES 022 or EES 004 for 4 credits.
Attribute/Distribution: NS

EES 028 Conservation and Biodiversity 3 Credits
An introduction to the science of conservation biology. We examine the evolution of biodiversity on earth, spatial patterns of biodiversity, the impact of human activities on biodiversity, and assess strategies for the management and conservation of biodiversity. Students gain the scientific literacy necessary to make informed decisions about topics such as wilderness preservation, species conservation, and land use. May be combined with EES 022 or EES 004 for 4 credits.
Attribute/Distribution: NS

EES 032 Oceanography 3 Credits
An introduction to the structure, composition, and processes of the earth from a marine perspective. Topics include earth structure, plate tectonics, continental margins, coastal processes, seawater chemistry, ocean circulation, wave dynamics, primary productivity, plankton and plants, marine organisms and communities. May be combined with EES 022 or EES 004 for 4 credits.
Attribute/Distribution: NS

EES 042 The Natural History of Costa Rica 3 Credits
The interaction of ecology, geology, and climate shaping the natural history of Costa Rica. Population, community, and ecosystem ecology; evolution and natural selection; biodiversity and conservation biology. Offered during the winter inter-term through Lehigh Study Abroad, and involving lectures, electronic media, observations, and field experiences. Consent of instructor required. Limited enrollment. Requires payment of additional program fee and transportation to Costa Rica.
Attribute/Distribution: NS

EES 080 Introduction to the Earth System 4 Credits
Study of the integrated earth system, including the atmosphere, biosphere, geosphere, and hydrosphere and interactions between these components (e.g., plate tectonics, biogeochemical cycling, climate, anthropogenic impacts). The course is designed to prepare students for a major in earth and environmental sciences and includes a lab that develops skills relevant to this broad field including data analysis, modeling, use of maps and geospatial data, and field work. Lectures and lab.
Attribute/Distribution: NS
EES 089 Geographic Analysis of our Changing World 3 Credits
This course will introduce students to maps, spatial data, and electronic tools for geographic analysis. Fundamental geographic and database concepts will include map types, spatial referencing systems, map projection systems, map scale, and database characteristics. Tools including ArcGIS Desktop software and Global Positioning System receivers will be used to acquire and analyze spatially referenced data sets drawn from diverse sources and disciplines relating to the environment. Students will use their new skills in geographic analysis to develop an electronic portfolio.
Attribute/Distribution: NS

EES 093 Freshman Supervised Internship in Earth and Environmental Sciences 1-2 Credits
Experiential learning opportunities supervised by EES faculty, including fieldwork, data collection or analysis, literature review, and information management. A maximum of two credits is allowed. Consent of supervising faculty required.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

EES 115 Surficial Processes 4 Credits
An introduction to process geomorphology and sedimentology that emphasizes the dynamic interactions of climate, tectonics, and watershed hydrology on the erosional, transportational, depositional, and biological processes that shape landscapes. Includes a field and computer-intensive lab.
Prerequisites: EES 080
Can be taken Concurrently: EES 080
Attribute/Distribution: NS

EES 131 Introduction to Rocks and Minerals 4 Credits
Hand-specimen identification of the major mineral groups and rock types. Atomic structure of minerals; relationship of mineral structure to chemical and physical properties. Placement of igneous, sedimentary, and metamorphic rocks into a plate tectonics context. Introduction to optical mineralogy and x-ray diffraction techniques. Lectures, laboratories, field trips.
Prerequisites: EES 080 or (EES 021 and EES 022)
Can be taken Concurrently: EES 080
Attribute/Distribution: NS

EES 132 Ecology 4 Credits
The study of relationships among organisms and their physical environment. Ecology of individual organisms, populations, communities, ecosystems, landscapes, and the biosphere. Topics include organism adaptations and natural selection, life histories, population growth and dynamics, species interactions, energy flow, nutrient cycling, and ecological impacts of human activities. Field-based laboratories focus on the quantitative study of biological populations and communities. Lectures, field-based laboratories, and applied activities.
Prerequisites: EES 025 or EES 028 or EES 080
Can be taken Concurrently: EES 025, EES 028, EES 080
Attribute/Distribution: NS

EES 172 Topics in Earth & Environmental Science 1-4 Credits
Study of topics in earth and environmental science not covered in other 100-level courses. Primarily used for transfer credit. Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: NS

EES 200 Earth History 4 Credits
Review of the coevolution of Earth, life, and the environment, and introduction to the records used to constrain this history. The course addresses environmental changes at both geologic and human time spans. Includes laboratory exercises and field trips.
Prerequisites: EES 080
Attribute/Distribution: NS

EES 201 Seismology: The Earth and Environment 4 Credits
An examination of how earthquakes and active source seismology are used to understand the Earth beneath our feet. Fundamentals of seismic wave propagation in the Earth. Study of earthquakes, and reflection and refraction techniques at a variety of scales: near-surface, crustal, lithospheric, and whole Earth. Practical applications to both earth and environmental science, experiment design, data collection, processing, analysis and interpretation. Field and laboratory projects.
Prerequisites: EES 080 and EES 115 and EES 131
Can be taken Concurrently: EES 115
Attribute/Distribution: NS

EES 223 Structural Geology and Tectonics 4 Credits
Material behavior of rocks and the architecture of the Earth’s crust. Plate tectonic processes and plate margin deformation. Introduction to geologic maps and field techniques. Lectures, laboratories, and one or two weekend fieldtrips.
Prerequisites: EES 115 or EES 131
Can be taken Concurrently: EES 131
Attribute/Distribution: NS

EES 250 Terrestrial Ecosystems 4 Credits
Ecosystem ecology in the context of the Earth system; discussion of mechanisms by which terrestrial ecosystems function, including the flow of water and energy and the cycling of carbon and nutrients; characterization of temporal and spatial patterns in ecosystem processes and their sensitivity to environmental and biotic changes; integration of global scale effects of these processes. Includes lectures, field trips and laboratories.
Prerequisites: EES 115 or EES 152
Attribute/Distribution: NS

EES 293 Supervised Internship in Earth and Environmental Sciences 1-4 Credits
Experiential learning opportunities supervised by EES faculty, including data collection or analysis, literature review, and/or information management most likely as part of a longterm, continued project. The student should submit a work plan that describes activities involved and credits requested. A maximum of four credits of EES 293 and no more than eight credits combined from EES 093, EES 293 and 393 may be applied to EES B.A. and B.S. degrees (additional credits apply to free electives). Consent of supervising faculty required.
Repeat Status: Course may be repeated.
Attribute/Distribution: NS

EES 300 Apprentice Teaching 3 Credits

EES 306 Geologic Records of Environmental Change 3-4 Credits
This course provides an overview of high-resolution geologic records of environmental and global change, how they are analyzed, and how they can be used in a variety of disciplines. Time series analysis, age control, completeness of sequences, and correlation of records will be covered. A class project will use acquisition and analysis of environmental magnetic data to demonstrate how records of global and environmental change are constructed.
Prerequisites: EES 080 and EES 115
Attribute/Distribution: NS

EES 316 (CEE 316) Hydrogeology 3-4 Credits
Water plays a critical role in the physical, chemical, and biological processes that occur at the Earth’s surface. This course is an introduction to surface and groundwater hydrology in natural systems, providing fundamental concepts and a process-level understanding using the hydrologic cycle as a framework. Geochemistry will be integrated to address natural variations and the human impact on the environment. Topics covered include: watershed hydrology, regional and local groundwater flow, water chemistry, and management of water resources. Lectures and recitation/laboratory.
Prerequisites: (EES 080 and EES 115 or EES 131 or EES 152) or (CEE 170)
Can be taken Concurrently: EES 115, EES 131, EES 152
Attribute/Distribution: NS
EES 318 Geographic Analysis in EES 3-4 Credits
Techniques for acquisition, manipulation and integration of data in Geographic Information System (GIS) environment, with emphasis on statistical and spatial analysis. Traditional and digital maps, spatial data collection and integration, geodesy concepts and time series analysis will be applied to case studies and projects relevant to Earth sciences, environmental sciences, and other disciplines according to the diversity of the audience. Different OS platforms and software will be used throughout the course. Includes lectures and laboratory exercises.
Prerequisites: EES 080 and (EES 115 or EES 152)
Attribute/Distribution: NS

EES 320 (CEE 320) Engineering Hydrology 3 Credits
Prerequisites: (CEE 222)
Attribute/Distribution: NS

EES 323 (CEE 323) Environmental Groundwater Hydrology 3 Credits
The study of subsurface water, its environment, distribution, and movement. Included are flow patterns, well hydraulics, and an introduction to the movement of contaminants. Design problems are included to simulate flow with analytical and numerical models, and contaminant migration using analytical models.
Prerequisites: CEE 121 or CEE 316 or EES 316
Attribute/Distribution: NS

EES 325 Remote Sensing of Terrestrial and Aquatic Environments 3,4 Credits
Techniques of observing the Earth from air- and space-borne instruments, including issues of geometry and scale associated with making measurements, electromagnetic properties of Earth surface materials, the range of instruments used to observe the Earth, image interpretation, and applications of satellite remote sensing to geological, ecological, and environmental questions. Lecture and lab.
Prerequisites: EES 080
Attribute/Distribution: NS

EES 327 (CEE 327) Surface Water Quality Modeling 3 Credits
Fundamentals of modeling water quality parameters in receiving water bodies, including rivers, lakes, and estuaries. Modeling of dissolved oxygen, nutrients, temperature, and toxic substances. Emphasis on water quality control decisions as well as mechanics and model building.
Prerequisites: CEE 121 and (CEE 122 or CEE 222) and (CEE 170 or CEE 270)
Attribute/Distribution: NS

EES 334 Geosphere Structure and Evolution 3-4 Credits
Synthesis of the state of knowledge of Earth structure and long-term evolution, with emphasis on the crust and mantle, and integrating petrologic, geophysical, and geochemical perspectives. Mass and energy transfer through time among the crust, mantle, hydrosphere, biosphere, and atmosphere. Petrographic study of selected rock suites, and introduction to geophysical observations of the deep structure of the solid Earth. Lectures, discussion, laboratories, field trip.
Prerequisites: EES 080 and EES 115 and EES 131
Attribute/Distribution: NS

EES 341 Field Camp in Earth and Environmental Sciences 6 Credits
Integrated, capstone field experience for Earth and Environmental scientists using the diverse natural settings of the Rocky Mountains as the classroom. Projects challenge students to synthesize field data in solving real science problems. Projects include but not limited to classic and computer-based geologic mapping, section measuring, structural analysis, stream hydrology, sediment transport. Five weeks in the field; summer session. Students must apply through the Lehigh Field Camp Program, consent of Field Camp director required. Must have declared major in EES.
Prerequisites: EES 131 and EES 115 and EES 223 and EES 316
Attribute/Distribution: NS

EES 342 Atmospheric Science 3,4 Credits
An intermediate course on the basic principles of meteorology. The course considers atmospheric structure and composition, earth’s energy balance and radiation laws, cloud formation and precipitation, atmospheric motion and circulation, including jet streams and planetary waves, atmospheric stability, frontal systems and air masses, regional climatologies, weather and climate modeling, and the latest ideas about future climate change and global warming. Students will view daily atmospheric charts to enable them to relate theory to observations from real weather data.
Prerequisites: EES 080 and EES 200 and MATH 021 and MATH 022
Attribute/Distribution: NS

EES 352 Limnology 3,4 Credits
Study of inland waters, incorporating physical, chemical, and biological aspects of the environment. The origin and morphology of lakes; light, heat, carbon, salinity, nutrients (N+P), dissolved gases, primary production, and secondary production. Emphasis is on lakes, but watersheds, streams and wetlands are also considered. Relies heavily on laboratory exercises and data analysis to underscore critical principles in limnology.
Attribute/Distribution: NS

EES 357 Paleoclimatology and Landscape History 3-4 Credits
Principles and methodologies of paleoclimatology, with emphasis on paleontology. Applications of paleo-records in tracing flora, vegetation, climate and landscape history. Long-term ecological interactions and ecosystem responses to past environmental change. Field and laboratory experiences in collecting and characterizing sediments and in processing and interpreting fossil pollen and other proxy data. Students will explore regional vegetation, climate and landscape history by coring and analyzing sediments from lakes and wetlands. requires one or more weekend day-long field trips.
Prerequisites: EES 080 or EES 115 or EES 152 or EES 250
Attribute/Distribution: NS

EES 358 Microbial Ecology 3-4 Credits
The role of microorganisms in the environment. Topics include: Survey of microbial classification, structure, and metabolism; study of microbes at population, community, and ecosystem levels of organization; the role of microbes in biogeochemical cycles; application of microbes to bioremediation and resource recovery problems. Fall (alternate (even) years).
Prerequisites: EES 152
Attribute/Distribution: NS

EES 363 Volcanology 3,4 Credits
Volcanic eruptions can result in devastating effects on both a regional and a global scale. This course will examine physical dynamics that control eruptive processes at active volcanoes. Topics will include the role of volatiles, magma decompression, magma chamber and conduit dynamics, magma rheology, crystallization, fragmentation criteria, and transitions from explosive to effusive behavior. We will examine specifically how geochemical/textural analyses of volcanic rocks and minerals can provide quantifiable information on eruption processes.
Prerequisites: EES 131 and EES 115
Attribute/Distribution: NS

EES 364 Glacial and Periglacial Processes 4 Credits
The mineral ice. The formation, deformation and flow of glaciers. Erosion and deposition by glaciers and glacial meltwater. Subglacial processes. Distribution and age of Quaternary glacial deposits. Quaternary dating techniques and periglacial processes. A three day required field trip, recitations, readings from the primary literature and student presentations augment instructor lectures.
Prerequisites: EES 131 and EES 115
Attribute/Distribution: NS
EES 371 Methods in Water Quality Analysis 3-4 Credits
Survey of methods used in water quality analysis. The course will include: (1) theory and application of standard techniques and instrumentation, (2) quantitative analysis or modeling of existing or acquired data sets, and (3) data presentation and scientific report writing. Fulfills both lecture and laboratory requirements. Includes both lectures and laboratories.
Prerequisites: CHM 025
Attribute/Distribution: NS

EES 372 Topics in Earth & Environmental Science 1-4 Credits
Study of topics in earth and environmental science not covered in other 300-level courses. Primarily used for transfer credit. Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: NS

EES 376 Geochemistry of Natural Waters 3-4 Credits
Introduction to aqueous geochemistry. Applications of thermodynamics, mass balance, systems science, and kinetics to understanding mineral-water interactions in natural aquatic systems on a variety of spatial and temporal scales. Laboratories emphasize analytical and computer methods. Lectures, discussion, student presentations, and recitation/laboratory.
Prerequisites: EES 080 and EES 115
Can be taken Concurrently: EES 080
Attribute/Distribution: NS

EES 379 (CEE 379) Environmental Case Studies 3-4 Credits
Case studies will be used to explore the impact of politics, economics, society, technology, and ethics on environmental projects and preferences. Environmental issues in both affluent and developing countries. Multidisciplinary student teams investigate site characterization; environmental remediation design; environmental policy; and political, financial, social, and ethical implications of environmental projects.
Prerequisites: (EES 022 or CEE 276 or CHE 276)
Attribute/Distribution: NS

EES 380 The Practice of Science 1 Credit
The knowledge, skills, and discipline of mind developed in the Earth and Environmental Sciences major present students with a number of opportunities and career paths. This senior seminar provides students with the opportunity to synthesize their knowledge and expertise in EES in the context of the broader field and the opportunities and challenges facing society. The seminar also helps students explore a variety of career paths (industry, business, education, government, non-profits, etc.) and further develops professional skills. Students will build a portfolio of previous work and prepare a reflective narrative integrating their educational experiences into a greater whole. The seminar explores strategies for applying to graduate school or for a job, professional ethics and responsibility, and the methods and process of effective communication. Must have senior standing and EES major.
Prerequisites: EES 200
Attribute/Distribution: NS

EES 386 Wetland Ecology 3,4 Credits
Ecology of wetlands and factors controlling wetland structure and function. Responses and feedbacks of wetlands to natural and human-induced environmental variability. Topics include wetland classification and delineation, origin and development of wetlands, biotic adaptations to the wetland environment, wetland hydrology, wetland biogeochemistry and microbial communities, wetland vegetation dynamics, and wetland restoration. Lectures, laboratories, applied activities, and field trips.
Prerequisites: EES 152
Attribute/Distribution: NS

EES 393 Supervised Research in Earth and Environmental Sciences 1-4 Credits
Research opportunities supervised by EES faculty to carry out a well-defined project, including exposure to problem definition, selection of research approach, and communication of results. The student should prepare a proposal and, if taking 3 or more credits, should present the results at Undergraduate Research Symposium and write a research thesis. Both proposal and thesis are filed with EES Department. No more than eight credits may be applied to EES B.A. and B.S. degrees (additional credits apply to free electives). Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: NS

EES 402 (ES 402) Scientific Foundations for Environmental Policy Design 3 Credits
This course explores the science behind the environmental issues that bear on policy process at local, national and global scales. The course delves into the science of selected environmental issues that have either arisen from anthropogenic activities, that impact social systems, or that help policy-makers understand the consequence of different policy options. The course consists of readings and discussions of timely topics and one major project.
Attribute/Distribution: NS

EES 403 Earth System Modeling 3 Credits
The concepts behind computer modeling, including stocks and fluxes, finite differencing, initial boundary conditions, feedbacks calibration, validation, data visualization, Monte Carlo, and sensitivity. We will apply these ideas to radiative energy balance, atmospheric and ocean dynamics, hydrological cycling, terrestrial carbon and nitrogen dynamics, and vegetation biogeography. Students will learn both agent-based and systems dynamics modeling using NetLogo and Stella, simple box modeling in Excel, and research-oriented models such as the NCAR Community Climate System Model using C++, Fortran and IDL.

EES 405 Paleo- and Environmental Magnetism 3 Credits
Topics in paleomagnetism and environmental magnetism. Class will design and conduct a research project, read the relevant literature and write a research paper. Consent of instructor required.

EES 407 Seismology 3 Credits
Seminar on advanced topics in seismology, review of classic and current literature. Topics include but are not limited to: wave propagation in ideal media and earth materials, seismic imaging of complex structures, tomography, modeling, and high-resolution seismic imaging. Must have completed an introductory geophysics course.

EES 411 Physical and Chemical Processes at the Earth’s Surface 3 Credits
An advanced treatment of physical and chemical processes and their interaction in the critical zone. Quantitative methods, modeling, and process-oriented approaches are presented in a systems context from the meter, to watershed, to continental scale. Topics include weathering and soils, chemical and physical fluxes from watersheds, and global hydrology and erosion.

EES 412 Advanced Fluvial and Tectonic Geomorphology 3 Credits
Lecture, seminar, lab, and field-based investigation of the classic and contemporary geomorphologic literature using the processes and evolution of a watershed and its dynamic interaction with tectonics as an integrative common theme. Topics change according to student interest but typically include active tectonics, fluvial processes, landscape response to climate, and biogeomorphology. Include ArcGIS training, field trips, flume analogue modeling, and class projects with the goal of a published paper.

EES 414 Glacial and Quaternary Geology 3 Credits
Study of the origin, distribution, and movement of present and past glaciers. Special emphasis on glacial land forms and deposits, Quaternary stratigraphy and dating techniques, periglacial phenomena, and Pleistocene environments. Lectures and required field trips. Consent of instructor required.
EES 415 Paleoclimatology 3 Credits
Overview of climate system, including energy budget, feedbacks, atmospheric and ocean circulations, and their interactions. Earth’s climate history and mechanisms of past climate variations at various time scales, with emphasis on late Quaternary. Lectures, presentations and discussion of recent literature, especially on approaches to studying climate change and palaeo-perspectives on ongoing climate change. Must have graduate standing in EES, or consent of course instructor. Repeat Status: Course may be repeated.

EES 426 Tectonic Processes 3 Credits
Current models of tectonic processes in intraplate settings and at plate boundaries. Critical evaluations by the class of the geological, geochemical and geophysical data sets which gave rise to these models. Must have graduate standing in EES, or consent of department chairperson.

EES 427 Orogenic Belts 3 Credits
Geometry, kinematics, and mechanics of orogenic belts. Will explore current paradigms of deposition, deformation, and metamorphic processes in the Earth’s crust. Lectures, seminars, and field trips. Topically variable Consent of instructor required. Repeat Status: Course may be repeated.

EES 429 Methods and Applications of Geochronology 3 Credits
Examination of isotopic techniques used to measure geologic time, and their applications. Lectures, laboratories, research projects, field trips. Must have graduate standing in EES. Repeat Status: Course may be repeated.

EES 438 Petrogenetic Processes 3 Credits
Metamorphism, melting, and magmatism in the Earth’s crust and mantle. Tectonic evolution, crust-mantle heat and mass transfer, fluid-rock interactions, and rate processes. Varying combinations of lecture and seminar formats. May be repeated for credit when topics differ. May include laboratory and field experience and computational exercises. Consent of instructor required. Repeat Status: Course may be repeated.

EES 453 Advanced Microbial Ecology 3 Credits
Lectures and seminars will focus on topics of current interest in the microbial ecology of pelagic (freshwater and marine), sediment, and/or soil environments. Emphasis will be placed on the role of microbes in ecosystems level processes such as energy transformations and elemental cycling. May include laboratory and field exercises. Must have graduate standing or consent of course instructor.

EES 457 Advanced Remote Sensing of the Environment 3 Credits
Seminars and hands-on, quantitative analysis of specialized satellite and aircraft data, including microwave and hyperspectral sources, will be used to investigate significant environmental questions. Students will refine visual and technical skills for image interpretation, digital image processing, change detection of environmental systems, and presentation of spatial data. Required research project. Must have graduate standing in EES or consent of the instructor.

EES 459 Reconstructing Environmental Change 3 Credits
Lectures, seminars, and in-depth discussion on current issues and selected topics in Quaternary paleoecology and paleoclimatology. Survey of techniques in studying and reconstructing environmental changes and biological responses. Use of multiple proxy data from paleo-archives (e.g., ice cores, lake sediments) to address nature of past climate variability. Quantitative analyses of paleo-records to test paleoecological hypothesis (e.g., multivariate analysis) and to infer possible causes and forcing mechanisms of past climate change (e.g., time series analysis). May include field and laboratory exercises.

EES 471 Stable Isotope Chemistry - Theory, Techniques, and Applications in Earth and Environmental Sciences 3 Credits
Distributions of stable isotopes (primarily of O, H, C, S, and N) in the lithosphere, hydrosphere, biosphere, and atmosphere. Topics include mechanisms of fractionation and mixing, advancements in techniques for extractions and mass spectrometry, and recent applications of stable isotopes in the earth and environmental sciences. Lectures, seminars, laboratory sessions. Consent of instructor required.

EES 473 Aqueous Geochemistry 3 Credits
Advanced study of the equilibria and kinetics of chemical reactions occurring at the earth’s surface. A review of concepts in geochemistry including activity, solubility, thermodynamics, kinetics, and oxidation-reduction reactions is followed by readings from the literature. Topics covered depend on student interest, and have included chemical weathering, chemical evolution of surface and groundwater, acid mine drainage, trace element chemistry, biogeochemical cycles, and ocean chemistry. Must have graduate standing in EES or consent of instructor. Repeat Status: Course may be repeated.

EES 476 Environmental Engineering Microbiology 3 Credits
Fundamentals of microbiology and biochemistry applied to environmental systems and water quality control. Systems ecology, energetics and kinetics of microbial growth, nutrition and toxicology, use of microorganisms for pollution monitoring and control. Pathogenicity and disease transmission, water quality using biological indices. Prerequisites: CEE 375 or CHE 375

EES 484 Ecosystem Processes 3 Credits
Theoretical and experimental approaches to investigate ecosystem processes at local, regional, and global scales. Emphasis on interactions among physical, chemical, and biotic components of ecosystems. Must have graduate standing in EES.

EES 485 Advanced Topics in Geophysics 1-6 Credits
Intensive study of topics in geophysics not covered in more general courses. Repeat Status: Course may be repeated.

EES 487 Bio-Optics 3 Credits
Bio-optics includes the ecosystem role and fate of solar radiation and the optical properties of biotic and abiotic components of ecosystems. This course will explore advanced topics through selected readings, data analysis, and modeling. Topics will emphasize aquatic ecosystems and may include optical models, atmospheric factors, inherent and apparent optical properties, algal fluorescence, photodamage, and photodamage, ultraviolet radiation, and optical stratification. Repeat Status: Course may be repeated.

EES 490 Thesis Research 1-6 Credits
Masters’ thesis research directed by research committee. 3-6 credits required for EES M.S. programs. Consent of research advisor required. Repeat Status: Course may be repeated.

EES 491 Investigations in Earth and Environmental Sciences 1-3 Credits
Research on a special problem; field, laboratory, or library study; report required. Credit above three hours granted only when a different problem is undertaken.

EES 492 Advanced Topics in Modern and Quaternary Processes 3 Credits
Intensive study of topics in modern and Quaternary geology not covered in more general courses. Repeat Status: Course may be repeated.

EES 493 Advanced Topics in Tectonics 1-6 Credits
Intensive study of topics in tectonics processes and products not covered in more general courses. Repeat Status: Course may be repeated.

EES 494 Advanced Topics in Ecosystem Ecology 1-6 Credits
Intensive study of ecosystem processes not covered in more general courses. Repeat Status: Course may be repeated.

EES 496 Advanced Topics in Geochemistry 1-4 Credits
Intensive study of geochemical processes not covered in more general courses. Repeat Status: Course may be repeated.

EES 497 Advanced Topics in Paleoenvironment and Paleoclimatology 3 Credits
Intensive study of paleoecology and paleoclimatology not covered in more general courses. Repeat Status: Course may be repeated.
EES 499 Dissertation Research 1-15 Credits
Ph.D. dissertation research directed by research committee. Consent of research advisor required.
Repeat Status: Course may be repeated.

Eckardt Scholars Program

Program Director: Heather Johnson, Ph. D. (Northeastern)
Email: hbj2@lehigh.edu # Phone: 610-758-3816
Website: https://cas.cas2.lehigh.edu/content/eckardt-scholars-program
Supported by the Office of Interdisciplinary Programs 610-758-3996; incasip@lehigh.edu
Williams Hall, 31 Williams Drive

The Eckardt Scholars Program is a highly selective and unique honors program in the College of Arts and Sciences. The program emphasizes deep intellectual curiosity, independent work, and close mentoring relationships between the very highest achieving students and faculty at Lehigh. Students in the program are exempt from the Arts & Sciences distribution requirements and work with their major advisor and the Eckardt Scholars Program Director to create a flexible course of study that best suits their academic interests and ambitions. Although exempt from Arts and Sciences distribution requirements, students will complete the requisite number of credits for their degrees and all correlative requirements for their departmental or interdisciplinary majors. The program includes participation in two Eckardt Scholar Seminars, and completion of a large independent project (in the form of a thesis, artistic creation, or other capstone experience) during the senior year.

For program requirements, see Eckardt Scholars Program (p. 53).

Courses
ECK 081 Eckardt Scholars Seminar 4 Credits
Seminar for first-year Eckardt Scholars offered during the Fall semester. Consent of program director required.

ECK 281 Eckardt Scholars Seminar 4 Credits
Seminar for Eckardt Scholars offered during the Fall semester. Consent of program director required.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

ECK 282 Independent Study 2-4 Credits
Directed readings for Eckardt Scholars. Requires consent of program director.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

ECK 389 Honors Project for Eckardt Scholars 1-8 Credits
Opportunity for Eckardt Scholars to pursue an extended project for senior honors. Transcript will identify department in which project was completed. Consent of department required.
Repeat Status: Course may be repeated.

Economics

Though economics is variously defined, modern-day definitions generally suggest that it is the study of the principles that govern the efficient allocation of resources. One of the greatest of the 19th century economists who did much to uncover these principles suggested a broader definition. Alfred Marshall described economics as "a study of mankind in the ordinary business of life and a part of the study of man." This dual nature of economics, technical and humanistic, is reflected in the fact that at Lehigh the economics major is available to students in the College of Arts and Sciences as well as in the College of Business and Economics.

Professors: Shin-Yi Chou, PhD (Duke University); James A. Dearden, PhD (The Pennsylvania State University); Mary E. Deily, PhD (Harvard University); Frank R. Gunter, PhD (Johns Hopkins University); Thomas J. Hyclak, PhD (University of Notre Dame); Judith A. McDonald, PhD (Princeton University); Vincent G. Munley, PhD (State University of NY, Binghamton University); Larry W Taylor, PhD (University of North Carolina Chapel Hill); Robert J. Thornton, PhD (University of Illinois Upper Chicago); Todd A. Watkins, PhD (Harvard University)

Associate Professors: Chad Meyerhoefer, PhD (Cornell University); Oleksandr Nikolaev Rzhevskyy, PhD (University of Houston University Park); Muzhe Yang, PhD (University of California Berkeley)

Assistant Professors: Weijia Dai, PhD (University of Maryland); Ernest Kong-Wah Lai, PhD (University of Pittsburgh); Alberto Lamadrid, PhD (Cornell University); Irina Panovska, PhD (Washington University); Seth Richards-Shubik, PhD (University of Pennsylvania)

Professor Of Practice: Marija Baltrusaitiene, MA (University of Iowa)
Emeriti: J. Richard Aronson, PhD (Clark University); Nicholas W. Balabkins, PhD (Rutgers University); Jon T. Innes, PhD (University of Oregon); Arthur E. King, PhD (Ohio State University); John R. McNamara, PhD (Rensselaer Polytechnic Institute); Anthony Patrick O'Brien, PhD (University of California Berkeley); Warren A. Pillsbury, PhD (University of Virginia)

COLLEGE OF BUSINESS AND ECONOMICS

Major in Economics

Students in the College of Business and Economics electing to major in economics must take the college core courses listed in the College of Business and Economics section of this catalog. They must also take ECO 119 and at least 12 credit hours of 200- and 300-level economics courses beyond the core requirements. These courses may be chosen so as to form an area of specialization or to provide a broad exposure to the various aspects of the discipline. In any case, students should consult with the major advisor in forming their programs.

Major in Business Economics

The business economics major prepares students for careers as business consultants or analysts by teaching the application of microeconomic theory to the analysis of critical business issues. The emphasis is on rigorous, quantitative business analysis through the use of theoretical and mathematical models and econometric analysis of data. Students electing the major in business economics must take the college core courses, ECO 245, ECO 322, ECO 333, two elective courses from an approved list, and a course involving student research on a problem identified by an external client. Students should consult with the major advisor in forming their program.

Minor in International Economics

The minor in International Economics aims to prepare non-economics majors in the CBE, as a complement to their major programs, with a fundamental understanding of international trade, finance and economic development, and to develop skills in applying economic analysis to international economic issues and social problems. This minor is open to any CBE undergraduate student not majoring in economics or business economics.

International Economics Minor Requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ECO 119</td>
<td>Intermediate Macroeconomic Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ECO 339</td>
<td>International Trade</td>
<td>3</td>
</tr>
<tr>
<td>or ECO 340</td>
<td>International Finance</td>
<td>6</td>
</tr>
</tbody>
</table>

Select two of the following (at least one at the 300 level):

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECO 203</td>
<td>Microfinance: Financial Inclusion for the Poor</td>
<td>3</td>
</tr>
<tr>
<td>ECO 209</td>
<td>Comparative Economic Systems</td>
<td>3</td>
</tr>
<tr>
<td>ECO 303</td>
<td>Economic Development</td>
<td>3</td>
</tr>
<tr>
<td>ECO 339</td>
<td>International Trade</td>
<td>3</td>
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<tr>
<td>ECO 340</td>
<td>International Finance</td>
<td>3</td>
</tr>
<tr>
<td>ECO 345</td>
<td>Political-Economy of Iraq</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Credits: 12

Minor in Public Policy Economics

The minor in Public Policy Economics aims to prepare non-economics majors in the CBE, as a complement to their major programs, with a fundamental understanding of the main economic policy issues and the role of government in markets, and to develop skills in applying economic analysis to the development of public policies and potential solutions to social problems. This minor is open to any CBE undergraduate student not majoring in economics or business economics.
### PUBLIC POLICY MINOR REQUIREMENTS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>ECO 119</td>
<td>Intermediate Macroeconomic Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ECO 353</td>
<td>Public Finance: Federal</td>
<td>3</td>
</tr>
</tbody>
</table>

Select two of the following: 6

- ECO 235 Labor Economics
- ECO 311 Environmental Economics
- ECO 336 Business and Government
- ECO 354 Public Finance: State and Local
- ECO 365 Business, Government, and Macroeconomic Policy
- ECO 368 Health Economics

Or approval by Minor Advisor

**Total Credits**: 12

### COLLEGE OF ARTS AND SCIENCES

#### Major in Economics

The B.A. major in economics is designed to prepare students for graduate study in economics or law, and for entry into careers in business, government or service organizations. The requirements for the economics major are:

**Economic Core**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECO 001</td>
<td>Principles of Economics</td>
<td>4</td>
</tr>
<tr>
<td>ECO 119</td>
<td>Intermediate Macroeconomic Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ECO 029</td>
<td>Money, Banking, and Financial Markets</td>
<td>3</td>
</tr>
<tr>
<td>ECO 045</td>
<td>Statistical Methods</td>
<td>3</td>
</tr>
<tr>
<td>ECO 146</td>
<td>Applied Microeconomic Analysis</td>
<td>3</td>
</tr>
</tbody>
</table>

**Collateral Calculus Courses**

Select one of the following: 7-8

- MATH 021 & MATH 022 Calculus I and Calculus II
- MATH 081 & MATH 022 Calculus with Business Applications and Calculus II
- MATH 081 & MATH 052 Calculus with Business Applications and Survey of Calculus II
- MATH 051 & MATH 052 Survey of Calculus I and Survey of Calculus II

**Electives**

Select five courses in economics at the 200- or 300-level. 15

**CBE’s Excel competency exam**

**Total Credits**: 38-39

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Interested students are encouraged to consult with the major advisors in the economics department to select elective courses that match their needs and interests.

#### MAJOR IN INTERNATIONAL RELATIONS AND ECONOMICS

IR-Eco Major (p. 289) (60-61 credits)

**Honors in Economics**

Economics majors who wish to be considered for departmental honors must consult with their major advisor and request such consideration by the beginning of their senior year. The criteria for departmental honors are:

1. Completion of the major program with at least 33 credits of economics and a grade point average in those courses of 3.5 or better.
2. Submission of an acceptable research paper to the Departmental Honors committee. This paper must report on original research conducted by the student. An economics faculty member will direct the honors paper. Students who successfully complete the paper will receive independent study credit, which can be applied to economics major requirements. The committee will notify students of submission deadlines and other requirements for satisfying this criterion.

**Minor in Economics**

This minor is available only to students in the College of Arts and Sciences and in the College of Engineering and Applied Science. Interested students should contact the minor advisor.

A minor in economics consists of 12 credit hours beyond ECO 001. Required courses in the minor are:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECO 105</td>
<td>Intermediate Microeconomic Analysis</td>
<td>3</td>
</tr>
<tr>
<td>or ECO 146</td>
<td>Applied Microeconomic Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ECO 119</td>
<td>Intermediate Macroeconomic Analysis</td>
<td>3</td>
</tr>
<tr>
<td>or ECO 029</td>
<td>Money, Banking, and Financial Markets</td>
<td>3</td>
</tr>
</tbody>
</table>

Two elective courses

**Courses**

**ECO 001 Principles of Economics 4 Credits**

A one-semester course in the principles of economics. General topics covered are: supply and demand; pricing and production decisions of firms; the role of government in the economy; the determination of national income; money and banking; monetary and fiscal policy; and government finance.

**Attribute/Distribution**: SS

**ECO 029 Money, Banking, and Financial Markets 3 Credits**

The nature and functions of money. Global money and financial markets. The role of commercial and central banks. Effects of the interest rate, exchange rate, and the money supply on the economy. Examination and evaluation of current and past monetary policies.

**Prerequisites**: ECO 001

**Attribute/Distribution**: SS

**ECO 045 Statistical Methods 3 Credits**

Descriptive statistics, probability and probability distributions, sampling, estimation, hypothesis testing, chi-square tests, simple regression and correlation. Note: CBE students may not take MATH 012 as a replacement for ECO 045.

**Prerequisites**: Must have Excel competency

**ECO 105 Intermediate Microeconomic Analysis 3 Credits**

Determination of prices in terms of the equilibrium of the business enterprise and consumer choice in markets of varying degrees of competition; analysis of market structures; determination of wages, rent, interest and profits. Not available for credit to students who have taken ECO 146.

**Prerequisites**: ECO 001 and (MATH 021 or MATH 051 or MATH 081 or MATH 076)

**Attribute/Distribution**: SS
ECO 119 Intermediate Macroeconomic Analysis 3 Credits
Macroeconomic measurement, theory and policy. The use of alternative macroeconomic models to analyze the level of national income, inflation, unemployment, economic growth; the balance of payments, and exchange rate determination.
Prerequisites: ECO 001
Attribute/Distribution: SS

ECO 146 Applied Microeconomic Analysis 3 Credits
The application of economic analysis to managerial and public policy decision-making. Not available for credit to students who have taken ECO 105. Note: MATH 012 does not serve as a pre-requisite for ECO 146.
Prerequisites: (ECO 145 or ECO 045 or PSYC 110 or ISE 111 or IE 111 or CEE 012 or MATH 231) and (ECO 001) and (MATH 021 or MATH 031 or MATH 051 or MATH 076 or MATH 097 or MATH 081)
Attribute/Distribution: SS

ECO 201 Federal Reserve Challenge Competition 1-3 Credits
To prepare for the Federal Reserve Challenge Competition. Course may be repeated for credit. Credits are assigned based on role - 1 credit for 1st time researchers, 2 credits for 2nd time researchers, and 3 credits for speakers. Up to three credits of the course can be counted toward the economics major, but the course cannot count toward the economics minor. Department permission is required for enrollment.
Repeat Status: Course may be repeated.
Prerequisites: ECO 119
Can be taken Concurrently: ECO 119

ECO 203 Microfinance: Financial Inclusion for the Poor 3 Credits
Non-technical survey of the global microfinance industry, which provides financial services to the poor on a large scale, mostly in developing nations. Historical origins and industry evolution. Nature and developmental role of microenterprises and informal finance. Methods and technologies used by microfinance institutions (MFIs). Case studies of leading MFIs and the lives of their clients. Policy and regulatory environments. Debates over profiting from the poor, and over health and environmental goals. Conflicting evidence on economic and social impact. Meetings with practitioners.
Prerequisites: ECO 001
Attribute/Distribution: SS

ECO 209 Comparative Economic Systems 3 Credits
An analysis of the micro- and macro-economic, institution and political dimensions of various economic systems, with particular emphasis on former centrally planned economies in their transition to a market orientation.
Prerequisites: ECO 001 or ECO 011 or ECO 012
Attribute/Distribution: SS

ECO 211 Introduction to Environmental Economics 3 Credits
An examination of the interactions between our economic systems and the environment. Pollution as a consequence of human activity within a framework for analyzing the relationships between environmental quality, scarcity of resources and economic growth. How to develop appropriate policies to deal with these issues.
Attribute/Distribution: SS

ECO 235 Labor Economics 3 Credits
The economic analysis of labor markets, with emphasis on labor supply and demand, wage and employment theory, and the economics of unionism and other labor market institutions.
Prerequisites: ECO 001 or (ECO 011 and ECO 012) or (ECO 011 and ECO 022) or (ECO 012 and ECO 021)
Attribute/Distribution: SS

ECO 245 Statistical Methods II 3 Credits
This course is a continuation of Economics 045, and gives broader coverage of linear regression and the construction of empirical models. Topics include the analysis of variance, simple and multiple regression, index numbers, forecasting, nonparametric methods, and statistical methods for quality control.
Prerequisites: MATH 012 or MATH 231 or ECO 145 or ECO 045
Attribute/Distribution: ND

ECO 246 Business Cycles and Forecasting 3 Credits
A study of short-term business fluctuations, growth, forecasting and stabilization.
Prerequisites: (ECO 001 or ECO 011 or ECO 012) and (ECO 145 or MATH 012 or ECO 045 or MATH 231 or SR 111 or PSYC 110) and (ECO 145 or MATH 012 or MATH 231 or ISE 111 or IE 111 or SR 111)
Attribute/Distribution: ND

ECO 247 Sabermetrics 3 Credits
The class will discuss the development and theory of quantitative analysis in baseball. Students will be introduced to modern sabermetric theory and introduced to various datasets, publications, database skills, and research methods commonly used in the sabermetric industry. Topics will include hitting, pitching, and defensive analysis, player valuation and the free agent market, in-game strategy, and the amateur draft.
Prerequisites: ECO 001 and (ECO 045 or PSYC 110 or ISE 111 or CEE 012 or MATH 231 or MATH 012)
Attribute/Distribution: SS

ECO 259 Athletic Complex Design 3 Credits
This course is for students to participate in cross discipline Integrated Learning Experience (ILE) research projects. The twin purposes of the course are to provide real-world, team-oriented learning experiences and to apply economic analysis in evaluating the costs and benefits of newly proposed, or renovations and expansions of, existing athletic facilities.
Prerequisites: ECO 105 or ECO 146

ECO 273 Community Consulting Practicum 3 Credits
ECO 274 Supervised Research 1-3 Credits
An apprenticeship in ongoing faculty research program. Literature review, experimental design, data collection and analysis, and professional writing under faculty supervision. Consent of faculty sponsor required. Up to three research credits can be used toward the CAS and CBE economics majors, and three credits may be used to satisfy the consulting project requirement of the business economics major. Supervised research credits may not be applied to the economics minor.
Repeat Status: Course may be repeated.
Prerequisites: ECO 119 or ECO 146 or ECO 245
Attribute/Distribution: SS

ECO 300 Apprentice Teaching 1-3 Credits
An opportunity to become proficient in the powerful statistical package, Stata, which which has been widely and heavily used by economic consulting firms and economists from academia and the private and public sectors. Students will learn how to utilize Stata to bridge the gap between source data and final analysis. Working with World Bank data will provide hands-on, practical experience. Upon completion of this course students will be able to manage data to boost their research and analysis skills.
Prerequisites: ECO 105 or ECO 115 or ECO 146
Attribute/Distribution: SS

ECO 301 Econometric Software 1 Credit
A continuation of Economics 045, and gives broader coverage of linear regression and the construction of empirical models. Topics include the analysis of variance, simple and multiple regression, index numbers, forecasting, nonparametric methods, and statistical methods for quality control.
Prerequisites: MATH 012 or MATH 231 or ECO 145 or ECO 045
Attribute/Distribution: ND

ECO 303 Economic Development 3 Credits
Economic development, economic growth and their political environment are discussed in detail. The principal economic development theories are examined. These theories are used to examine a variety of development issues including planning, poverty, rural-urban relationships, physical and human capital accumulation, international trade, and the environment. Emphasis on institutions and development policy.
Prerequisites: ECO 105 or ECO 115 or ECO 146
Attribute/Distribution: SS
ECO 311 Environmental Economics 3 Credits
Resource allocation implications of environmental degradation. Analysis of the benefits and costs associated with alternative pollution control programs and strategies.
Prerequisites: ECO 105 or ECO 115 or ECO 146
Attribute/Distribution: SS

ECO 314 Energy Economics 3 Credits
The economic theory of natural resource allocation over time. Economics of exhaustible and renewable resources. Environmental effects of energy production and consumption. Government regulation of the energy industry. Computer models for energy system forecasting and planning.
Prerequisites: ECO 105 or ECO 146
Attribute/Distribution: SS

ECO 315 Industrial Organization 3 Credits
Structure of American industry. Development of economic models to describe behavior in markets with varying degrees of competition. Technological innovation, relationship between industry concentration and rates of return on capital, role of information and advertising, dynamics of monopoly and oligopoly pricing.
Prerequisites: ECO 105 or ECO 146
Attribute/Distribution: SS

ECO 322 Competitor and Market Analysis 3 Credits
Competitors, partners, and firms and governments strategically interact. This course uses game theory to analyze issues like pricing by competitors, vertical integration and contracting issues in supplier-buyer relationships, collective actions and joint ventures, and research and development programs. Students use both mathematical models and cases to analyze these interactions.
Prerequisites: (ECO 105 or ECO 115 or ECO 146) and (ECO 145 or ECO 045 or MATH 021 or MATH 231 or ISE 111 or IE 111 or SR 111) and (MATH 021 or MATH 031 or MATH 051 or MATH 081 or MATH 076)
Attribute/Distribution: SS

ECO 323 Evolution of Business Strategy 3 Credits
Analyses how business firms have adapted to changes in technology, relative factor prices, globalization, and the extent of government intervention in the market. Material will be presented through discussion of case studies from the nineteenth and twentieth centuries.
Prerequisites: (ECO 001)
Attribute/Distribution: SS

ECO 324 The Economics of the Sports Industry 3 Credits
This course analyzes the role of basic economic forces in shaping today’s sports industry. Topics include: competition in the market for professional franchises; public subsidies for stadiums and arenas; compensation of professional athletes; the NCAA as an economic enterprise; and the impact of athletics on a university’s budget.
Prerequisites: ECO 105 or ECO 146
Attribute/Distribution: SS

ECO 325 (MKT 325) Consumer Insights through Data Analysis 3 Credits
Explores marketing analytic approaches aimed to improve the understanding of customer and customer perceptions thereby enhancing the effectiveness of marketing decision making and implementation. Foundational data analysis techniques are examined in such areas as advertising, customer acquisition and retention (customer relationship management), segmentation, customer loyalty, lifetime-value analysis of the customer, pricing, sales force management, sales promotions and new products. The development, implementation, and utilization of quantitative models on customer data are emphasized. Prerequisites as noted below.
Prerequisites: MKT 111 and ECO 146
Attribute/Distribution: ND

ECO 327 Real Options and Investment Strategy 3 Credits
This is an introductory course in financial economics. It focuses on the principles underlying financial decision-making, with applications to stocks, bonds, and real estate. It is intended for students with strong technical backgrounds who are comfortable with mathematical arguments. The course is divided into three main parts: deterministic finance, single-period uncertainty finance, and options theory.
Prerequisites: FIN 323
Attribute/Distribution: ND

ECO 328 (ECE 328) Electricity Systems 3 Credits
The course is intended primarily for students who are interested in a exploration of the electricity market. Its operation and the main considerations to implement it, in the wake of a smart grid implementation, with basic college-level calculus.
Repeat Status: Course may be repeated.
Prerequisites: ECO 001 and (MATH 023 or ECO 146)
Attribute/Distribution: ND

ECO 332 Monetary-Fiscal Policy 3 Credits
Monetary, credit and fiscal policies of governments and central banks with particular reference to the policies of the United States Treasury and the Federal Reserve System.
Prerequisites: ECO 119 or ECO 129 or ECO 029
Attribute/Distribution: SS

ECO 333 The Economics of Business Decisions 3 Credits
Students analyze business problems using economic logic and techniques like mathematical programming, marginal analysis, and decision making under risk and uncertainty. New topics like asymmetric information and the analysis of organizations are introduced. Case studies are emphasized.
Prerequisites: (ECO 105 or ECO 115 or ECO 146) and (ECO 145 or ECO 045 or MATH 021 or MATH 231 or ISE 111 or IE 111 or SR 111) and (MATH 021 or MATH 031 or MATH 051 or MATH 081 or MATH 076) and ECO 245
Attribute/Distribution: SS

ECO 336 Business and Government 3 Credits
Analysis of government involvement in the private sector. The problems of monopoly, oligopoly, and externalities in production and consumption. Optimum responses to market failure and analysis of the performance of actual government policies.
Prerequisites: ECO 105 or ECO 146
Attribute/Distribution: SS

ECO 339 International Trade 3 Credits
The theory of international trade; the theory of tariffs; United States commercial policies; the impact of growth and development of the world economy.
Prerequisites: ECO 105 or ECO 146
Attribute/Distribution: SS

ECO 340 International Finance 3 Credits
The monetary side of an open economy and the financial transactions that accompany trade in goods and services. Macroeconomic links among participants in the global economy; currency and financial crises illustrate how difficult it is for countries to remain insulated from external shocks. Topics include: balance-of-payments accounting; exchange-rate models; and macroeconomic policies under different exchange-rate regimes and capital-mobility assumptions.
Prerequisites: ECO 119
Attribute/Distribution: SS

ECO 342 Economic Development in China 3 Credits
An examination of the economic, political and social forces at work in the development process in China since 1949. Special emphasis on post-1978 market reforms, the rural-urban divergence, the role of foreign trade and investment, the accumulation of human capital, and the deterioration of the physical environment. Concludes with a detailed discussion of possible futures of the Chinese economy.
Prerequisites: ECO 303
Attribute/Distribution: SS
ECO 343 European Economic Integration 3 Credits
Study of the problems of economic integration throughout Europe, especially in the Post-Cold War era among Western, Central and Eastern European nations.
Prerequisites: ECO 209
Attribute/Distribution: SS

ECO 345 Political-Economy of Iraq 3 Credits
An examination of the economic, political and social forces at work in Iraq with emphasis on the post-2002 period. Major topics include petroleum production and transport, corruption, education and other forms of human capital accumulation in an Islamic state, the agricultural transition, the rural-urban divergence, the economic impact of the ongoing conflict, unemployment and underemployment, poverty and population, the economic and political role of the state owned enterprises, entrepreneurship and the informal economy, traditional banking and micro-finance, and the inconsistencies between current political and economic development policies. concludes with a discussion of the possible futures for the Iraqi economy.
Prerequisites: ECO 303 or (ECO 105 and ECO 119)

ECO 346 Numerical Methods for Business Decisions 3 Credits
This course provides a connection between textbook economics/finance and the problems of real world business. It emphasizes practical numerical methods rather than mathematical proofs. Problems in finance are emphasized. The course teaches students how to use EXCEL macros and advanced VBA (the industry standard) programming techniques to model and manipulate financial data.
Prerequisites: FIN 323
Attribute/Distribution: ND

ECO 353 Public Finance: Federal 3 Credits
A course dealing with the expenditures and revenues of the federal government. Major topics include public choice theory, benefit-cost analysis, the theory of public goods, the economics of taxation, and the design of tax structures.
Prerequisites: ECO 105 or ECO 115 or ECO 146
Attribute/Distribution: SS

ECO 354 Public Finance: State and Local 3 Credits
A course dealing with the expenditures and revenues of state and local governments. Major topics include the theory of fiscal federalism, intergovernmental fiscal transfers, the design of state and local tax structures, capital budgeting and debt finance, pension funds, and school finance.
Prerequisites: ECO 105 or ECO 115 or ECO 146
Attribute/Distribution: SS

ECO 357 Econometrics 3 Credits
Problems in construction, evaluation and use of econometric models. Applications based on research and case studies.
Prerequisites: (ECO 105 or ECO 115 or ECO 146 or MATH 012 or MATH 231 or ISE 111 or IE 111 or SR 111) and (ECO 245)
Attribute/Distribution: ND

ECO 358 (ISE 358) Game Theory 3 Credits
A mathematical analysis of how people interact in strategic situations. Applications include strategic pricing, negotiations, voting, contracts and economic incentives, and environmental issues.
Prerequisites: (ECO 105 or ECO 115 or ECO 146) and (MATH 021 or MATH 031 or MATH 051 or MATH 081 or MATH 076)
Attribute/Distribution: SS

ECO 362 Martindale Research Seminar 1-3 Credits
This course prepares students to undertake research on various topics in business and/or economics. Admission to this course is limited to student associates of the Martindale Center for the Study of Private Enterprise. Consent of the instructor is required. This course does not count towards an Economics major or minor.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

ECO 365 Business, Government, and Macroeconomic Policy 3 Credits
This course analyzes particular domestic and foreign macroeconomic policy episodes. Through the case study method, the provides both an historical and an international context for understanding current macroeconomic policy issues.
Prerequisites: ECO 023 or ECO 119
Attribute/Distribution: SS

ECO 367 Applied Microeconometrics 3 Credits
An empirical class with concentration in Applied Microeconometrics. Its goal is to give you knowledge (various econometrics methods) and a tool (Stata) to solve real-life problems.
Prerequisites: ECO 245 or ECO 357

ECO 368 Health Economics 3 Credits
Supply and demand in the health service markets for the U.S. and Canada. Unique features of health care which interfere with competitive market allocation and pricing. Overview of insurance systems and other payment methods.
Prerequisites: ECO 145 or ECO 045 or MATH 012 or MATH 231 and (ECO 105 or ECO 146)
Attribute/Distribution: SS

ECO 371 Special Topics in Economics 1-3 Credits
Study in various fields of economics, designed for the student who has a special interest in a subject not included in the regular course schedule or for the student interested in pursuing a significant supervised research project in economics. Students interested in enrolling in this course must submit a written proposal to a member of the faculty with expertise in the proposed subject area and to the department chair prior to the registration period for the relevant semester. This course may count towards the ECO major only once; it does not count towards the ECO minor.
Repeat Status: Course may be repeated.
Prerequisites: (ECO 105 or ECO 146 or ECO 119)
Attribute/Distribution: ND

ECO 389 Honors Project 1-6 Credits
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

ECO 401 Basic Statistics for Business and Economics 3 Credits
Descriptive statistics, probability and probability distributions, estimation, hypothesis testing, correlation and regression, chi-square analysis, and analysis of variance. Computer applications.

ECO 402 Managerial Economics 3 Credits
Prerequisites: MATH 021 and (MATH 022 or MATH 096) and ECO 401

ECO 403 Econometric Software 1 Credit
An opportunity to become proficient in the powerful statistical package, Stata, which has been widely and heavily used by economic consulting firms and economists from academia and the private and public sectors. Students will learn how to utilize Stata to bridge the gap between source data and final analysis. Working with World Bank data will provide hands-on, practical experience. Upon completion of this course students will be able to manage data to boost their research and analysis skills.
Repeat Status: Course may be repeated.

ECO 404 Applied Microeconometrics 3 Credits
The purpose of this course is to expose students to econometric techniques frequently used in applied microeconomic research. The course features critical reading of empirical research papers and the implementation of econometric methods on actual data sets.

ECO 409 Money, Banking and Macroeconomic Analysis 2 Credits
The role of financial intermediation in the U.S. economy, the process of money creation, impacts of fiscal and/or monetary policy on the goals of macroeconomic policy, inflation and unemployment.
ECO 412 Mathematical Economics 3 Credits
Applications of various mathematical techniques in the formation and development of economic concepts and theories. Consent of instructor required.

ECO 413 Advanced Microeconomics Analysis 3 Credits
A survey of methods of decision-making at the microeconomic level; price theory and econometric applications.
Prerequisites: ECO 402

ECO 414 Advanced Topics in Microeconomics 3 Credits
Resource allocation and price determination. Theories of choice of consumers, firms, and resource owners under various market forms.
Prerequisites: ECO 413

ECO 415 Econometrics I 3 Credits
Prerequisites: ECO 401

ECO 416 Econometrics II 3 Credits
Mathematical and statistical specification of economic models. Statistical estimation and tests of parameters in single and multiple equation models. Prediction and tests of structural change.
Prerequisites: ECO 415

ECO 417 Advanced Macroeconomic Analysis 3 Credits
Macroeconomic theory and policy. Emphasis on theoretical models and policy implications.

ECO 418 Advanced Topics in Macroeconomics 3 Credits
Prerequisites: ECO 417

ECO 423 Real Options 3 Credits
This is an introductory graduate level course in financial economics. It is intended for students with strong technical backgrounds who are comfortable with mathematical arguments. The course is divided into three major parts: deterministic finance, single-period uncertainty finance, and options theory and its applications.
Prerequisites: GBUS 420

ECO 425 Cost-Benefit Analysis 3 Credits
Theory and methods of cost-benefit analysis; efficiency and equity as criteria in program evaluation; proper measurement of market and non-market costs and benefits; consideration of risk, uncertainty, appropriate discounting techniques, and distributional consequences; applications to the evaluation of health care policies and therapies.
Prerequisites: ECO 402 and (ECO 357 or ECO 415)

ECO 427 Statistical Analysis for Management 2 Credits
Descriptive statistical measures, probability and probability distributions, statistical inference (estimation and hypothesis testing), correlation and regression. EXCEL will be used for statistical computing.

ECO 429 Monetary Theory 3 Credits
The role of money in the economy from theoretical and empirical perspectives. The influence of money and prices, interest rates, output, and employment.

ECO 430 Public Finance 3 Credits
The economics of public spending and taxation; principles of government debt management; theories of budgeting and cost-benefit analysis and public choice.

ECO 440 Labor Economics I 3 Credits
The economics of labor markets and various labor-market institutions with emphasis on current theoretical and empirical research. Topics include labor supply and demand, human capital, the structure of labor markets, labor market regulation, information and job search, labor mobility, unionism, and labor market discrimination.
Prerequisites: ECO 401 and ECO 402

ECO 441 Labor Economics II 3 Credits
An examination of empirical research in labor economics, focusing on topics such as human resource management and internal labor market outcomes, wage and income inequality and poverty, unemployment, and other issues current in the literature.
Prerequisites: ECO 402 and ECO 415

ECO 447 Economic Analysis of Market Competition 3 Credits
Mathematical models based on game theory and industrial organization. Cases are used to analyze the strategic interaction of firms and governments as competitors and partners.
Prerequisites: ECO 402

ECO 448 Business Economics 3 Credits
Applications of economic analysis to business decision-making; technology in economic systems; resource allocation and pricing strategies in various market structures; decisions under risk and uncertainty; and government regulation and support of business and innovation.

ECO 454 Economics of Environmental Management 3 Credits
Economic theory of natural resources. Optimal policies for the development of renewable and nonrenewable resources and environmental quality.
Prerequisites: ECO 402

ECO 455 Health Economics I 3 Credits
Economic theory and empirical analysis of health production, the demand for health services, and health insurance. Implications for the current institutional structure of health care and health delivery systems will also be discussed. Additional topics and extensions will be selected based on developments in the literature.
Prerequisites: ECO 402 and ECO 415

ECO 456 Industrial Organization 3 Credits
The goal of the course is to review theoretical and empirical attempts by economists to understand market structures lying between the extremes of perfect competition and monopoly. The course will focus first on describing the current U.S. industrial structure and reviewing models of imperfect competition. The course then shifts to a closer study of individual firm behavior. The final segment of the course is an overview of two significant relationships between government and industry caused by the existence of imperfect.
Prerequisites: ECO 415 and ECO 447

ECO 457 Bio-Pharmaceutical Economics 3 Credits
Characteristics of the market for pharmaceuticals; barriers to entry, competition and innovation; pricing and regulation; physician prescribing behavior; commercialization and financing of biotech startups; international comparisons of public policy.
Prerequisites: ECO 401 and ECO 402

ECO 460 Time Series Analysis 3 Credits
Classical decomposition of time series, trend analysis, exponential smoothing, spectral analysis and Box-Jenkins autoregressive and moving average methods.

ECO 461 Forecasting 3 Credits
Methods of economic and business forecasting.

ECO 463 Topics in Game Theory 3 Credits
A mathematical analysis of how people interact in strategic situations. Topics include normal-form and extensive-form representations of games, various types of equilibrium requirements, the existence and characterization of equilibria, and mechanism design. The analysis is applied to micro-economic problems including industrial organization, inter-national trade, and finance. Must have completed two semesters of calculus.
Prerequisites: ECO 412 and ECO 413
ECO 464 Applied Econometrics I 3 Credits
This course focuses on the identification of causal relationships using cross-sectional and panel data. The objectives are to 1) familiarize students with identification assumptions for causal inference; and 2) enable students to select appropriate econometric tools for empirical economic problems and policy evaluation. Topics include robust inference and bootstrap; instrumental variables and generalized method of moments (GMM); quantile and nonparametric regression methods; treatment effect analysis; and models for discrete choices, panel data, and social interactions.
Prerequisites: ECO 416

ECO 465 Applied Econometrics II 3 Credits
Econometric analysis of skewed and truncated distributions, discrete outcomes, and missing or incomplete data. The first part of this course will involve the functional specification and testing of appropriate estimators in these situations, while the second part of the course will focus on conducting causal inference using nonlinear models in the presence of unobserved heterogeneity. Emphasis will be given to common applications in health and labor economics.
Prerequisites: ECO 416

ECO 472 International Trade Theory 3 Credits
Theories of comparative advantage, factor price equalization, trade and welfare, tariffs, trade and factor movements.
Prerequisites: ECO 413

ECO 473 International Monetary Economics 3 Credits
Theory of the balance of payments, the microeconomics of international finance, various approaches to balance-of-payments adjustments, theories of foreign exchange-rate determination, and macroeconomic policy under fixed and flexible exchange rates.
Prerequisites: ECO 417

ECO 490 (ENGL 490) Master’s Thesis 0-6 Credits
Extended study of an approved topic not covered in scheduled courses. Course may be repeated.

ECO 491 Doctoral Pre-Dissertation Research Project - Independent Study 1-9 Credits
Independent study on a topic that is being pursued to fulfill the third year paper requirement, and has been approved by the student's interim advisor.

ECO 498 Dissertation 1-15 Credits
Repeat Status: Course may be repeated.

Educational Leadership
The Educational Leadership program offers a master’s (M.Ed.) and a doctoral degree (Ed.D.), both in Educational Leadership. The program also offers K-12 Principal, Supervisor of Curriculum and Instruction, and Superintendent (Pennsylvania Letter of Eligibility) certification through the state of Pennsylvania.

The Educational Leadership program is approved by the Pennsylvania Department of Education (PDE). Thus, graduates of our approved preparation programs are eligible for state certification.

Our graduates typically assume positions as superintendents, principals, assistant principals, and directors of pupil services, special education, and curriculum and instruction. Some of our graduates are now faculty members in universities where they teach and conduct research. Internationally, our graduates lead schools around the world (for example, in China, Columbia, Italy, and The Middle East).

The Educational Leadership program has a unique blend of both theory and practice, and a long history of excellence and high quality. In addition, through Lehigh’s partnerships and programming, students may have the opportunity to take coursework with peers who work in international schools, bringing a different perspective to their classes. Further, this program has a history of strong commitment to improving educational opportunities for all students. This is evident in the practices of our many graduates who now hold leadership positions in schools and districts in the local area, region, nation and throughout the world.

The International School Leadership Program offers educational opportunities at the master’s and doctoral level to people interested in leadership in the international school community.

The Urban Principals Academy at Lehigh (U*PAL) program is designed to develop urban school leaders who will think and act in ways that disrupt the stagnation and mediocrity that exists in too many of our nation’s schools. This cohort-based program utilizes the underlying themes of creativity and imagination in leadership to address issues of diversity and organizational culture.

The Allentown Principal Leadership Initiative (APLI, pronounced “apply”) focuses on all the current principals and assistant principals, as well as future school administrators, in the Allentown School District (ASD). The program actively recruits exemplary teachers who demonstrate the key attributes for successful turnaround leadership: instructional leadership focused on results, influencing for performance, problem solving, and personal effectiveness. These aspiring leaders participate in a collaboratively designed and individually tailored graduate-level program (at Lehigh University) that includes a full-time yearlong internship in preparation for principal and assistant principal positions in the most at-risk schools in the district. In tandem, current ASD school leaders participate in professional development to promote consistent turnaround leadership practices across the district, and to maintain long-term and sustainable change.

For additional information about the program, please visit: http://coe.lehigh.edu/academics/disciplines/edl

Professor. George P. White, EdD (Vanderbilt University, Peabody College)
Assocate Professors. Floyd D. Beachum, PhD (Bowling Green State University); Jill Sperandio, PhD (University of Chicago)
Assistant Professor. Craig Hochbein, PhD (University of Virginia)
Professor Of Practice. Louise E. Donohue, PhD (Lehigh University)
Emeritus. Perry A. Zirkel, JD (University of Connecticut)

Eligibility
Superintendent of Schools Certification: Pennsylvania Letter of Eligibility
K-12 Principal Certification

***You currently have no program requirements listed in the catalog.***

Master of Education in Educational Leadership
The Masters degree is designed to provide a core foundation of understanding in the areas of leadership, organizational development and change management. Students are required to complete the Core Requirements prior to taking other courses in the program. The student and the academic advisor should design the elective portion of the program jointly. A minimum of 30 credits are required to complete the Masters degree in Educational Leadership.

Core Requirements (15 credits)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>EDL 400</td>
<td>Organizational Leadership and Change</td>
<td>3</td>
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<tr>
<td>Management</td>
<td></td>
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<tr>
<td>EDL 420</td>
<td>Data Based Decision Making</td>
<td>3</td>
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<tr>
<td>EDL 424</td>
<td>Leadership: Self and Groups</td>
<td>3</td>
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<tr>
<td>EDUC 403</td>
<td>Research</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 471</td>
<td>Diversity and Multicultural Perspectives</td>
<td>3</td>
</tr>
<tr>
<td>Leadership &amp; Management Skills (15 credits; must be approved by Advisor)</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

Total Credits

**K-12 Principal Certification**

***You currently have no program requirements listed in the catalog.***

Superintendent of Schools Certification: Pennsylvania Letter of Eligibility

***You currently have no program requirements listed in the catalog.***
Supervisor of Curriculum and Instruction Certification
Program Requirements: All candidates must have an earned Master’s degree in an educationally related area (e.g., Elementary/Secondary Education, Educational Leadership, Curriculum and Instruction, or Teaching, Learning & Technology). In addition, the candidate must have a minimum of four years of elementary and or secondary school teaching experience. Students will be admitted as a cohort group. Each cohort will begin course work during the summer. Prior to receiving endorsement from the College of Education for certification the student must submit passing scores on the PRAXIS Supervision and Administration examination (#0410) and shall have demonstrated a minimum of five years of certificated teaching experience.

**Summer 1 (6 cr.)**
- EDL 421 Instructional Leadership 3
- EDL 422 Curriculum Management for the School Executive 3

**Fall (5 cr.)**
- EDL 400 Organizational Leadership and Change Management 3
- EDL 428 Practicum in Supervision of Curriculum and Instruction I 2

**Spring (5 cr.)**
- EDL 467 Supervision and Professional Development 3
- EDL 429 Practicum in Supervision of Curriculum and Instruction II 2

**Summer 2 (3 cr.)**
- EDL 420 Data Based Decision Making 3

**Total Credits**: 19

**Courses**
- EDL 400 Organizational Leadership and Change Management 3 Credits
  Theory development relating to individuals and organizations emphasizing leadership, decision-making, motivation, and change. Analysis of existing leadership approaches focusing on demonstrating the application theories to administrative practice.

- EDL 404 The Principalship I 3 Credits
  Roles, responsibilities, and operational tasks of principals in the first half of the school year; engagement in practical application of the knowledge, theories, systems, and processes with an emphasis on fall semester responsibilities. Focus on applying the skills and knowledge of the course using problem based learning experiences drawn directly from internship. Must be completed during Principal Internship I (EDL 414).

- EDL 405 The Principalship II 3 Credits
  Roles, responsibilities, and operational tasks of principals in the second half of the school year; engagement in practical application of the knowledge, theories, systems, and processes with an emphasis on fall semester responsibilities. Focus on applying the skills and knowledge of the course using problem based learning experiences drawn directly from internship. Must be completed during Principal Internship II (EDL 415).  
  **Prerequisites**: EDL 400

- EDL 408 Central Office Internship I 2 Credits
  Practical experiences in meeting the challenges inherent in the Superintendent and associated central office positions. Emphasis on the five basic functional office roles of the superintendent: CEO to the school board, human resource manager, instructional leader, financial manager, and director of community relations.

- EDL 409 Central Office Internship II 2 Credits
  Practical experiences in meeting the challenges inherent in the Superintendent and associated central office positions. Emphasis on the budgeting process, state testing requirements and other priorities in the second half of a school year. Must have completed Central Office Internship I.  
  **Prerequisites**: EDL 408

- EDL 414 Principal Internship I 2 Credits
  Practical experiences in meeting the challenges inherent in the principal positions during the first half of the school year. Emphasis on data based decision making, instructional leadership, and day to day operations. Must be completed with EDL 404.  
  **Corequisites**: EDL 404

- EDL 415 Principal Internship II 2 Credits
  Practical experiences in meeting the challenges inherent in the principal positions during the second half of the school year. Emphasis on data based decision making, instructional leadership, and day to day operations. Must be completed with EDL 405.  
  **Corequisites**: EDL 405

- EDL 420 Data Based Decision Making 3 Credits
  Theory, research, and processes associated with the design and management of school curriculum; implementation of effective instructional and assessment practices enhancing student learning.  
  **Prerequisites**: EDL 404

- EDL 421 Instructional Leadership 3 Credits
  Skills, competencies, and best practices of instructional leadership and student achievement. Includes framing and communicating school goals dealing with student learning, supervising and evaluating instructional practices, coordinating the curriculum to student outcomes, monitoring student progress, creating a professional learning community, and engaging in reflective practice as a school leader.

- EDL 422 Curriculum Management for the School Executive 3 Credits
  A survey of the methods used to facilitate a curriculum development process based on the theories and findings from research and practice. Application of concepts to practical problems in curriculum leadership to acquire skills in the change process for instruction innovation. Emphasis on current theory and research in standards, technology, and curriculum integration.

- EDL 423 Leading Inclusive Learning Systems 3 Credits
  Issues facing school administrators as they develop and implement plans to address the needs of all students in their schools and districts. Addresses administrators’ obligations for the development and monitoring of Individualized Education Programs for children and youth with disabilities as well as other duties encumbered by administrators.

- EDL 424 Leadership: Self and Groups 3 Credits
  Exploration of the development and practice of leadership with experiential opportunities for application. Formal and informal authority, the practice of leadership, and individual and organizational dynamics are explored to improve the understanding of adaptive work in organizations.

- EDL 425 Leading and Managing Change 3 Credits
  Practices and theories about reform, change, and decision making look at who you need to communicate with and why each entity needs to be managed differently. Identify the educational stakeholders, the current trends that effect change, and what precipitates the need for change in the educational system. Addresses the process of change as it relates to individuals, the school board, teachers, students, and the administration with special emphasis on leadership, decision-making, motivation, and the dimensions of change.

- EDL 426 Introduction to Relational Leadership: Theory and Practice 3 Credits
  Theory development relating to individuals and organizations with special emphasis on the superintendents prolonged effective working relationship with the board of education, the administration, the professional and support staffs and the community. Implementation, follow through, and maintenance are emphasized relating to the interpersonal savvy a superintendent needs to effectively establish trust, build and mend relationships, guide decision-making, instill motivation, lead stakeholders and manage change.

- EDL 428 Practicum in Supervision of Curriculum and Instruction I 2 Credits
  Supervised field experience in all aspects of district-wide curriculum and instructional activities. Requires monthly seminar meetings.
EDL 429 Practicum in Supervision of Curriculum and Instruction II
2 Credits
Advanced supervised field experience in all aspects of district-wide curriculum and instructional activities. Requires monthly seminar meetings.
Prerequisites: EDL 428

EDL 430 Development and Administration of Special Education Programs 3 Credits
Exploration of the research and practice of an effective special education program. Emphasis on curriculum development, field-based research, and data-based decision-making program design and evaluation, and the relationship of the special education program to the pupil services program and the regular curriculum.

EDL 432 Special Education Law 3 Credits
An overview of the relevant legislation, regulations, and case law concerning the education of students with disabilities in pre-k through secondary school.

EDL 434 Leadership and Management of Special Education Programs 3 Credits
Introduction to the management practices related to effective leadership of special education programs including budget development and management, staffing, instructional practices, student assessment practices, and parent involvement.

EDL 436 School District Governance: Planning Policy, Ethics and Law 3 Credits
Examines federal and state Department of Education policies, laws, and regulations governing educational practice, policy, ethics and programming at the district level. Topics include a study of policy-making and related policies in a district, the role of the educational community in developing a collaborative decision-making organization, equality of educational opportunity for all students, and how policy efforts are reshaped by federal, state and local systemic reform efforts.

EDL 437 School District Resource Management 3 Credits
Theoretical and practical foundation in school resource allocation from the superintendent district wide perspective. Trends in revenue and expenditures, staffing, and operations, including school board issues, are explored. The economics of education and school business administration are discussed in terms of the policies they affect and create.

EDL 438 Practicum in Supervision of Special Education and Pupil Services Programs I 2 Credits
Supervised field experience in all aspects of district-wide special education programs. Requires monthly seminar meetings.

EDL 439 Practicum in Supervision of Special Education and Pupil Services Programs II 2 Credits
Supervised field experience in all aspects of district-wide special education programs. Requires monthly seminar meetings.
Prerequisites: EDL 438

EDL 440 Development and Administration of Pupil Services Programs 3 Credits
Exploration of the research and practice of an effective comprehensive pupil services program. Emphasis on involvement of community agencies, field-based research, and data-based decision-making, program design and evaluation, and the relationship of the pupil services program to the regular and special education curriculum.

EDL 442 Leadership and Management of Pupil Services Programs 3 Credits
Overview of the management practices related to effective leadership of pupil services programs, including budget development and management, staffing, instructional practices, community agency partnerships, student assessment, legal issues, and parent involvement.

EDL 450 Curriculum Design in a Global Society 3 Credits
Exploration of global issues and their effects on what is taught in schools, specifically in international schools. Emphasis on the analysis of curriculum and the influence that culture plays in decision making.

EDL 452 Comparative Education 3 Credits
Survey of education practices abroad. Systems of articulation, social and legal foundations, and structure in government. Emphasis on the nature and purpose schools in various cultural contexts and the major problems and trends occurring throughout the world.

EDL 461 Facilitating Organizational Inquiry 2 Credits
Exploration into the use of reflective practice and inquiry for professional development and school improvement. Development of group facilitation skills for collective inquiry. Reflection and inquiry will serve as the foundation for development of an action research project.

EDL 462 Transforming the Learner 2 Credits
Exploration of the integration of social, personal, cognitive, and knowledge-building dimensions to support learning and literacy. Focusing on the metacognitive conversations with self and others essential for developing learning and leadership.

EDL 463 Designing Systems of Action 3 Credits
Implementation of action research project. Building understanding of how the project impacts and is influenced by school and community systems. Explores the application of learning theory as related to leadership. Continued development of leadership concept and tools.

EDL 464 Sustaining Learning Communities 2 Credits
Completion of action research. Design and facilitation of a symposium of inquiry results. Review the behaviors of leadership that sustain learning in the classroom, school, and community.

EDL 467 Supervision and Professional Development 3 Credits
Emphasis on establishing skills in human resource management and supervision, including staff selection, supervision models, assessment and feedback methods, managing a diverse workforce, and adult development related to professional growth options. This course is designed specifically for individuals enrolled in a supervisory certification program.

EDL 468 Applied Learning Theory for School Leadership 3 Credits
Overview of the foundations, principles, and theories of curriculum, teaching, and learning. Emphasis on historical perspectives, teaching and learning for understanding, and schools as professional organizations. The purpose is to provide prospective administrators with the background for developing a balanced and challenging school-wide curriculum, for supervising instruction, and for supporting school improvement.

EDL 470 Special Topics in Educational Leadership 1-3 Credits
Intensive study and discussion of a specialized area. Title will vary. Repeat Status: Course may be repeated.

EDL 476 School Resources Management 3 Credits
Theoretical and practical foundation in school resource allocation. Trends in revenue and expenditures, staffing, and operations are explored. The economics of education and school business administration are discussed in terms of the policies they affect and create.

EDL 477 Seminar in School-Community Relations 3 Credits
Analysis and development of the communication and public relations skills needed by educators in dealing with the public.

EDL 479 School Law and Ethics 3 Credits
Examination of legal and ethical issues in effective leadership in the public schools, including awareness, analysis and applications of judicial interpretations of the constitutions, statutes, regulations, and common law relating to educational issues.

EDL 481 Policy and Politics in Public Education 3 Credits
Analysis of the forces, factors, agencies, formal governmental systems and informal subsystems that influence educational policy in local districts and state and national governments.
EDL 482 Practicum in University Teaching: Educational Leadership
1-4 Credits
Mentored and guided co-teaching focused on the design, organization, pedagogy and assessment of university courses in Educational Leadership. Students in this course will work with a faculty member to apply best practices in university teaching with feedback while co-teaching students in a course in the College of Education. Students taking the course must meet the college standards for participation and be approved by the program director and department chair.

Repeat Status: Course may be repeated.

EDL 485 The Superintendency 3 Credits
A theoretical and historical examination of superintendents’ leadership, school board/superintendent relations, and the array of duties and demands upon the superintendency.

EDL 488 Program Evaluation 3 Credits
The historical background, theory, methodology, and current practices of program evaluation in the human services area. Emphasis on conducting evaluations of educational programs and gathering data to make effective program decisions. Participants are required to design a program evaluation research plan.

EDL 489 Doctoral Seminar in School Administration 3 Credits
Analysis of the theoretical, empirical, and conceptual aspects of contemporary issues in educational administration and their implications for policy formulation and implementation in educational institutions. Must have official standing as a doctoral student in educational leadership.

EDL 499 Dissertation 1-15 Credits

Education and Human Services

The Department of Education and Human Services (EHS) includes six academic programs:

- Comparative and International Education,
- Counseling Psychology,
- Educational Leadership,
- School Psychology,
- Special Education, and
- Teaching, Learning, and Technology

Although the EHS department does not offer an undergraduate major, the Teaching, Learning, and Technology program offers an Education minor, as well as a five-year program leading to a master’s degree and certification in a teaching field. Across the six academic programs, the department offers a variety of master’s degrees (M.Ed., M.S., and M.A.) and doctoral degrees (Ph.D. and Ed.D.), as well as an Educational Specialist degree (Ed.S.). In addition, in cooperation with the College of Business and Economics, the department offers a combination MBA/M.Ed. degree. Further, programs in the college offer coursework-only study toward Pennsylvania state certification, without having to earn a degree. Lastly, there are numerous non-degree programs of study in the college leading to a Lehigh University post-bachelor’s certificate.

Programs of study vary in the number of credits required for completion. Please consult the appropriate academic program to learn more about those requirements.

Agencies accrediting our programs include the Pennsylvania Department of Education, the American Psychological Association, the National Association of School Psychologists, and the Masters in Psychology and Counseling Accreditation Council.

Graduates of our programs may work in schools or other educational settings, in health settings and agencies, in government agencies and non-governmental organizations focused on education, in industry, in private practice, or as consultants. While many graduates work in the United States, others work in countries around the world. For more information on what our graduates do after graduation, please consult the appropriate academic program.

The College of Education subscribes to a research-to-practice model, and all academic programs in the department train their graduates in research-based and evidence-based practices and policies that seek to create inclusive environments in which all individuals are able to work to their potential and social justice is well served.

The department is home to projects funded by the National Science Foundation, the National Institutes of Health, and the Department of Education.

For additional information about the program, please visit: coe.lehigh.edu/insidecoe/ehs

Professor Of Practice. Qiong Fu, PhD (University of Illinois at Chicago)

Emeriti. Raymond Bell, EdD (Lehigh University); Joseph P. Kender, EdD (University of Pennsylvania); Robert L. Leight, EdD (Lehigh University); J. Gary Lutz, EdD (Lehigh University); Alden J. Moe, PhD (University of Minnesota); Roland K. Yoshida, PhD (University Southern Calif)

Courses

EDUC 383 Supervised Research in Applied Psychology 1-3 Credits
Provides undergraduate junior and senior psychology majors a formal supervised research experience in applied psychology. Students are assigned for the semester to a research team led by a participating faculty member in the counseling psychology or school psychology programs in the College of Education.

Repeat Status: Course may be repeated.

EDUC 388 Statistical Computing 3 Credits
Use of one or more major statistical software packages. Principles of data coding, editing, integrity checking, and management. Emphasis on link between personal computers, mainframes, and other software.

Prerequisites: EDUC 408

EDUC 394 Special Topics In Education 3 Credits
Repeat Status: Course may be repeated.

EDUC 402 (PSYC 402) Developmental Psychology 3 Credits
Survey of theories and research concerning perceptual, cognitive, social, and personality development through infancy and childhood. Must have graduate standing.

EDUC 403 Research 3 Credits
Basic principles of research; techniques of gathering and analyzing data; design of studies in education. Emphasis on critical reviews of research reports representing various methodologies. Research report required.

EDUC 405 Qualitative Research Methods 3 Credits
Foundations of qualitative research and research methodology for answering questions in education. Topics include history, philosophy, types, methods, applications, and critical reading of qualitative research reports. Emphasis on developing key researcher skills of gaining entrance, collecting, analyzing and interpreting data, establishing credibility, and writing and publishing results.

EDUC 408 Introduction to Statistics 3 Credits
Organization and description of data. Principles of statistical inference including hypothesis testing, interval estimation, and inferential error control. Emphasis on application.

EDUC 409 Analysis of Experimental Data 3 Credits
Emphasis on analysis of variance designs including one-way, factorial, nested, and repeated measures designs. Introduction to multiple regression and the analysis of covariance.

Prerequisites: EDUC 408

EDUC 410 Univariate Statistical Models 3 Credits
The univariate general linear model. Principles of expressing models and hypotheses about those models. Emphasis on similarity among the analysis of variance, multiple regression, and the analysis of covariance. Examples of nonstandard models and generalization to complex designs.

Prerequisites: EDUC 409

EDUC 411 Multivariate Statistical Models 3 Credits
The multivariate general linear model. Principles of expressing multivariate models and hypotheses about those models. Emphasis on similarity among the multivariate analysis of variance, multiple regression, and the analysis of covariance. Examples of non-standard models and generalization to complex designs.

Prerequisites: EDUC 410
EDUC 412 Advanced Applications of Psychometric Principles 3 Credits
Conceptual examination of exploratory and confirmatory factor analysis, cluster analysis, latent-trait modeling, and other advanced psychometric topics.
Prerequisites: EDUC 409 or SCHP 427 or CPSY 427

EDUC 419 Second Language Acquisition (SLA) Theory 3 Credits
This course introduces theories of second language acquisition, including issues of acquisition of English as a second language as well as other languages. Various theories of communication and language acquisition will be covered.

EDUC 421 Intercultural Communication 3 Credits
Language is ambiguous by nature, and discourse is interpreted in cultural and linguistic contexts. This course covers different cultural and linguistic strategies individuals use to communicate, essential concepts for interacting with individuals from other cultural and linguistic backgrounds, and different strategies of communication as defined by specific cultures. Covering the theory and practice of intercultural interaction, the course examines assumptions about language and culture and includes practical advice to help students develop the cultural sensitivity essential for communication today.

EDUC 422 Theory and Practice for Second Language Learning 3 Credits
This course presents the application of second language acquisition (SLA) theories in relationship to teaching, and reviews methods and materials needed for ESL instruction in a regular classroom and in a pullout program. This course will demonstrate the knowledge of fundamental concepts and practices of English as a second language (ESL) instruction with an emphasis on instructional materials and strategies. Participants will be able to identify appropriate materials and resources to be used with students at each level of English proficiency.

EDUC 423 Second Language Assessment 3 Credits
This is a broad-spectrum course around the use of assessment tools, and other evaluation measurements for diagnosis, prescription, and evaluation of students in English as a second language (ESL) programs. This course will address part three: English Language Learners (ELLs) Language Support Services Knowledge. Participants will learn the effective assessment practices and support services available to ELL students. Participants will examine, explore and understand the purposes for assessment, multiple assessment models, use of evaluation techniques, scaffolding of assessments, and formal/informal assessment tools. Finally, participants will gain hands-on experience in test administration, interpretation and reporting.

EDUC 451 Applied Principles of Cognitive Psychology 3 Credits
Basic principles and contemporary theories of cognitive psychology will be covered, especially regarding the application of these principles to education. Experimental research relevant to contemporary theories of cognitive psychology and the application of these theories in educational settings will be reviewed.

EDUC 461 Single-Subject Research Design 3 Credits
Experimental designs for use with small N's. Topics include design theory and application, experimental validity (internal, external, statistical conclusions and construct validity) and an overview of data analysis procedures.

EDUC 471 (CPSY 471) Diversity and Multicultural Perspectives 3 Credits
Examination of the influence of culture, gender, and disabilities on behavior and attitudes. Historical and current perspectives on race, culture, gender, and minority group issues in education and psychology. Lecture/small group discussion is restricted to graduate students in the College of Education only.

EDUC 473 Social Basis of Human Behavior 3 Credits
Development of human behavior from a social psychological perspective. Emphasis placed on the impact of society upon school-age children and adolescents.

EDUC 482 Practicum in University Teaching: Education 1-4 Credits
Mentored and guided co-teaching focused on the design, organization, pedagogy and assessment of university courses in Education. Students in this course will work with a faculty member to apply best practices in university teaching with feedback while co-teaching students in a course in the College of Education. Students taking the course must meet the college standards for participation and be approved by the program director and department chair. May be repeated for credit.
Repeat Status: Course may be repeated.

EDUC 486 Doctoral Qualifying Research Project 1-3 Credits
Design and implement research project under faculty supervision to meet requirements for doctoral programs.
Repeat Status: Course may be repeated.

EDUC 490 Thesis 1-6 Credits

EDUC 491 Advanced Seminars: (with subtitle) 1-6 Credits
Intensive study and discussion of a specialized area. Title will vary.
Repeat Status: Course may be repeated.

EDUC 493 Internship in: (with subtitle) 1-6 Credits
Opportunity for students to apply theory to practice in a variety of educational settings. Students will be supervised in the field and participate in seminars dedicated to addressing specific concerns and issues encountered during their experience. Consent of program director required.

EDUC 494 Field Work in: (with subtitle) 3 Credits
Identification of significant problems in an educational environment, review of the literature, and development of appropriate research plans.

EDUC 495 Independent Study in: (with subtitle) 1-6 Credits
Individual or small group study in the field of specialization. Approved and supervised by the major adviser.
Repeat Status: Course may be repeated.

EDUC 496 Doctoral Research Seminar 3 Credits
For doctoral students. Research design and application to various kinds of educational problems; data collection and analysis. Criticism and evaluation of student proposals.
Repeat Status: Course may be repeated.

EDUC 499 Dissertation 1-15 Credits

Electrical and Computer Engineering

The department of electrical and computer engineering (ECE) offers undergraduate and graduate programs of study along with supporting research for students interested in the field of electrical engineering. It also jointly supports undergraduate and graduate programs in computer engineering, and computer science with the computer science and engineering (CSE) department. Graduate study leads to the degrees, master of science, master of engineering, and doctor of philosophy in electrical engineering, and the master of science and doctor of philosophy in computer engineering.

The undergraduate programs emphasize the fundamental aspects of their respective areas. Engineering design concepts are introduced early in the curriculum, and required instructional laboratories introduce design as a hands-on activity. Electives permit students to tailor their programs according to their interests and goals, whether they be in preparation for graduate study or entry into industry. Students are free to select courses offered by other departments and are encouraged to do so when appropriate. In this way they can prepare themselves for activities which straddle departmental boundaries or for entry into professional schools such as medicine or management. Students have the opportunity to synthesize and apply their knowledge in a senior design project. Students may use the senior design project as a way to participate in the various research projects in the department.

The department maintains a number of laboratories in support of its curricular programs. These laboratories include the sophomore and junior lab electronic circuits and systems laboratory, microcomputer laboratory, electromechanics laboratory, digital signal processing laboratory, digital systems laboratory and senior projects laboratories.

The department has research laboratories in computer architectures, wireless communications, optoelectronics, compound semiconductors, electron device physics, microelectronics fabrication, signal processing,
The graduate programs allow students to deepen their professional knowledge, understanding, and capability within their subspecialties. Each graduate student develops a program of study in consultation with his or her graduate advisor. Key research thrust areas in the department include:

1. Microelectronics and Nanotechnology.
2. Wireless Communications and Networking.
3. Optoelectronics.

Graduate research is encouraged in these and other areas. Computers and computer usage are an essential part of the student’s environment. The university provides a distributed network of about 75 high-performance workstations and over 300 PC-compatible microcomputers in public sites throughout the campus. The ECE department, in conjunction with the CSE department, has state-of-the-art systems to augment and extend the generally available university systems. A primary resource is a network of more than 60 Sun workstations, file servers, and compute servers, running the Unix operating system. In addition, the ECE department has a 16 node cluster that is used for high performance computing. Additional resources to facilitate learning are the approximately 90 workstations running the Microsoft and Linux platforms that are located in the various ECE teaching labs. These systems provide an array of software tools for students and researchers, such as Cadence, Freescale, Agilent. A detailed description of the curricular programs follows with a listing of the required courses and with a listing of the departmental course offerings. The departmental courses carry the prefix ECE for electrical and computer engineering. Courses given by the Computer Science and Engineering department have the prefix CSE. Students are urged to search both listings for courses appropriate to their career goals.

**Professors.** Filbert J. Bartoli, PhD (Catholic University of America); Ricky S. Blum, PhD (University of Pennsylvania); David Richard Decker, PhD (Lehigh University); Stephen Paul DeWeerth, PhD (California Institute of Technology); Yujie Ding, PhD (Johns Hopkins University); Douglas R. Frey, PhD (Lehigh University); Miltiadis K. Hatalis, PhD (Carnegie Mellon University); James C. Hwang, PhD (Cornell University); Shalinee Kishore, PhD (Princeton University); Alan J. Snyder, PhD (The Pennsylvania State University); Nelson Tansu, PhD (University Wisconsin at Madison); Svetlana Tatic-Lucic, PhD (California Institute of Technology)

**Associate Professors.** Sushil Kumar, PhD (Massachusetts Institute of Technology); Jing Li, PhD (Texas A&M University); Karl H Norian, PhD (University of London); Parvathanah Venkitasubramaniam, PhD (Cornell University); MeghnaD. Wagh, PhD (Indian Institute of Technology Bombay); Jonathan J. Wiener, PhD (University of Illinois Urbana); Zhiyuan Yan, PhD (University of Illinois Urbana)

**Assistant Professors.** Yevgeny Berdichevsky, PhD (University of California San Diego); Xiaochen Guo, PhD (University of Rochester); Wenxin Liu, PhD (University Missouri, Rolla); Chao Zhou, PhD (University of Pennsylvania)

**Professors Of Practice.** William R. Haller, MS (Lehig University); Ramesh Shankar, PhD (University of Delaware)

**Emeriti.** Bruce D. Fritchman, PhD (Lehig University); Frank H. Hielscher, PhD (University of Illinois Urbana); Carl S. Holzinger, PhD (Lehig University); Alastair D. McAulay, PhD (Carnegie Mellon University); Donald L. Talheim, MS (Lehig University); Eric D. Thompson, PhD (Massachusetts Institute of Technology); Kenneth Kai-Ming Tzeng, PhD (University of Illinois Urbana); George D. Watkins, PhD (Harvard University); Marvin H. White, PhD (Ohio State University)

**UNDERGRADUATE PROGRAMS**

**Mission Statement for the Electrical Engineering and Computer Engineering Programs**

The mission of the electrical engineering and computer engineering programs is to prepare engineers to meet the challenges of the future, to promote a sense of scholarship, leadership, and service among our graduates, to instill in the students the desire to create, develop, and disseminate new knowledge, and to provide international leadership to the electrical engineering and computer engineering professions.

**Program Educational Objectives in Electrical Engineering and Computer Engineering**

The graduates of the electrical engineering program will:

1. Solve technologically challenging problems in electrical engineering using their fundamental knowledge of math, science and engineering.
2. Attain positions of responsibility in their chosen careers, including industry, government, medicine, business, law and academia by applying their electrical engineering skills, professional attitudes and ethics.
3. Engage in lifelong learning through graduate studies, research, and continuing education.
4. Apply their knowledge of global, societal and environmental issues in solving engineering problems.
5. Function on multidisciplinary teams using their technical knowledge and effective communication skills.

**BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING**

The required courses for this degree contain the fundamentals of linear circuits, systems and control theory, electronic circuits, signal theory, physical electronics, electromagnetic theory, energy conversion, digital systems, and computing techniques. A strong foundation in the physical sciences and in mathematics is required. Approved electives, chosen with the advisor’s consent, are selected in preparation for graduate study or entry into industry according to individual interests. The program requires a minimum of 134 credit hours. The recommended sequence of courses follows:
MATH 208  3  MATH 231  3
HSS elective  3-4  approved technical elective  3
free elective  3  free elective  3

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<tr>
<th>Fourth Year</th>
<th>Credits</th>
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<tr>
<td>First Semester</td>
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<td>ECE 136</td>
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<td>ECE 258</td>
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<td>ECE 257</td>
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<td>free elective</td>
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<tr>
<td>free elective</td>
<td>3</td>
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</tbody>
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Total Credits: 133-139

1 Required natural science courses, one taken fall semester and the other taken in spring

2 Approved technical electives are subjects in the area of science and technology. Students must select a minimum of four courses (totaling at least 12 credits) from the ECE or CSE course listings, with a minimum of two courses in one of the technical areas described in the following list. Students must also choose at least one engineering elective in either materials, mechanics, thermodynamics, fluid mechanics or physical chemistry, and at least one science elective in physics, chemistry or biology. For students interested in solid-state electronics, quantum mechanics is recommended for the science elective.

Approved Technical Electives for Electrical Engineering

Breadth Requirement
Minimum of 4 ECE or CSE elective courses spanning more than one technical area below.

Depth Requirement
Minimum of 2 courses in one of the technical areas described below.

Solid-State Circuits

| ECE 308 | Physics and Models of Electronic Devices | 3 |
| ECE 332 | Design of Linear Electronic Circuits | 3 |
| ECE 333 | Medical Electronics | 3 |
| ECE 337 | Introduction to Micro- and Nanofabrication | 3 |
| ECE 351 | Microelectronics Technology | 3 |
| ECE 355 | Applied Integrated Circuits | 3 |
| ECE 361 | Introduction to VLSI Circuits | 3 |
| ECE 362 | Introduction to VLSI System Design | 3 |

Signal Processing and Communications

| ECE 212 | Control Theory | 3 |
| ECE 339 | Graphical Signal Processing | 3 |
| ECE 341 | Fundamentals of Wireless Communications | 3 |
| ECE 342 | Communication Theory | 3 |
| ECE 343 | Digital Signal Processing | 3 |
| ECE 344 | Statistical Signal Processing | 3 |
| ECE 364 | Introduction to Cryptography and Network Security | 3 |
| ECE 387 | Digital Control | 3 |
| ECE 389 | Control Systems Laboratory | 2 |

Microwaves and Lightwaves

| ECE 310 | Wireless Circuits | 3 |
| ECE 325 | Semiconductor Lasers I | 3 |
| ECE 326 | Semiconductor Lasers II | 3 |
| ECE 338 | Quantum Electronics | 3 |
| ECE 347 | Introduction to Integrated Optics | 3 |
| ECE 348 | Lightwave Technology | 3 |
| ECE 371 | Optical Information Processing | 3 |
| ECE 372 | Optical Networks | 3 |

Computers

Any CSE course except CSE 012, CSE 015, or CSE 252

ECE 201 | Computer Architecture | 3 |
| ECE 316 | Microcomputer System Design | 3 |
| ECE 319 | Digital System Design | 3 |
| ECE 320 | Logic Design | 3 |
| ECE 324 | Microprocessors | 3 |
| ECE/CSE 336 | Embedded Systems | 3 |

Note: Special Topics (3) (The area of each course must be evaluated individually)

MINOR IN ELECTRICAL ENGINEERING

Minor Program Director: William R. Haller

The purpose of the Electrical Engineering minor is to enable students to supplement their major with knowledge and skills that increase their ability to realize their multi-disciplinary goals and/or make them more marketable upon graduation.

Required Courses

ECE 081 | Principles of Electrical Engineering 1 | 4 |
ECE 083 or ECE 162 | Introduction to Electrical Engineering and Electrical Laboratory |
ECE 108 | Signals and Systems 2 | 4 |
ECE 123 | Electronic Circuits | 3 |
Select one of the following Electrical and Computer Engineering Courses or Other Approved Elective: 3-4

| ECE 033 | Introduction to Computer Engineering |
| ECE 125 | Circuits and Systems |
| ECE 126 | Fundamentals of Semiconductor Devices |
| ECE 136 | Electromechanics |
| ECE 339 | Graphical Signal Processing |
| ECE 341 | Fundamentals of Wireless Communications |
| ECE 343 | Digital Signal Processing |
| ECE 371 | Optical Information Processing |
| ECE 372 | Optical Networks |

Total Credits: 14-15

1 ECE 083 and ECE 162 plus departmental approval.

2 Mechanical Engineering substitute ME 245 Engineering Vibrations for ECE 108, by petition, but must select an additional ECE elective. Because of similar course requirements between electrical and computer engineering majors, computer engineering students wishing to minor in electrical engineering can use one required course in their major and must choose four electives, excluding required courses, from the above list to satisfy the requirements of the electrical engineering minor. Computer engineering technical electives (chosen from the above list) can be used to satisfy the requirements of the minor.

Technical minors must be declared by the end of pre-registration of the student’s sixth semester. If course requirements change or a student wishes to vary the list of courses above, a revised minor declaration form must be submitted.

BACHELOR OF SCIENCE IN COMPUTER ENGINEERING

See catalog entry for Computer Engineering (p. 165).

GRADUATE PROGRAMS

Graduate programs of study provide a balance between formal classroom instruction and research and are tailored to the individual student’s professional goals. The programs appeal to individuals with backgrounds in electrical or computer engineering, mathematics, or the physical sciences. Research is an essential part of the graduate program. Major research areas include:

Wireless Communications and Networking

Signal design (CDMA, OFDM, etc), near-far communication strategies, space-time diversity coding, channel and interference modeling, digital
audio and video compression, digital signal processing, novel devices, communication networks, image processing, data fusion, and compound semiconductor devices.

**Microelectronics Devices, Integrated Circuits, VLSI Design**
Mixed Signal design, Silicon integrated circuit technology, processing, fabrication and testing. Semiconductor device physics, nano scale devices, CMOS VLSI logic design and verification, computer-aided design (CAD), VLSI chip architectures, computer architecture including embedded systems and systems-on-a-chip. New sensors, actuators and novel microsystems, ranging from micro-electromechanical-systems (MEMS) to chemical microreactors and Biochips.

**Optoelectronics and Photonics**
Fiber optic communications and networks, applications of nonlinear optics, optical switching, novel devices, and optical computing. Freespace optical communication systems. Terahertz generation, amplification, detection, and applications, nanostructures and nanodevices. Biophotonics.

The Master of Science degree requires the completion of 30 credit hours of work that may include a six credit hour thesis for the EE and CompE degrees. A program of study must be submitted in compliance with the graduate school regulations. An oral presentation of the thesis is required.

The Master of Engineering degree requires the completion of 30 credit hours of work, which includes design-oriented courses and an engineering project. A program of study must be submitted in compliance with the college rules. An oral presentation of the project is required.

The Ph.D. degree in electrical engineering requires the completion of 42 credit hours of work (including the dissertation) beyond the master’s degree (48 hours if the master’s degree is non-Lehigh), the passing of a departmental qualifying examination appropriate to each degree within one year after entrance into the degree program, the passing of a general examination in the candidate’s area of specialization, the admission into candidacy, and the writing and defense of a dissertation. Competence in a foreign language is not required.

The ECE Department has a core curriculum requirement for graduate students in each of the degree programs. The purpose of this requirement is to guarantee that all students pursuing graduate studies in the department acquire an appropriate breadth of knowledge of their discipline.

**Electrical Engineering**
To satisfy the core curriculum requirements in Electrical Engineering:

Select three courses from the following five different areas: 9

- ECE 401 Advanced Computer Architecture
- ECE 402 Advanced Electromagnetics
- ECE 441 Fundamentals of Wireless Communications
- ECE 420 Advanced Circuits and Systems
- ECE 451 Physics of Semiconductor Devices

**Total Credits** 9

**Computer Engineering**
See catalog entry for Computer Engineering (p. 165).

**M.S. in Photonics**
The Masters of Science degree in Photonics is an interdisciplinary degree that is designed to provide students with a broad training experience in the various aspects of photonics, including topics in Physics, Electrical Engineering and Materials Science and Engineering. It covers both theoretical and practical topics in areas such as fiber optics, integrated optics, lasers, nonlinear optics and optical materials to prepare the students to work in industry directly after graduation. The program is also designed so as to make it possible for students who wish to continue on for a Ph.D. to still satisfy the requirements of their individual departments for the more advanced degree. For details on this program, see the separate catalog section under Interdisciplinary Graduate Study and Research.

**M. S. in Wireless Communications and Network Engineering**
The Master of Science degree in Wireless Communications and Network Engineering at Lehigh University is designed to prepare the next generation of engineers for the communications and networking industries. The curriculum aims to produce graduates that can contribute to the design and analysis of communication systems in the broadest context. To accommodate the student’s study of various aspects of wireless communications and networking, we have limited the number of required core courses to allow maximum flexibility in pursuing specific interests.

**Required Core Courses**

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ECE 342</td>
<td>Communication Theory ¹</td>
<td>3</td>
</tr>
<tr>
<td>ECE 441</td>
<td>Fundamentals of Wireless Communications</td>
<td>3</td>
</tr>
<tr>
<td>ECE 404</td>
<td>Computer Networks</td>
<td>3</td>
</tr>
</tbody>
</table>

**Advanced Courses** ²

¹ ECE 342 must be the first course taken and the core courses should precede advanced courses.
² In addition to the core courses, the students will take advanced courses that are aimed to furnish the student with a deeper knowledge of more specific types and aspects of information networks.

**DEPARTMENTAL COURSES**
Courses are listed under the prefixes ECE and CSE. Generally, electrical engineering courses carry the ECE prefix and appear in the following listing. Computer science courses carry the CSE prefix. Computer engineering courses are found under either prefix. The CSE courses are listed in the Computer Science and Engineering department section in this catalog. The reader should consult both listings.

**Courses**

- **ECE 033 Introduction to Computer Engineering 4 Credits**
  Analysis, design and implementation of small digital circuits. Boolean algebra. Minimization techniques, synchronous sequential circuit design, number systems and arithmetic. Microcomputer architecture and assembly level programming.
  **Prerequisites:** CSE 017 or ENGR 010 or ENGR 097
- **ECE 081 Principles of Electrical Engineering 4 Credits**
  Circuit elements and laws. Behavior of simple linear networks, include equivalent circuits and solution techniques. Solution of DC circuits and AC circuits using phasor techniques. Introduction to operational amplifiers. Steady state and transient response of simple circuits. Includes a weekly session for review and discussion. May not be taken with ECE 083 for credit.
  **Prerequisites:** (MATH 022 or MATH 096) and PHY 021
  **Can be taken Concurrently:** PHY 021
- **ECE 083 Introduction to Electrical Engineering 3 Credits**
  Circuit elements and laws. Behavior of simple linear networks. Characteristics of electronic circuits and modeling. Introduction to functional circuits, such as operational amplifiers, instrumentation amplifiers, and power systems. Introduction to basic filters and data converters. May not be taken with ECE 081 for credit.
  **Prerequisites:** MATH 022 and PHY 021
  **Can be taken Concurrently:** PHY 021
- **ECE 108 Signals and Systems 4 Credits**
  Continuous and discrete signal and system descriptions using signal space and transform representations. Includes Fourier series, continuous and discrete Fourier transforms, Laplace transforms, and z-transforms. Introduction to sampling.
  **Prerequisites:** ECE 081
- **ECE 121 Electronic Circuits Laboratory 2 Credits**
  One lecture and one laboratory per week. Experiments illustrating the principles of operation of electronic devices and their circuit applications. Basic electronic instrumentation and measurement techniques.
  **Prerequisites:** ECE 081
ECE 123 Electronic Circuits 3 Credits
Methods for analyzing and designing circuits containing electronic devices. Topics include device models, basic amplifier configurations, operating point stabilization, frequency response analysis, and computer-aided analysis of active circuits.
Prerequisites: ECE 081

ECE 125 Circuits and Systems 3 Credits
Prerequisites: ECE 108

ECE 126 Fundamentals of Semiconductor Devices 3 Credits
Introduction to the physics of semiconductors in terms of atomic bonding and electron energy bands in solids. Charge carriers in semiconductors and carrier concentration at thermal equilibrium. Principles of electron and hole transport, drift and diffusion currents, generation and recombination processes, continuity. Treatment of semiconductor devices including p-n junctions, bipolar junction transistors and field effect transistors.
Prerequisites: ECE 081

ECE 136 Electromechanics 0-3 Credits
Two lectures and one laboratory per week. An experimental introduction to electromechanical energy conversion. Basic concepts of magnetic fields and forces and their application to electrical apparatus including electromechanical transducers, transformers, AC and DC machines.
Prerequisites: ECE 081

ECE 138 Digital Systems Laboratory 2 Credits
Implementation issues and techniques for digital logic design. Combinational and sequential logic design using standard integrated circuits. Input/output and interrupt processing. Design and implementation of real-time complex digital logic using microprocessor systems.
Prerequisites: ECE 033

ECE 162 Electrical Laboratory 1 Credit
Experiments on circuits, machines, and electronic devices. Elementary network theory. Survey laboratory for students not majoring in electrical or computer engineering.
Prerequisites: ECE 081 or ECE 083
Can be taken Concurrently: ECE 081, ECE 083

ECE 182 Junior Laboratory 1 Credit
Experiments designed to exploit the students understanding of basic circuits and filters. Experiments designed to help students understand basic signals and systems concepts such as time-frequency domain duality, power measurement, modulation, sampling and data conversion. Students are introduced to a variety of integrated circuits including multipliers, analog switches, digital electronics, S/H, A/D, and D/A converters. Computer software design aids, especially Spice and LabView, are used throughout the semester. One three-hour laboratory per week.
Prerequisites: ECE 033 and ECE 121 and ECE 123

ECE 201 Computer Architecture 3 Credits
Prerequisites: ECE 033

ECE 202 Introduction to Electromagnetics 3 Credits
Elements of vector analysis, Coulomb’s law, Biot-Savart’s and Ampere’s laws, Lorentz Forces, Laplace’s, and Maxwell’s equations, boundary conditions, methods of solution in static electric and magnetic fields, including finite element numerical approach. Quasistationary fields, inductance.
Prerequisites: MATH 205 and PHY 021

ECE 203 Introduction to Electromagnetic Waves 3 Credits
Uniform plane waves in free space and in materials, skin effect. Waves in transmission lines and waveguides, including optical fibers. Energy and power flow, Poynting’s theorem. Reflection and refraction. Resonators. Radiation and diffraction.
Prerequisites: ECE 202

ECE 212 Control Theory 3 Credits
Prerequisites: ECE 125

ECE 256 Honors Project 1 Credit
Open by invitation only to students who have completed ECE 257. Senior Project. Selection is based upon the quality of the senior project with regard to ingenuity, design approach and completeness. The objective of this course is to carry the successful senior projects forward to completion of a technical paper suitable for publication or submission to a technical conference. A written paper and oral presentation are required by mid-semester. Oral presentations will be made before an appropriate public forum. Enrollment limited.

ECE 257 Senior Lab I 0,3 Credits
Continuation of ECE 257. Complete design, construction, and testing of projects selected and developed in ECE 257. Present final design reviews and project presentations. Submit a final written report. Discuss development issues, including manufacturability, patents, and ethics. Two three-hour sessions per week.
Prerequisites: ECE 257

ECE 300 Apprentice Teaching 1-4 Credits

ECE 308 Physics and Models of Electronic Devices 3 Credits
Physics of metal-semiconductor junction, p-n junctions, and MOS capacitors. Models of Schottky barrier and p-n junction diodes, JFET, MOSFET, and bipolar transistors.
Prerequisites: ECE 126

ECE 310 Wireless Circuits 3 Credits
Theory and design of high-frequency circuits for wireless communications. Transmission lines and microwave networks. Types of circuits explored include filters, amplifiers, mixers, voltage controlled oscillators (VCOs), phase locked loops (PLLs), synthesizers, modulators and demodulators, and antennae. Design using scattering parameters, Smith chart and RF/microwave CAD programs for simulation. System performance analysis based on noise figure, antenna gain and the Friis equation will be developed. Modulation techniques of AM, FM, PM, and QPSK systems will be compared based on bit error rates (BER) calculated from system parameters.
Prerequisites: ECE 203

ECE 316 Microcomputer System Design 3 Credits
Content is primarily hardware oriented, but software issues are covered where required. Includes performance characteristics of the more popular devices on the market today. Specific topics include: basic microcomputer structure, bus interconnections, memory systems, serial and parallel interfacing, CRT controllers, interrupt structures, DMA.
Prerequisites: ECE 033

ECE 319 Digital System Design 3 Credits
Design techniques at the register transfer level. Control strategies for hardware architectures. Implementation of microprogramming, intersystem communication and peripheral interfacing. Hardware design languages and their use in design specification, verification and simulation.
Prerequisites: ECE 138
ECE 320 Logic Design 3 Credits
Review of basic switching theory, vector boolean algebra, canonical implementations of medium size circuits, threshold logic, fault detection in combinational and sequential logic, Multivalued and Fuzzy logic, regular expressions, nondeterministic sequential machines.
Prerequisites: ECE 033

ECE 324 Microprocessors 3 Credits
Microprocessor architectures with focus on Motorola 8, 16, and 32-bit microprocessors (68HC11, 9S12DP256 and Coldfire MCF5XXX series). Chip features, programming model, instruction set, use of programming tools, flash memory programming, interrupt programming and interfacing to external devices and memory. Programming primarily in C-language with some assembly. (two lectures and one laboratory per week).
Prerequisites: ECE 033

ECE 325 Semiconductor Lasers I 3 Credits
Prerequisites: ECE 203

ECE 326 Semiconductor Lasers II 3 Credits
Continuation of Semiconductor Lasers I. Topics covered include: Gain and current relations; dynamic effects; perturbation and coupled-mode theory; dielectric waveguides; and photonic integrated circuits. Credit will not be given for both ECE 326 and ECE 426.
Prerequisites: ECE 325

ECE 328 (ECO 328) Electricity Systems 3 Credits
The course is intended primarily for students who are interested in an exploration of the electricity market, its operation and the main considerations to implement it, in the wake of a smart grid implementation, with basic college-level calculus.
Repeat Status: Course may be repeated.
Prerequisites: (ECO 001 and MATH 023) or ECO 146
Attribute/Distribution: ND

ECE 332 Design of Linear Electronic Circuits 3 Credits
Introduction to a variety of linear design concepts and topologies, with audio networks providing many of the concrete examples. Topics include preamplifiers, equalizers and filters, multipliers, voltage-controlled amplifiers, level detectors, and power amplifiers.
Prerequisites: ECE 123 and ECE 125
Can be taken Concurrently: ECE 125

ECE 333 Medical Electronics 3 Credits
Bioelectric events and electrical methods used to study and influence them in medicine, electrically excitable membranes, action potentials, electrical activity of muscle, the heart and brain, bioamplifiers, pulse circuits and their applications.
Prerequisites: ECE 123

ECE 336 (CSE 336) Embedded Systems 3 Credits
Prerequisites: CSE 017

ECE 337 Introduction to Micro- and Nanofabrication 3 Credits
Survey of the standard IC fabrication processes, such as photolithography, dry and wet etching, oxidation, thin-film deposition and chemical mechanical polishing. In-depth analysis of MEMS-specific processes such as wafer bonding, wet anisotropic etching, photolithography using thick photoresist, and deep reactive ion etching of silicon. The basics of nanofabrication techniques. The fundamentals of MEMS design will be outlined. A wide variety of MEMS and NEMS devices will be discussed.
Prerequisites: (MAT 033 and MATH 231) or ECE 351

ECE 338 Quantum Electronics 3 Credits
Prerequisites: ECE 203

ECE 339 Graphical Signal Processing 3 Credits
Application of graphical programming to mathematical principles in data analysis and signal processing. Review of digital signal processing, use of structures, arrays, charts, building virtual instruments, graphical programming for linear algebra, curve fitting, solving differential and difference equations, signal generation, DFT and FFT analysis, windowing and filtering.
Prerequisites: ECE 108

ECE 341 Fundamentals of Wireless Communications 3 Credits
Prerequisites: ECE 108

ECE 342 Communication Theory 3 Credits
Theory and application of analog and digital modulation. Sampling theory with application to analog-to-digital and digital-to-analog conversion techniques. Time and frequency division multiplexing. Introduction to random processes including filtering and noise problems. Introduction to statistical communication theory with primary emphasis on optimum receiver principles.
Prerequisites: ECE 125 and (MATH 309 or MATH 231)

ECE 343 Digital Signal Processing 3 Credits
Study of orthogonal signal expansions and their discrete representations, including the Discrete Fourier Transform and Walsh-Hadamard Transform. Development of fast algorithms to compute these, with applications to speech processing and communication. Introduction to the z-transform representation of numerical sequences with applications to input/output analysis of discrete systems and the design of digital filters. Analysis of the internal behavior of discrete systems using state variables for the study of stability, observability and controllability.
Prerequisites: ECE 108

ECE 344 Statistical Signal Processing 3 Credits
Introduction to random processes, covariance and spectral density, time average, stationarity, and ergodicity. Response of systems to random inputs. Sampling and quantization of random signals. Optimum filtering, estimation, and hypothesis testing.
Prerequisites: (ECE 108) and (MATH 231 or MATH 309)

ECE 345 Fundamentals of Data Networks 3 Credits
Analytical foundations in the design and evaluation of data communication networks. Fundamental mathematical models underlying network design with their applications in practical network algorithms. Layered network architecture, queuing models with applications in network delay analysis, Markov chain theory with applications in packet radio networks and dynamic programming with applications to network routing algorithms. Background on stochastic processes and dynamic programming will be reviewed. Prereq: MATH 231 and ECE125.
Prerequisites: MATH 231 and ECE 125
ECE 347 Introduction to Integrated Optics 3 Credits
Theory of dielectric waveguides (ray and wave approach). Modes in planar slab optical guides and in waveguides with graded index profiles. Coupled-mode formalism and periodic structures. Coupling of optical beams to planar structures. Switching and modulation of light in dielectric guides: phase, frequency and polarization modulators; electro-optic, acousto-optic and magneto-optic modulators. Semiconductor lasers. Fabrication of semiconductor components. Recent advances. Prerequisites: (ECE 202 and ECE 203)

ECE 348 Lightwave Technology 3 Credits
Concepts of signal generation, modulation, transmission, isolation, detection, and switching in current optical fiber networks. Classical and quantum properties of radiation and matter in optoelectronic devices. Physics of light propagation in optical waveguides, and of light generation and detection in optoelectronic devices. Fundamentals of operation of common types of discrete and integrated optical components such as light-emitting diodes and lasers, photodetectors, modulators, and optical couplers. Credit will not also be given for ECE 448. Prereq: ECE 203. Prerequisites: ECE 203

ECE 350 Special Topics 3 Credits
Selected topics in the field of electrical and computer engineering not included in other courses. Repeat Status: Course may be repeated.

ECE 351 Microelectronics Technology 3 Credits
Technology of semiconductor devices and of integrated circuits, including crystal growth and doping, phase diagrams, diffusion, epitaxy, thermal oxidation and oxide masking, lithography. The major emphasis will be on silicon technology, with additional lectures on GaAs technology. Prerequisites: ECE 126

ECE 355 Applied Integrated Circuits 3 Credits
Analysis and design of contemporary mixed signal electronic circuits, including phase-locked loops, A/D and D/A converters, sigma-delta converters, and switching power supplies. Continuous and discrete time simulation of mixed signal systems starting with operational amplifiers as a prototype feedback system using Spice and Matlab. Prerequisites: ECE 108 and ECE 123

ECE 361 Introduction to VLSI Circuits 3 Credits
The design of Very Large Scale Integrated (VLSI) Circuits, with emphasis on CMOS Standard Cell design. Topics include MOS transistor physics, device behavior and device modeling, MOS technology and physical layout, design of combinational and sequential circuits, static and dynamic memories, and VLSI chip organization. The course includes a design project using CAE tools for layout, design rule checking, parameter extraction, and SPICE simulations for performance prediction. Two one-hour lectures and three hours of laboratory per week. Prerequisites: ECE 123

ECE 362 Introduction to VLSI System Design 3 Credits
Structured hierarchical approach to the design of digital VLSI circuits and systems. Use of CAE tools for design and verification. Topics include: systems aspects of VLSI design, design methodologies, schematic capture, functional verification, timing simulation, use of a CMOS standard cell library and of a silicon compiler. The course includes a semester-long design project, with the design to be fabricated by a foundry. Two one-hour lectures and three hours of design laboratory per week. Prerequisites: ECE 138

ECE 364 Introduction to Cryptography and Network Security 3 Credits
Introduction to cryptography, classical cipher systems, cryptanalysis, perfect secrecy and the one time pad, DES and AES, public key cryptography covering systems based on discrete logarithms, the RSA and the knapsack systems, and various applications of cryptography. May not be taken with ECE 464 for credit. Must have junior or senior standing.

ECE 366 (BIOE 366) Neural Engineering 3 Credits
Neural system interfaces for scientific and health applications. Basic properties of neurons, signal detection and stimulation, instrumentation and microfabricated electrode arrays. Fundamentals of peripheral and central neural signals and EEG, and applications such as neural prostheses, implants and brain-computer interfaces. Closed to students who have taken BIOE 366, BIOE 466, and ECE 466. Prerequisites: ECE 081

ECE 368 (BIOE 368) Introduction to Biophotonics and Optical Biomedical Imaging 3 Credits
Optical principles, techniques, and instruments used in biomedical research and clinical medicine. Fundamental concepts of optical imaging and spectroscopy systems, and details of light-tissue interaction. Commercial devices and instruments, as well as novel optical imaging technologies in development. Closed to students who have taken ECE 468, BIOE 368, or BIOE 468. Prerequisites: ECE 202 or PHY 212

ECE 371 Optical Information Processing 3 Credits
Introduction to optical information processing and applications. Interference and diffraction of optical waves. 2D optical matched filters that use lenses for Fourier transforms. Methods and devices for modulating light beams for information processing, communications, and optical computing. Construction and application of holograms for optical memory and interconnections. Prerequisites: (ECE 108 and ECE 202)

ECE 372 Optical Networks 3 Credits
Study the design of optical fiber local, metropolitan, and wide area networks. Topics include: passive and active photonic components for optical switching, tuning, modulation and amplification; optical interconnection switches and buffering; hardware and software architectures for packet switching and wavelength division multiplex systems. The class is supported with a laboratory. Prerequisites: (ECE 081 and ECE 202)

ECE 387 (CHE 387, ME 387) Digital Control 3 Credits
Sampled-data systems; z-transforms; pulse transfer functions; stability in the z-plane; root locus and frequency response design methods; minimal prototype design; digital control hardware; discrete state variables; state transition matrix; Liapunov stability; state feedback control. Prerequisites: CHE 386 or ECE 212 or ME 343

ECE 389 (CHE 389, ME 389) Control Systems Laboratory 2 Credits
Experiments on a variety of mechanical, electrical and chemical dynamic control systems. Exposure to state of the art control instrumentation: sensors, transmitters, control valves, analog and digital controllers. Emphasis on comparison of theoretical computer simulation predictions with actual experimental data. Lab teams will be interdisciplinary. Prerequisites: CHE 386 or ECE 212 or ME 343

ECE 392 Independent Study 1-3 Credits
An intensive study, with report of a topic in electrical and computer engineering which is not treated in other courses. Consent of instructor required. Repeat Status: Course may be repeated.

ECE 401 (CSE 401) Advanced Computer Architecture 3 Credits
Design, analysis and performance of computer architectures; high-speed memory systems; cache design and analysis; modeling cache performance; principle of pipeline processing, performance of pipelined computers; scheduling and control of a pipeline; classification of parallel architectures; systolic and data flow architectures; multiprocessor performance; multiprocessor interconnections and cache coherence. Prerequisites: ECE 291

ECE 402 Advanced Electromagnetics 3 Credits
ECE 404 (CSE 404) Computer Networks 3 Credits
Study of architecture and protocols of computer networks. The ISO model; network topology; data-communication principles, including circuit switching, packet switching and error control techniques; sliding window protocols, protocol analysis and verification; routing and flow control; local area networks; network interconnection; topics in security and privacy.

ECE 407 Linear and Nonlinear Optics 3 Credits
Diffraction theory, Gaussian beams. Optical resonators and waveguides. Crystal optics, second harmonic generation, parametric amplification. Third order nonlinearities and associated phenomena such as phase conjugation, optical bistability, self-focusing, optical switching, solutions, etc. Photo refractive effect. Brilloin and Raman scattering.

ECE 410 Digital Communication Systems 3 Credits
Unified description of digital communication systems based on signal space concepts. Analysis of system performance in the presence of channel noise and bandwidth limitations. Comparison of many different types of digital-modulation techniques, combined with error correction, against theoretical limits. Both bandpass and baseband systems are considered. Optimum methods of detection are considered for all systems. Suboptimum techniques such as adaptive equalization are considered for baseband systems. Basic spread-spectrum concepts are introduced.

ECE 411 Information Theory 3 Credits
Introduction to information theory. Topics covered include: development of information measures for discrete and continuous spaces study of discrete-stochastic information courses, derivation of noiseless information measures for discrete and continuous spaces study of information measures for discrete and continuous spaces study. Introduction to information theory. Topics covered include: development of information measures for discrete and continuous spaces study of information measures for discrete and continuous spaces.

ECE 412 Advanced Digital Signal Processing 3 Credits
Design and analysis of signal processing algorithms, number theoretic foundations of algorithm design, bilinear algorithms, computational techniques for digital filtering and convolution, Fourier transform and its algorithms, number theoretic transforms and applications to digital filtering, general and special purpose signal processor designs, application specific techniques in signal processing.

ECE 414 Signal Detection and Estimation 3 Credits
Brief review of probability and random process theory. Hypothesis Testing as applied to signal detection. Various optimality criterion including Bayes and Neyman-Pearson and their applications in digital communications, radar, and sonar systems. Optimum and locally optimum detection schemes for Gaussian and non-Gaussian noise. Estimation of unknown signal parameters. Topics of current interest including, distributed signal detection, robust signal detections and quantization for detection as time permits.

ECE 415 Numerical Processors 3 Credits
Design strategies for numerical processors, cellular array adders and multipliers, conditional sum and carry-save asynchronous processors, data recording and Booth’s algorithms, use of alternate numerical bases, CORDIC trigonometric calculator, accumulator orientations, bit slice and bit-sequential processors, pipelining and parallel processing considerations.

ECE 416 VLSI Signal Processing 3 Credits
The fundamentals of performance-driven VLSI systems for signal processing. Analysis of signal processing algorithms and architectures in terms of VLSI implementation. VLSI design methodology. Includes a design project which requires use of a set of tools installed on SUN workstations for behavioral simulation, systolic simulation, circuit simulation, layout, functional simulation, timing and critical path analysis, functional testing, and performance measurement.

ECE 417 Pattern Recognition 3 Credits

ECE 420 Advanced Circuits and Systems 3 Credits
Review of the fundamentals of Circuits and Systems theory, including the time and frequency domain response of linear time-invariant circuits. Equation formulation for general lumped circuits, including node voltage and loop current analysis. Basic graph theoretic properties of circuits including Tellegen’s Theorem. Discussion of passivity and reciprocity including multipport network properties. State space formulation and solution of general circuits (and systems). Modern filter concepts, including synthesis techniques for active filters and externally linear filters, such as Log Domain filters. Techniques for the analysis of weakly nonlinear systems, as time permits. Must have graduate standing.

Prerequisites: ECE 125

ECE 422 Advanced Circuits and Systems II 3 Credits
Continuation of Semiconductor Lasers I. Topics covered include: Gain and current relations; dynamic effects; perturbation and coupled-mode theory; dielectric waveguides; and photonic integrated circuits. This course, a version of ECE326 for graduate students, requires research projects and advanced assignments. Credit will not be given for both ECE 326 and ECE 422.

Prerequisites: ECE 203

ECE 423 Digital Image Processing 3 Credits
Fading and dispersive channel model, direct sequence spread spectrum, frequency hopping spread spectrum, DS-CDMA, FH-CDMA, spread sequences and their properties, multi-user detection, PN code acquisition, wireless communication systems, industrial standards (IS-95, WCDMA, CDMA2000)

ECE 426 Semiconductor Lasers II 3 Credits
State-space methods of feedback control system design and design optimization for invariant and time-varying deterministic, continuous systems; pole positioning, observability, controllability, modal control, observer design, the theory of optimal processes and Pontryagin’s Maximum Principle, the linear quadratic optimal regulator problem, Lyapunov functions and stability theorems, linear optimal open loop control; introduction to the calculus of variations; introduction to the control of distributed parameter systems. Intended for engineers with a variety of backgrounds. Examples will be drawn from mechanical electrical and chemical engineering applications.

Prerequisites: ME 343 or ECE 212 or CHE 386
ECE 434 (CHE 434, ME 434) Multivariable Process Control 3 Credits
A state-of-the-art review of multivariable methods of interest to process control applications. Design techniques examined include loop interaction analysis, frequency domain methods (Inverse Nyquist Array, Characteristic Loci and Singular Value Decomposition) feed forward control, internal model control and dynamic matrix control. Special attention is placed on the interaction of process design and process control. Most of the above methods are used to compare the relative performance of intensive and extensive variable control structures.
Prerequisites: CHE 433 or ME 433 or ECE 433

ECE 435 Error-Correcting Codes 3 Credits
Error-correcting codes for digital computer and communication systems. Review of modern algebra concentrating on groups and finite fields. Structure and properties of linear and cyclic codes for random or burst error correction covering Hamming, Golay, Reed-Muller, BCH and Reed-Solomon codes. Decoding algorithms and implementation of decoders.
Prerequisites: ECE 433 or ME 433 or ECE 433

ECE 436 (CHE 436, ME 436) Systems Identification 3 Credits
The determination of model parameters from time-history and frequency response data by graphical, deterministic and stochastic methods. Examples and exercises taken from process industries, communications and aerospace testing. Regression, quasilinearization and invariant-embedding techniques for nonlinear system parameter identification included.
Prerequisites: ECE 433 or ME 433 or ECE 433

ECE 437 (CHE 437, ME 437) Stochastic Control 3 Credits
Prerequisites: ME 433 or CHE 433 or ECE 433

ECE 438 Quantum Electronics 3 Credits
Electromagnetic fields and their quantization. propagation of optical beams in homogeneous and lens-like media. Modulation of optical radiation. Coherent interactions of radiation fields and atomic systems. Introduction to nonlinear optics-second-harmonic generation. Parametric amplification, oscillation, and fluorescence. Third-order optical nonlinearities. This course, a version of ECE 338 for graduate students, requires research projects and advanced assignments. Credit will not be given for both ECE 338 and ECE 438.

ECE 441 Fundamentals of Wireless Communications 3 Credits
Characterization of mobile radio channels. Wireless information transmission: modulation/demodulation, equalization, diversity combining, coding/decoding, multiple access methods. Overview of cellular concepts and wireless networking. This course, a version of ECE 341 for graduate students, requires research projects and advanced assignments. Credit will not be given for both ECE 341 and ECE 441.
Prerequisites: ECE 342 or ECE 342

ECE 443 RF Power Amplifiers for Wireless Communications 3 Credits
Review of linear power amplifier design. Discussion of major nonlinear effects, such as high-efficiency amplifiers modes, matching network design for reduced conduction angle, overdrive and limiting effects, and switching mode amplifiers. Discussion of other nonlinear effects, efficiency enhancement and linearization techniques. Companion course to ECE 463.

ECE 447 Introduction to Integrated Optics 3 Credits
Theory of dielectric waveguides (ray and wave approach). Modes in planar slab optical guides and in waveguides with graded index profiles. Coupled-mode formalism and periodic structures. Coupling of optical beams to planar structures. Switching and modulation of light in dielectric guides: phase, frequency and polarization modulators; electro-optic, acousto-optic and magneto-optic modulators. Semiconductor lasers. Fabrication of semiconductor components. Recent advances. The course is an extension of ECE 347 for graduate students and it will include research projects and advanced assignments.
Prerequisites: ECE 202 and ECE 203

ECE 448 Lightwave Technology 3 Credits
Overview of optical fiber communications. Optical fibers, structures and waveguiding fundamentals. Signal degradation in fibers arising from attenuation, intramodal and intermodal dispersion. Optical sources, semiconductor lasers and LEDs. Rate equations and frequency characteristics of a semiconductor laser. Coupling efficiency of laser diodes and LEDs to single-mode and multimode fibers. PIN and avalanche photodetectors. Optical receiver design. Transmission link analysis. The course is an extension of ECE 348 for graduate students and it will include research projects and advanced assignments.

ECE 450 Special Topics 1-3 Credits
Selected topics in electrical and computer engineering not covered in other courses.
Repeat Status: Course may be repeated.
Prerequisites: ECE 126

ECE 452 Advanced Semiconductor Diode and Transport Theory 3 Credits
Properties of metal-semiconductor contacts, Schottky barriers, ohmic contacts, hot electrons, intervalley scattering, velocity saturation, secondary ionization, avalanche breakdown. Applications to microwave devices such as avalanche and Gunn diodes, Schottky barrier diodes, tunnel diodes and PIN diodes.

ECE 454 Turbo Codes and Iterative Decoding 3 Credits

ECE 455 Theory of Metal Semiconductor and Heterojunction Transistors 3 Credits

ECE 460 Engineering Project 3-6 Credits
Project work in an area of student and faculty interest. Selection and direction of the project may involve interaction with industry. Consent of department required.

ECE 461 Theory of Electrical Noise 3 Credits

ECE 463 Design of Microwave Solid State Circuits 3 Credits
Equivalent circuit modeling and characterization of microwave semiconductor devices, principles of impedance matching, noise properties and circuit interaction, introduction to the design of high power and non-linear circuits.

ECE 464 Introduction to Cryptography and Network Security 3 Credits
Introduction to cryptography, classical cipher systems, cryptanalysis, perfect secrecy and the one time pad, DES and AES, public key cryptography covering systems based on discrete logarithms, the RSA and the knapsack systems, and various applications of cryptography. This graduate version of ECE 364 requires additional work. May not be taken with ECE 364 for credit. Must have graduate student status.
ECE 465 VLSI Implementation of Error Control Coding 3 Credits
Error control coding, finite field arithmetic, encoding and decoding of BCH and Reed-Solomon codes, efficient iterative decoders for convolutional and Turbo codes, message passing and high performance decoders for low-density parity-check codes.
Prerequisites: ECE 435

ECE 466 (BIOE 466) 3 Credits
Neural system interfaces for scientific and health applications. Basic properties of neurons, signal detection and stimulation, instrumentation and microfabricated electrode arrays. Fundamentals of peripheral and central nervous systems and EEG, and applications such as neural prostheses, implants and brain-computer interfaces. Closed to students who have taken BIOE 366, ECE 366, or ECE 466. Students enrolled in the course at the 400-level must complete additional advanced assignments, as defined by the course instructor.

ECE 468 (BIOE 468) Introduction to Biophotonics and Optical Biomedical Imaging 3 Credits
Optical principles, techniques, and instruments used in biomedical research and clinical medicine. Fundamental concepts of optical imaging and spectroscopy systems, and details of light-tissue interaction. Commercial devices and instruments, as well as novel optical imaging technologies in development. Closed to students who have taken BIOE 468, ECE 368, or ECE 468. Students enrolled in the course at the 400-level must complete additional advanced assignments, as defined by the course instructor.

ECE 469 Process Modeling for Semiconductor Devices 3 Credits
Students will design and “manufacture” a Si or GaAs transistor through process simulation of ion implantation, epitaxial growth, diffusion and contact formation, etc. I-V characteristics and small signal parameters, suitable for digital and microwave circuit simulation programs, will be derived. Complimentary to ECE 463 and ECE 471.

ECE 471 Optical Information Processing 3 Credits
Introduction to optical information processing and applications. Interference and diffraction of optical waves. 2D optical matched filters that use lenses for Fourier transforms. Methods and devices for modulating light beams for information processing, communications, and optical computing. Construction and application of holograms for optical memory and interconnections. The course is an extension of ECE 371 for graduate students and it will include research projects and advanced assignments.
Prerequisites: (ECE 108)

ECE 472 Optical Networks 3 Credits
Study the design of optical fiber local, metropolitan, and wide area networks. Topics include: passive and active photonic components for optical switching, tuning, modulation and amplification; optical interconnection switches and buffering; hardware and software architectures for packet switching and wavelength division multiaccess systems. This class is supported with a laboratory. The course is an extension of ECE 372 for graduate students and it will include research projects and advanced assignments.
Prerequisites: ECE 081

ECE 474 Analog CMOS VLSI Design 3 Credits
The fundamentals of analog circuit design with CMOS linear IC techniques. Discrete Analog Signal Processing (DASP) is accomplished with switched-capacitor CMOS circuits. Analog building blocks include operational amplifiers, S/H circuits, comparators and voltage references, oscillators, filters, modulators, phase detectors/shifters, charge transfer devices, etc. Analog sub-system applications are phase-locked loops (PLL’s), A/D and D/A converters, modems, sensors, adaptive filters and equalizers, etc. The emphasis is on the physical operation of analog CMOS integration circuits and the design process.

ECE 476 Analysis and Design of Analog Integrated Circuits 3 Credits
Device and circuit models of bipolar and field effect transistors; bipolar and MOS integrated circuit technology; passive components; parasitic and distributed elements; amplifier gain stages; subthreshold gain stages; current sources and active loads; temperature and supply independent biasing; output stage design; frequency response and slew rate limitation; operational amplifier and analog multiplier design. Circuit simulation using SPICE.

ECE 478 Analysis and Design of Digital Integrated Circuits 3 Credits
Large signal models and transient behavior of MOS and bipolar transistors. Basic inverter and logic gate circuits. Noise margins, operating speed, and power consumption of various logic families, including MOS, CMOS, saturated logic TTL, ECL, and IIL. Regenerative logic circuits and digital memories. Circuit design and computer-aided circuit analysis for LSI and VLSI circuits.

ECE 479 Advanced MOS VLSI Design 3 Credits
The design of very large scale MOS and CMOS integrated circuits. Strong emphasis on device physics, and on novel circuit design approaches for VLSI implementation. Examination of second-order effects involved in designing high performance MOS digital integrated circuits, with the goal of pushing the design process to the limits determined by our current understanding of semiconductor device physics and of the currently available technologies. The topics include device physics (subthreshold conduction, short channel effects), important circuit innovations (substrate bias generators, sense amplifiers), systems aspects (clocking, timing, array structures), as well as static and dynamic circuit implementations. Design project, using VLSI design automation tools.

ECE 483 Advanced Semiconductor Devices for VLSI Circuits 3 Credits
Theory of small geometry devices for VLSI circuits. Emphasis of MOS bipolar device static and dynamic electrical characteristics. Carrier injection, transport, storage, and detection in bulk and interfacial regions. Limitations of physical scaling theory for VLSI submicron device structures. MOS physics and technology, test pattern device structures, charge-coupled devices, MNOS nonvolatile memory devices, and measurement techniques for device and process characterization. The influence of defects on device electrical properties.

ECE 485 Heterojunction Materials and Devices 3 Credits
Material properties of compound semiconductor heterojunctions, quantum wells and superlattices. Strained layer epitaxy and band-gap engineering. Theory and performance of novel devices such as quantum well lasers, resonant tunneling diodes, high electron mobility transistors, and heterojunction bipolar transistors. Complementary to ECE 452. Prerequisites: ECE 451

ECE 486 Integrated Solid-State Sensors 3 Credits
The physical operation of sensor-based, custom integrated circuits. Emphasis on the integration of sensors, analog, and digital circuits on a silicon chip with CMOS technology. Sensors include photocells, electrochemical transducers, strain gauges, temperature detectors, vibration and velocity sensors, etc. Analysis of sensor-circuit performance limits including signal-to-noise, frequency response, temperature sensitivity, etc. Examples of sensor-based, custom I.C.’s are discussed and analyzed with CAD modeling and layout.

ECE 490 Thesis 1-6 Credits
ECE 491 Research Seminar 1-3 Credits
Regular meetings focused on specific topics related to the research interests of department faculty. Current research will be discussed. Students may be required to present and review relevant publications. Consent of instructor required.

ECE 492 Independent Study 1-3 Credits
An intensive study, with report, of a topic in electrical and computer engineering which is not treated in other courses. Consent of instructor required.

ECE 493 Solid-State Electronics Seminar 3 Credits
Discussion of current topics in solid-state electronics. Topics selected depend upon the interests of the staff and students and are allied to the research programs of the Sherman Fairchild Laboratory for Solid State Studies. Students participation via presentation of current research papers and experimental work. Consent of instructor required.

ECE 499 Dissertation 1-15 Credits
Repeat Status: Course may be repeated.
Electrical Engineering and Engineering Physics

This dual-degree curriculum is particularly well suited for students seeking thorough preparation in the field of electronic device physics. It is a combination of the basic electrical engineering and engineering physics curricula and requires 162 credit hours, distributed over five years. The student will earn two degrees: B.S. in electrical engineering and B.S. in engineering physics.

Two alternative course sequences are listed below. Students who follow the EE-EP (EE first) course sequence will complete 135 credit hours, including all of the required electrical engineering courses, by the end of the fourth year and the remaining credit hours at the end of the fifth year. Since 134 credit hours are required for the electrical engineering degree, the student will complete the requirements for that degree at the end of the fourth year, and the requirements for the engineering physics degree at the end of the fifth year.

In the alternative EP-EE (EP first) course sequence, the student completes 133 credit hours by the end of the fourth year, including all the required physics courses, and the remaining credits at the end of the fifth year. Since 131 credit hours are required for the engineering physics degree, the student will complete the requirements for that degree at the end of the fourth year, and the requirements for the electrical engineering degree at the end of the fifth year.

Students interested in a dual-degree program combining physics (rather than engineering physics) and electrical engineering should consult the Physics section of this catalog. That program allows the student to earn the B.S. in physics and the B.S. in electrical engineering.

Students interested in either dual-degree program should contact Prof. Gary G. DeLeo, Department of Physics.

THE RECOMMENDED SEQUENCES OF COURSES FOR THE TWO DIFFERENT EEEP SEQUENCES

<table>
<thead>
<tr>
<th>EE-EP</th>
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<td>ENGL 002</td>
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<td>PHY 011 &amp; PHY 012</td>
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<td>PHY 213</td>
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<td>ECE 125</td>
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<td>ECO 001</td>
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</tbody>
</table>

**Total Credits: 164**

Credits in 4 yrs [135]
The EP-approved electives must include at least three courses from the following:

- PHY 363 Physics of Solids
- PHY 369 Quantum Mechanics I
- PHY 352 Modern Optics
- PHY 355 Nonlinear Optics
- PHY 348 Plasma Physics
- PHY 365 Physics Of Fluids
- PHY 380 Introduction to Computational Physics

The ECE-approved electives must be approved by the student’s advisor.
Energy Systems Engineering

PHY 363 3 HSS 3
HSS 3

15 18

Fifth Year
First Semester CR Second Semester CR
MATH 231 3 ECE 258 2
ECE 136 3 ECE - Ap. Elec. 9
ECE 257 3 Elective 4
ECE - Ap. Elec. 3
Electives

15

Total Credits: 163

Credits in 4 yrs [133]

The EP-approved electives must include at least three courses from the following:

PHY 363 Physics of Solids 3
PHY 369 Quantum Mechanics I 3
PHY 352 Modern Optics 3
or PHY 355 Nonlinear Optics
PHY 348 Plasma Physics 3
or PHY 365 Physics Of Fluids
PHY 380 Introduction to Computational Physics 3

The ECE-approved electives must be approved by the student's advisor.

Energy Systems Engineering

MASTER OF ENGINEERING IN ENERGY SYSTEMS ENGINEERING

For students with B.S. degrees in engineering, physics, computer science or mathematics, Lehigh's 10-month, 30-credit professional Master's program in energy systems engineering helps students develop into organizational and technical leaders in the energy and power industries. Learning takes place in an environment where potential employers actively guide curricular development and student research endeavors. Graduates of this program emerge with the skills and confidence to tackle the grand challenges facing the global energy infrastructure and its associated effect on the environment.

The hallmark of the program is student immersion in hands-on, industry-driven projects. Each student will apply advanced technical knowledge and skills and work collaboratively with a team of faculty, fellow students, and representatives from sponsor firms to complete a project of impact and significance in the field — a real project as conceptualized by the project's sponsoring researcher or industry concern. The development of targeted research projects serves as an entry point into the field for talented young innovators, and a source for firms to explore new skill sets and solutions required for success with emerging technologies and approaches.

The basic 30 credit hour course sequence consists of:

**ESE Core Courses** 12

- ESE 403 (p. 214) Energy and the Environment 3
- ESE 405 (p. 214) Energy Systems Project Management 3

**Total Credits: 6**

**Fall Semester**

- ESE 401 (p. 214) Energy Generation 3
- ESE 460 (p. 214) Energy Systems Engineering Project 3

**Electives (2)**

**Total Credits: 12**

**Spring Semester**

- ESE 402 (p. 214) Transmission and Distribution 3
- ESE 460 (p. 214) Energy Systems Engineering Project * 3

**Electives (2)*

**Total Credits: 12**

*Student may choose to take a third technical elective instead of ESE 460 in the Spring semester with the approval of the program Director.

Students acquire a level of specialized knowledge and experience through the completion of four to five technical electives courses. The electives should reflect the student's career interest. Below is the list of departments from which the technical electives are drawn from.

The full list of technical electives for each department listed below is available online at: www.lehigh.edu/esei/electives. Other electives may be considered with the approval of the program Director.

- Two (2) electives must be 400 level courses and
- Three (3) electives must be in the P.C. Rossin College of Engineering and Applied Science.

**Technical Elective Department List:**

- Engineering
  - Chemical Engineering
  - Civil & Environmental Engineering
  - Computer Science & Engineering
  - Electrical & Computer Engineering
  - Industrial & Systems Engineering
  - Materials Science & Engineering
  - Mechanical Engineering & Mechanics

- Business and Science
  - Chemistry
  - Earth & Environmental Science
  - Economics

Further information can be obtained from:

- www.lehigh.edu/esei
- Program Director
- Energy Systems Engineering Institute
- P.C. Rossin College of Engineering & Applied Science
- (610) 758-3529
- Program Coordinator

Energy Systems Engineering Institute
P.C. Rossin College of Engineering and Applied Science
(610) 758-3650

Recommended sequence of courses in the ESE M.Eng. program

Summer Session II (Late June/August)

<table>
<thead>
<tr>
<th>Summer</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ESE 403 (p. 214)</td>
<td>Energy and the Environment 3</td>
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<tr>
<td>ESE 405 (p. 214)</td>
<td>Energy Systems Project Management 3</td>
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**Total Credits: 6**

Fall Semester

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<th>Fall</th>
<th>Credits</th>
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<tr>
<td>ESE 401 (p. 214)</td>
<td>Energy Generation 3</td>
</tr>
<tr>
<td>ESE 460 (p. 214)</td>
<td>Energy Systems Engineering Project 3</td>
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</table>

**Electives (2)**

**Total Credits: 12**

Spring Semester

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<th>Spring</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ESE 402 (p. 214)</td>
<td>Transmission and Distribution 3</td>
</tr>
<tr>
<td>ESE 460 (p. 214)</td>
<td>Energy Systems Engineering Project * 3</td>
</tr>
</tbody>
</table>

**Electives (2)*

**Total Credits: 12**

Students typically begin this 10 month program in Summer Session II and will graduate spring of the following year with a Master of Engineering degree in energy systems engineering.

Further information can be obtained from:

www.lehigh.edu/esei
Courses

**ESE 401 Energy Generation 3 Credits**
This course provides an overview of the different methods of generating electricity, such as turbine driven electrochemical generators, fuel cells, photovoltaics, and thermoelectric devices. Topics include the combustion of fossil fuels (coal, natural gas, and oil), nuclear fission and fusion, and renewable resources (solar, wind, hydro, tidal, and geothermal sources). Sustainability, energy efficiency issues, as well as public interest and policy drivers are also addressed.

**ESE 402 Transmission & Distribution: Smart Grid 3 Credits**
This course provides an overview of modern power transmission and distribution systems. Topics include transformer technology, transmission grids, load management, distribution optimization, power supply reliability, and infrastructure systems. Security and deregulation issues are also addressed.

**ESE 403 Energy And The Environment 3 Credits**
This course provides an overview of the direct and indirect impact of energy generation and transmission technologies on the environment. Topics include global climate change, clean energy technologies, energy conservation, air pollution, water resources, and nuclear waste issues.

**ESE 405 Energy Systems Project Management 3 Credits**
This course introduces students to the basics of project management in the field of energy systems, which includes the broad spectrum of empirical, theoretical and policy issues of managing the electric power grid, its generation facilities and equipment. This focuses on the key elements of case studies in engineering that focus on the effective project management of tomorrow's intelligent energy system.

**ESE 460 Energy Systems Engineering Project 3-6 Credits**
A collaborative and intensive study in an area of energy systems engineering, with an emphasis on direct industrial applications. A written report plus a poster presentation or oral presentation is required. Students typically begin this 10 month program in SummerSession II and will graduate spring of the following year with a Master of Engineering degree in energy systems engineering.

Engineering

See additional information on the P.C. Rossin College of Engineering and Applied Science (p. 61).

**ENGINEERING MINOR**
See additional information on the Engineering Minor under the heading of the P.C. Rossin College of Engineering and Applied Science (p. 61).

<table>
<thead>
<tr>
<th>Core Prerequisites to begin the program</th>
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<tbody>
<tr>
<td><strong>MATH 051</strong></td>
<td>Survey of Calculus I (or equivalent)</td>
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<tr>
<td><strong>PHY 005</strong></td>
<td>Concepts In Physics (or equivalent)</td>
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<th><strong>Required Courses</strong></th>
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<tbody>
<tr>
<td><strong>EMC 001</strong></td>
<td>Macro and Micro View of Engineering</td>
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<tr>
<td><strong>EMC 002</strong></td>
<td>Engineering Practicum</td>
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<td>9</td>
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<tr>
<td><strong>Group A - Engineering Fundamentals</strong></td>
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<tr>
<td><strong>EMC 105</strong></td>
<td>Engineering Structures and Motion</td>
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<td><strong>EMC 110</strong></td>
<td>Energy Engineering</td>
</tr>
<tr>
<td><strong>EMC 115</strong></td>
<td>Engineering Materials and Electronics</td>
</tr>
<tr>
<td><strong>EMC 120</strong></td>
<td>Systems Engineering</td>
</tr>
<tr>
<td><strong>Group B - Integrated Engineering</strong></td>
<td></td>
</tr>
<tr>
<td><strong>EMC/CSE 042</strong></td>
<td>Game Design</td>
</tr>
<tr>
<td><strong>EMC 150</strong></td>
<td>Information and Knowledge Engineering</td>
</tr>
<tr>
<td><strong>EMC 155</strong></td>
<td>Enterprise Engineering</td>
</tr>
<tr>
<td><strong>EMC 156</strong></td>
<td>Embedded Systems</td>
</tr>
</tbody>
</table>

**Total Credits**

<table>
<thead>
<tr>
<th>Electives</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>EMC 160</strong></td>
<td>Computer Aided Engineering and Control Systems</td>
</tr>
<tr>
<td><strong>EMC/ISE 168</strong></td>
<td>Production Analysis</td>
</tr>
<tr>
<td><strong>EMC 170</strong></td>
<td>Software Engineering and Collaborative Environments</td>
</tr>
<tr>
<td><strong>EMC/CHE/CEE/ES 171</strong></td>
<td>Fund of Environmental Technology</td>
</tr>
<tr>
<td><strong>EMC 174</strong></td>
<td>Process Engineering</td>
</tr>
</tbody>
</table>

| **Total Credits** | 15 |

1. May be taken concurrently with EMC 001 and EMC 002.
2. Three electives are required and must include one from the Engineering Fundamentals course group and one from the Integrated Engineering course group. The student is free to choose the third elective from either group.

Number of credits to fulfill minor is 15 credits

**Note: The Minor in Engineering is not open to RCEAS students.**

**Engineering Minor Course Courses**

**EMC 001 Macro and Micro View of Engineering 3 Credits**
A course designed to be exciting and stimulate a student's further interest in the engineering minor. Hands-on experience with engineering problem solving, modeling, simulation, and analysis tools. Macro view of what engineering is and what engineers do. Interaction with practicing engineers; visits to local engineering facilities.

**EMC 002 Engineering Practicum 3 Credits**
Techniques and processes used in the creation of engineered products. Exposure to engineering tasks and processes in a hands-on laboratory; mechanical and electronic manufacturing and fabrication techniques. Disassembly and reassembly of common engineered products to assess how they work and are manufactured.

**EMC 042 (CSE 042) Game Design 3 Credits**
From the early text-based, one-player computer games to the modern 3D games with thousands of gamers sharing the same virtual gaming world simultaneously, computer games have gone through a remarkable evolution. Despite this evolution, principles of computer game design are not well understood. In this course we will study the broad issue of game design, particularly tailored towards video games. We will present an experimental model for game design and analyze various modern computer games from the perspective of this model.

**EMC 105 Engineering Structures and Motion 3 Credits**
Practical limits imposed on stationary or moving structures; why exceeding these limits can lead to failure. Basic principles governing both stationary structures; e.g. buildings and bridges, and things that move, e.g. cars and satellites, and how these principles apply in engineering practice. How a stationary structure effectively supports both its own weight and the weight of its users and why a structure will undergo deflections and deformations during use. How forces and energy are associated with a moving structure and how these affect the motion of the structure.

**EMC 110 Energy Engineering 3 Credits**
The amount of energy used by a modern society is quite staggering, and a clear understanding of energy processes and constraints is essential knowledge for every citizen. The basics of energy, its measurement, principles governing its use and conversion, methods of production, and the associated consequences on the environment. Fossil, nuclear, and renewable, energy sources. Energy utilization developed in a simple form and employed to examine the use of energy in large and small engineering systems and products, from power plants to air conditioners.

**EMC 115 Engineering Materials and Electronics 3 Credits**
"Materials" are the "stuff" from which we build TV’s, cell phones, cars, skyscrapers, etc., and affect design, performance, costs, and environmental impacts. How electronics, communications, and structures depend on advances in materials engineering; materials behavior, modeling and simulation of materials properties and performance; methods and databases for materials selection; and engineering processes to control material composition and structure.
EMC 120 Systems Engineering 3 Credits
Systems approach to problem solving in fields such as environmental planning, large-scale infrastructure systems, manufacturing, telecommunication, and delivery of services. Systems analysis concepts and their relation to the determination of preferred plans and designs of complex, large-scale engineering systems. Performance and cost in project engineering decisions that balance resource investments across the major stages of life of an engineering system. Development of functional requirements and satisfactory designs.

EMC 150 Information and Knowledge Engineering 3 Credits
How computers manage information for making decisions automatically or for advising decision makers. Characterization of database systems, of web technologies, of multimedia, and of the relationships among them. Representations of knowledge and the use of artificial intelligence techniques. Automated help-desk systems and computer generation of project plans.

EMC 155 Enterprise Engineering 3 Credits
The key elements of modeling and engineering the corporation. Enterprise engineering, decision analysis, application of quantitative methods to facilities planning, engineering economy, production planning and control, forecasting, material requirements planning, and agile business practices.
Prerequisites: EMC 001 or EMC 002
Can be taken Concurrently: EMC 001, EMC 002

EMC 156 Embedded Systems 3 Credits
Prerequisites: EMC 001 or EMC 002
Can be taken Concurrently: EMC 001, EMC 002

EMC 160 Computer Aided Engineering and Control Systems 3 Credits
Use of computer-based technologies to design and manufacture products. The design cycle to create product concepts. Analysis of product design. Specifications for the control of manufacturing processes. How control systems are used in creating agile manufacturing environments: discrete and analog signals, analog to digital conversion, and application case studies. Hands-on application(s) and sample exercises from real world examples.

EMC 168 (ISE 168) Production Analysis 3 Credits
A course for students not majoring in industrial engineering. Engineering economy; application of quantitative methods to facilities analysis and planning, operations planning and control, work measurement, and scheduling.

EMC 170 Software Engineering and Collaborative Environments 3 Credits
Discover why building large software systems is very different from using large databases, or designing products such as automobiles with CAD, etc. Design and implementation of a large team project involving complex data management in a collaborative environment. Learn why and how collaborative environments are becoming essential to modern engineering projects and require the tools and techniques of software engineering to succeed.
Prerequisites: EMC 001 or EMC 002
Can be taken Concurrently: EMC 001, EMC 002

EMC 171 (CEE 171, CHE 171, ES 171) Fund of Environmental Technology 4 Credits

EMC 174 Process Engineering 3 Credits
Semiconductor process engineering, including technology to process raw silicon wafer to electronics integrated circuits (ICs). Crystal growth, thin film deposition, photolithography, doping technology.
Prerequisites: EMC 001 or EMC 002
Can be taken Concurrently: EMC 001, EMC 002

EMC 252 (STS 252) Computers, the Internet, and Society 3 Credits
An interactive exploration of the current and future role of computers, the Internet, and related technologies in changing the standard of living, work environments, society and its ethical values. Privacy, security, depersonalization, responsibility, and professional ethics; the role of computer and Internet technologies in changing education, business modalities, collaboration mechanisms, and everyday life.

Engineering Courses
ENGR 005 Introduction to Engineering Practice 2 Credits
First year practical engineering experience; introduction to concepts, methods and principles of engineering practice. Problem solving, design, project planning, communication, teamwork, ethics and professionalism; innovative solution development and implementation. Introduction to various engineering disciplines and degree programs. Mandatory for and open only for first year RCEAS students.

ENGR 010 Applied Engineering Computer Methods 2 Credits
Introduction to programming for engineering tasks. Use of Matlab to program and solve engineering problems. Interfacing sensors and actuators to a microcontroller board and programming to interact with the world. Computer lab setting. Final project controls engineering equipment.
Attribute/Distribution: ND

ENGR 050 Directed Study 1-3 Credits
Engineering project work either as an individual or team member. Projects directed by faculty within the Rossin College of Engineering and Applied Science with possible interaction from outside consultants, community and industry leaders. Written report required. RCEAS permission required.
Repeat Status: Course may be repeated.

ENGR 130 Engineering Communications 1 Credit
Experience and theory in oral and written communications preparing students for their first Co-Op work assignments. Required of all Engineering Co-Op students.
Prerequisites: ENGR 200 or ENGR 198
Can be taken Concurrently: ENGR 200, ENGR 198

ENGR 160 Engineering Internship 1-3 Credits
Offers students who have attained at least Jr2 standing an opportunity to complement coursework with a work experience. Detailed rules can be obtained from the Associate Dean of Engineering. Report required. P/F grading.

ENGR 200 Engineering Co-op 3 Credits
Supervised cooperative work assignment to obtain practical experience. Must have acceptance into the program. P/F grading.
Repeat Status: Course may be repeated.

ENGR 212 (BUS 212, DES 212) Integrated Product Development-2 (IPD-2) 2 Credits
Business engineering, and design arts students work in cross disciplinary teams of 4-6 students on the detailed design, including fabrication and testing, of a prototype following industry and engineering standards for the new product designed in the IPD course 1. Additional deliverables include a detailed production plan, marketing plan, base-case financial models, project portfolio. Teams work on projects from industry and entrepreneurial start-ups. Oral presentations and written reports.
Prerequisites: ENGR 211
ENGR 300 Apprentice Teaching 1-3 Credits
Supervised cooperative work assignment to obtain practical experience in field of study. Requires consent of department chairperson. When on a cooperative assignment, the student must register for this course to maintain continuous student status. Limit to at most three credits per registration period. No more than six credits may be applied towards a master's program and no more than nine credits may be used throughout a student's entire graduate study at Lehigh.
Repeat Status: Course may be repeated.

ENGR 400 Engineering Co-op for Graduate Students 1-3 Credits
Supervised cooperative work assignment to obtain practical experience in field of study. Requires consent of department chairperson. When on a cooperative assignment, the student must register for this course to maintain continuous student status. Limit to at most three credits per registration period. No more than six credits may be applied towards a master's program and no more than nine credits may be used throughout a student's entire graduate study at Lehigh.
Repeat Status: Course may be repeated.

ENGR 401 Teaching/Presentation Skills 1 Credit
Development of teaching and presentation skills for scientific professionals. Presentation effectiveness, teaching/presentation methodologies, classroom management, course development/content preparation, lecture/presentation development and lecture/presentation delivery. Individualized undergraduate course specific modules selected by student. Enrollment limited to Rossin Doctoral Fellows.

ENGR 402 Preparing for the Professoriate 1 Credit
Overview of the job search, research program development and service skills for graduate students entering academic careers. Transition from graduate student to faculty responsibilities, the post-doctoral experience, time management, CV/resume preparation, faculty search process, tenure and promotion, research leadership and program development, research proposal preparation and research sponsorship. Enrollment limited to Rossin Doctoral Fellows.

ENGR 430 Technical Writing for Engineering and the Sciences 1 Credit
Formal composition and technical writing skills for advanced non-native English writers in Engineering and the Sciences. Instructor and peer review of writing, self-editing strategies, how to incorporate technical vocabulary and formulas, advanced sentence structure, and appropriate citation of research. Field-specific readings, which students must compile, critique, and model in their own writing. Designed for international graduate students who are writing or preparing to write publishable quality articles, theses, or dissertations.

ENGR 452 Mathematical Methods in Engineering 3 Credits
Analytical techniques are developed for the solution of engineering problems described by algebraic systems, and by ordinary and partial differential equations. Topics covered include: linear vector spaces; eigenvalues, eigen-vectors, and eigenfunctions. First and higher-order linear differential equations with initial and boundary conditions; Sturm-Liouville problems; Green's functions. Special functions; Bessel, etc. Qualitative and quantitative methods for nonlinear ordinary differential equations; phase plane. Solutions of classical partial differential equations from the physical sciences; transform techniques; method of characteristics.

ENGR 490 Thesis (Moc) 1 Credit
ENGR 499 Dissertation (Moc) 1 Credit

Engineering Mathematics

The Division of Engineering Mathematics was established within the Department of Mechanical Engineering and Mechanics to foster interdisciplinary research in the application of mathematics to the engineering and physical sciences. Interaction with industry is actively encouraged, and appropriate programs are designed for part-time students.

Division faculty are responsible for the graduate degree programs in computational and engineering mechanics as well as courses in engineering mathematics (see mechanical engineering and mechanics (p. 323)).

English

The Department of English has developed a focus on Literature and Social Justice, the outcome of a multi-year effort to revitalize the traditional period-based approach to literary studies. Our classes foster a series of related activities: an exploration of how studying literature contributes to questions of social justice; an immersion in historical periods informed by strong theoretical commitments; an engagement with contemporary literature and culture; and an emphasis on theorized pedagogy, reflective practice, and the scholar-teacher model. Our faculty interact with Lehigh's varied interdisciplinary programs, including Africana Studies; Classics; Women, Gender, and Sexuality Studies; Jewish Studies; and American Studies.

Professors. Elizabeth Filer, PhD (University of Michigan Ann Arbor); Edward J. Gallagher, PhD (University of Notre Dame); Scott Paul Gordon, PhD (Harvard University); Donald E. Hall, PhD (University of Maryland College Park); Dawn Keetley, PhD (University Wisconsin at Madison); Barry M. Kroll, PhD (University of Michigan Ann Arbor); Barbara R. Pavlock, PhD (Cornell University)

Associate Professors. Katherine Crassons, PhD (Duke University); Elizabeth A. Dolan, PhD (University of North Carolina); Lyndon Dominique, PhD (Princeton University); Suzanne Edwards, PhD (University of Chicago); Mary C. Foltz, PhD (Suny College Buffalo); David Michael Kramp, PhD (Washington State University); Jenna D. Lay, PhD (Stanford University); Edward E. Lotto, PhD (Indiana University); Seth Moglen, PhD (University of California Berkeley); James B. Peterson, PhD (University of Pennsylvania); Amardeep Singh, PhD (Duke University); Billie S Watts, PhD (University of Missouri, Columbia); Bobby Michael Watts, PhD (University of Missouri, Columbia); Edward Whitley, PhD (University of Maryland College Park)

Assistant Professors. Marilisa Jimenez Garcia, PhD (University of Florida); Brooke Elyse Rollins, PhD (University of South Carolina); Emily Weissbourd, PhD (University of Pennsylvania)

Emeriti. Rosemarie Arbur, PhD (University of Illinois at Chicago); Peter G. Beidler, PhD (Lehigh University); Addison C. Bross, PhD (Louisiana State University at Eunice); Jack A. DeBellis, PhD (University of California Los Angeles); Jan S. Fergus, PhD (City University New York); Rosemary J. Mundhenk, PhD (University of California Los Angeles); Barbara H. Traister, PhD (Yale University); John F. Vickrey, PhD (Indiana University Indianapolis)

UNDERGRADUATE MAJOR IN ENGLISH

The Department of English has developed a focus on Literature and Social Justice, the outcome of a multi-year effort to revitalize the traditional period-based approach to literary studies. Our classes foster a series of related activities: an exploration of how studying literature contributes to questions of social justice; an immersion in historical periods informed by strong theoretical commitments; and engagement with contemporary literature and culture; and an emphasis on theorized pedagogy, reflective practice, and the scholar-teacher model. Our faculty interact with Lehigh's varied interdisciplinary programs, including Africana Studies; Classics; Women, Gender, and Sexuality Studies; Jewish Studies, and American Studies.

The major in English is designed to give students experience in reading, analyzing, and formulating thoughts about people and ideas that matter; an understanding of how literary artists find the appropriate words to express their thoughts and feelings; and a basic knowledge of the historical development of British, American and world literature.

Students who major in English go on to careers in teaching, writing, law, business, science, medicine, engineering—and many others. The analytical and communication skills acquired in the study of literature and writing will be of use in almost any profession or human activity. Depending on their interests, abilities, and career plans, students who major in English are encouraged to consider double majors or one or two minor fields. The major in English is flexible enough to allow cross-disciplinary study with ease. The student majoring in English chooses from an extensive list of courses. Only one course is required of all students, the introduction to the major, English 100. To ensure breadth and depth of knowledge, each English major is required to take five courses at the 300 level, typically one in each of the four historical periods listed below and one as an elective. One of the five courses must be designated as WI.

ENGL 100 Working with Texts
Select four courses one from each of the following categories:

<table>
<thead>
<tr>
<th>British to 1660</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 125 British Literature I</td>
</tr>
<tr>
<td>ENGL 327 Major Medieval Writers</td>
</tr>
<tr>
<td>ENGL 328 Shakespeare</td>
</tr>
</tbody>
</table>
**ENGLISH MAJOR WITH CONCENTRATION IN CREATIVE WRITING**

Minimum number of hours: 16 (4 courses)

To have entered on the transcript Concentration in Creative Writing, the students must take:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 142</td>
<td>Introduction to Writing Poetry</td>
</tr>
<tr>
<td>ENGL 143</td>
<td>Introduction to Writing Creative Non-Fiction</td>
</tr>
<tr>
<td>ENGL 144</td>
<td>Introduction to Writing Fiction</td>
</tr>
</tbody>
</table>

Select one of the following:

<table>
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<tr>
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<tbody>
<tr>
<td>ENGL 342</td>
<td>Advanced Poetry Writing</td>
</tr>
<tr>
<td>ENGL 343</td>
<td>Advanced Creative Non-Fiction</td>
</tr>
<tr>
<td>ENGL 344</td>
<td>Advanced Fiction Writing</td>
</tr>
</tbody>
</table>

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</tr>
</tbody>
</table>

**DEPARTMENTAL HONORS IN ENGLISH**

In order to receive departmental honors the English major must attain a 3.5 grade-point average in courses presented for the major and must complete at least 44 credit hours of course work in English (beyond ENGL 001 and ENGL 002). For the additional credits beyond the 36 required of all English majors, honors students must take the following courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 309</td>
<td>Interpretation: Critical Theory and Practice</td>
</tr>
</tbody>
</table>

or ENGL 312 Studies in Literary and Cultural Theory

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 307</td>
<td>Undergraduate Thesis Proposal</td>
</tr>
<tr>
<td>ENGL 308</td>
<td>Undergraduate Thesis</td>
</tr>
</tbody>
</table>

**MINORS IN ENGLISH**

The Department of English offers three minors, each requiring 16 hours of course work beyond English 1 and 2. Students’ major advisors monitor the minor programs, but students should consult the minor advisor in the Department of English when setting up a minor program.

To minor in English students take 4 courses in literature or film, one at the 300 level.

To minor in creative writing, students take:

Select one of the following:

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<td>ENGL 144</td>
<td>Introduction to Writing Fiction</td>
</tr>
</tbody>
</table>

A literature course at the 100- or 300-level.

Select one of the following:

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</tr>
</thead>
<tbody>
<tr>
<td>ENGL 170</td>
<td>Amaranth</td>
</tr>
<tr>
<td>ENGL 201</td>
<td>Special Topics in Writing</td>
</tr>
<tr>
<td>ENGL 342</td>
<td>Advanced Poetry Writing</td>
</tr>
</tbody>
</table>
To minor in writing, students take:

**Total Credits**  15

1 Note: the same course cannot fulfill both the core requirements except in the case of a course that can be repeated for credit—ENGL 201, ENGL 342, ENGL 343, and ENGL 344—which can be taken twice, once for core credit and once as an elective.

**FILM STUDIES MINOR**

A Film Studies minor offers the opportunity to think analytically and critically about the forms of visual culture (especially film and television) that saturate our world. Courses offer a sustained and coherent examination of different genres of film, film from various national traditions, as well as recent television series that draw on the sophisticated visual and narrative strategies of cinema.

The minor will consist of four courses (16 credits) and will include ENGL 163 Introduction to Film and three electives, one of which may be a course in the production of visual images or film.

**Required:**

- ENGL 163 (Introduction to Film) *Students must take the introductory course prior to completing 300-level coursework*
- One course focused on non-English-language film/film traditions
- 8 elective credits of coursework
- at least 4 elective credits at the 300- or 400-level

**Ideal semester-by-semester roster**

**Sophomore:** ENGL 163: Introduction to Film

**Junior:** Non-English-language film course; elective

**Senior:** Elective

**FRESHMAN COMPOSITION REQUIREMENT**

With the two exceptions noted below, all undergraduate students take six credit hours of freshman English courses:

**Total Credits**  16

1 Note: the same course cannot fulfill both the core requirements except in the case of a course that can be repeated for credit—ENGL 201, ENGL 342, ENGL 343, and ENGL 344—which can be taken twice, once for core credit and once as an elective.

**ENGL 001** Critical Reading and Composition  3

**ENGL 002** Research and Argument  3

**Total Credits**  6

The exceptions are:

- Students who receive Advanced Placement or received 700 or higher on the writing section of the SAT or score a 5 on the IB High Level Examination.
- Students with English as a Second Language. Categories include students on non-immigrant visas, students on immigrant visas, registered aliens, and citizens either by birth or by naturalization.

Students in all these categories for whom English is not the first language may petition for special instruction through the program in English as a Second Language. All non-native English speakers will be assessed in their English skills either through the TOEFL or by other means to determine the kind of instruction best suited to their needs. From this determination, matriculating freshmen will either roster ENGL 001 followed by ENGL 002 or be enrolled in ENGL 003, followed by ENGL 005 (or ENGL 002)

Students enrolled in the English as a Second Language program are expected to reach a level of competence comparable to those in the usual freshman program. The form of instruction, however, will differ in the ESL program by taking into account the special language and cultural needs of non-native speakers.

Matriculating students in all the above categories who are entering at a level above the freshman year, but who need composition credit, should consult the department for advice.

**GRADUATE WORK IN ENGLISH**

The Department of English has developed a focus on Literature and Social Justice, the outcome of a multi-year effort to revitalize the traditional period-based approach to literary studies. Our graduate programs provide students with skills necessary to recognize how literature and other forms of cultural production intervene in questions of justice and shape our conceptions of the world.

**The Master of Arts Program**

Candidates for the master’s degree must complete at least 33 credit hours. Students take at least seven of the required courses at the 400 level but may select the balance of their curricula from 300-level course offerings. Course work for the M.A. must include:

- Two courses in pre-1830 literature
- Two courses in post-1830 literature
- ENGL 482, Theories of Literature and Social Justice

One additional theory course

This distribution allows for some concentrated study at the master’s level. ENGL 485 and ENGL 486, the required courses for new teaching fellows, are not counted in the 33 credits toward the M.A. but will be counted later toward the Ph.D., even if rostered during the M.A. program.

**The Doctor of Philosophy Program**

The department admits to its doctoral program only students of proven competence and scholarly promise. An average of 3.5 in M.A. course work and strong endorsements from graduate instructors are minimum requirements for acceptance.

Doctoral candidates with a Lehigh master’s degree are required to take eight courses and register for 42 credit hours beyond the M.A. Those entering the doctoral program with a master’s from another institution are required to take nine courses and register for 48 credit hours.

Candidates must also demonstrate a reading knowledge of one or two foreign languages after having agreed on choices with the director of graduate studies.

No later than six months after completing their course work, candidates will take written and oral examinations in one major field and two minor fields.
Candidates write their dissertations after having their dissertation proposals approved by the department and being admitted to candidacy by the appropriate college.

UNDERGRADUATE COURSES
ENGL 052, ENGL 054, ENGL 056, ENGL 058, ENGL 087 and ENGL 089 are open to all undergraduates, including first-year students also taking freshman English. Courses numbered at the 100-level are open to students who have completed or who are exempt from the required six hours of freshman English. First-year students who have completed with a grade of A or A- may roster one of the 100-level courses as a second English course to be taken concurrently with the second-semester English composition requirement.

Prerequisites: Each course is a self-contained unit. None has any other prerequisite than two semesters of freshman English. Thus, students may roster ENGL 126 whether or not they have had, or ever plan to take, ENGL 125. For all courses above 200, it is understood that students will have completed six hours of freshman English, even though that is not specified in the course description.

Graduate Students taking 300-level courses receive 3 credits; undergraduates receive 4 credits.

GRADUATE COURSES IN ENGLISH
Graduate (400-level) courses are seminars, ordinarily limited to no more than twelve graduate students, but undergraduate English majors who are planning to go on to graduate school in English and who have shown proficiency in the study of literature may petition to take one of these seminars in their senior year.

Courses
ENGL 001 Critical Reading and Composition 3 Credits
Introduction to academic writing that supports a claim in respectful conversation with others. Topics drawn from important issues in the world in which students live. The course provides multiple opportunities to engage thoughtfully in the writing process. Students must receive a grade of C- or higher to advance to English 2.

ENGL 002 Research and Argument 3 Credits
Continuation of ENGL 1. Designed to refine the skills of argument and research. Students will make persuasive, thoughtful, and well-supported arguments in a variety of forms, including multi-modal genres. The course provides a number of occasions to think, research, and write about pressing issues of public concern. Must have a grade of C- or higher in English 1.

Prerequisites: (ENGL 001)
Attribute/Distribution: ND

ENGL 003 Composition and Literature I for International Writers 3 Credits
Students improve both their advanced academic written English and academic writing style through a process of reading fiction and non-fiction and by writing well-organized, coherent essays for academics. Author citation, style, and written fluency and accuracy are addressed within students’ writing. Enrollment is limited to nonnative speakers; prior academic writing history, English placement testing, and/or ESL director’s recommendation determines placement.

Attribute/Distribution: ND

ENGL 005 Composition and Literature II for International Writers 3 Credits
Continuation of English 3. Students practice more advanced methods and modes of writing for academics, including writing and reading for their specific field of study. Students continue to work on advanced written fluency and accuracy of idiomatic language and expression and are taught advanced methods of author citation and source integration.

Prerequisites: (ENGL 003)
Attribute/Distribution: ND

ENGL 011 Literature Seminar for First-Year Students 3 Credits
Alternative to ENGL 002 for students who have earned exemption from English 1. Topics vary by section. Must have a score of 4 on either Advanced Placement Test in English or 700-749 on the writing section of the SAT or a 5 on the IB High Level Examination.

Prerequisites: APEN or APES or ATWR or S07

ENGL 015 Speech Communication for International Speakers of English 1 Credit
Spoken English improvement through the practice of American English in “real contexts.” This course is for first or second year undergrads who have advanced English skills, but who need to improve their advanced communication and idiomatic language skills for the advanced speaking contexts of the American university classroom and campus. Advanced Spoken English accent improvement and academic presentations skills are also practiced as needed.

Attribute/Distribution: ND

ENGL 038 (AAS 038) Introduction to African Literature 3 Credits
Sub-Saharan African literary themes and styles; historical and social contexts, African folktales, oral poetry, colonial protest literature, postcolonial writing, and films on contemporary Africa.

Repeat Status: Course may be repeated.

Attribute/Distribution: HU

ENGL 050 (CLSS 050) Classical Mythology 4 Credits
Introduction to the study of the Greco-Roman myths in their social, political, and historical contexts. Equal emphasis on learning the myths and strategies for interpreting them as important evidence for studying classical antiquity.

Attribute/Distribution: HU

ENGL 052 (CLSS 052) Classical Epic 4 Credits
Study of major epic poems from Greece and Rome. Works include Homer’s Iliad and Odyssey, Apollonius’ Argonautica, Vergil’s Aeneid, and Ovid’s Metamorphoses.

Repeat Status: Course may be repeated.

Attribute/Distribution: HU

ENGL 054 (CLSS 054, THTR 054) Greek Tragedy 4 Credits
Aspects of Greek theater and plays of Aechylus, Sophocles, and Euripides in their social and intellectual contexts.

Attribute/Distribution: HU

ENGL 056 (CLSS 056) Topics in Greek and Roman Literature 4 Credits
Classical literature in translation, including themes or specific periods in Greek or Roman literature.

Repeat Status: Course may be repeated.

Attribute/Distribution: HU

ENGL 058 (CLSS 058, THTR 058) Greek and Roman Comedy 4 Credits
Study of comedy as a social form through plays of Aristophanes, Menander, Plautus, and Terence.

Attribute/Distribution: HU

ENGL 060 (THTR 060) Dramatic Action 4 Credits
How plays are put together; how they work and what they accomplish. Examination of how plot, character, aural and visual elements of production combine to form a unified work across genre, styles and periods. Recommended as a foundation for further studies in design, literature, or performance.

Attribute/Distribution: HU

ENGL 065 Introduction to Playwriting 4 Credits
An introduction to writing for the stage, with an emphasis on creating characters, maintaining tone, shaping metaphor, and using the resources available to theatre artists to a writer’s best advantage. This course combines in-class exercises with seminar-style discussion of the student’s work.

Attribute/Distribution: HU

ENGL 087 Themes in Literature 4 Credits
Study of a theme as it appears in several works of literature such as Love in the Middle Ages. May be repeated as content changes. Cannot be taken pass/fail.

Repeat Status: Course may be repeated.

ENGL 089 Popular Literature 4 Credits
The form of literature that has been designated in one way or another as “popular,” such as folklore and detective fiction. May be repeated for credit as content changes. Cannot be taken pass/fail.

Repeat Status: Course may be repeated.
ENGL 091 Special Topics 1-4 Credits
A topic, genre, or approach in literature or writing not covered in other courses.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 100 Working with Texts 4 Credits
A course to help students to become, through intense practice, independent readers of literary and other kinds of texts; to discern and describe the devices and process by which texts establish meaning; to gain an awareness of the various methods and strategies for reading and interpreting texts; to construct and argue original interpretations; to examine and judge the interpretations of other readers; to write the interpretive essay that supports a distinct position on some literary topic of importance; and to learn to find and assimilate into their own writing appropriate information from university library resources. To be rostered as early as possible in the English major’s program.
Attribute/Distribution: HU

ENGL 102 (AAS 102, JST 102, REL 102) Promised Lands: Jewish and African American Children’s Literature 4 Credits
In the Hebrew Bible, Psalm 137 asks, “How can we sing the Lord’s song in a strange land?” For Jews, blacks, and black Jews, this was and is a poignant question. This course examines how these two rich, often overlapping and interacting groups tell their stories in literature for children and young adults, with a particular focus on the mediation of traumatic pasts. What does it mean to imagine promised lands beyond such pasts—and can they be reached?
Attribute/Distribution: HU

ENGL 104 (WGSS 104) Special Topics in Gender Studies 4 Credits
This course will involve extended study in a sub-area of English language culture, and literature with a focus on gender, sexuality, and/or race/ethnicity.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 115 (HMS 115) Topics in Literature, Medicine, and Health 4 Credits
Largely focused on narratives about health, illness and disability, this course will examine individual experiences with attention to social context. Topics may include the physician/patient relationship, illness and deviance, plague literature, gender and medicine, autism, AIDS, mental illness, aging.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 119 Introduction to the Horror Film 4 Credits
Examination of the horror film from beginnings to the present, including classic horror of the 1930s, the emergence of the slasher film in the 1970s, the self-reflective horror of the 1990s, the faux-documentary horror at the end of the 20th century, and the virulent renaissance of the genre in our post 9/11 world, notably so-called “torture porn” and the return of the “possession” film. The course will ask fundamental questions about what we find horrifying, as well as particular questions about the changing shape of horror through the decades. The course will focus on U.S. film but will sometimes include the highly influential horror traditions of other countries (for example, Germany, Japan, and Spain.).
Repeat Status: Course may be repeated.

ENGL 120 (AAS 120) Literature from Developing Nations 4 Credits
Contemporary literature from Africa, Central and South America, and Asia. Must have completed six hours of freshman English. Cannot be taken pass/fail.
Attribute/Distribution: HU

ENGL 121 (AAS 121) Topics in African-American Literature 4 Credits
Selected works of African American literature and/or the literatures of the African diaspora. Must have completed six hours of first-year English. Cannot be taken pass/fail.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 123 American Literature I 4 Credits
American literary works through the mid-19th century. Must have completed six hours of freshman English. Cannot be taken pass/fail.
Attribute/Distribution: HU

ENGL 124 American Literature II 4 Credits
American literature from the middle of the 19th century to the present. Must have completed six hours of freshman English. Cannot be taken pass/fail.
Attribute/Distribution: HU

ENGL 125 British Literature I 4 Credits
British literature and literary history from Beowulf through the Pre-Romantics. Must have completed six hours of freshman English. Cannot be taken pass/fail.
Attribute/Distribution: HU

ENGL 126 British Literature II 4 Credits
British literature and literary history from the Romantic period into the 20th century. Must have completed six hours of freshman English. Cannot be taken pass/fail.
Attribute/Distribution: HU

ENGL 127 (THTR 127) The Development of Theatre and Drama I: Rituals to Romantics 4 Credits
Survey of theatre and dramatic literature from ritual origins to the 18th century.
Attribute/Distribution: HU

ENGL 128 (THTR 128) The Development of Theatre and Drama II 4 Credits
Survey of theatre and dramatic literature from the Renaissance to the present.
Attribute/Distribution: HU

ENGL 130 Playwriting II 4 Credits
For students interested in continuing and deepening their writing for the stage. Instructor approval required.
Attribute/Distribution: HU

ENGL 135 Playwriting I 4 Credits
Instruction in the craft of writing for the stage. Instructor approval required.
Attribute/Distribution: HU

ENGL 136 (AAS 136) Introduction to African American Literature 4 Credits
Survey of African American prose narrative and poetry from the 18th century to the present. Features writers from the Harlem Renaissance, the Black Arts Movement, and the post-Black Power era.
Attribute/Distribution: HU

ENGL 142 Introduction to Writing Poetry 4 Credits
Instruction in the craft of writing poetry, with a focus on prosody. Practice in and classroom criticism of poems written by students taking the course. Must have completed six hours of freshman English.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

ENGL 143 Introduction to Writing Creative Non-Fiction 4 Credits
Practice in writing non-fiction from immediate experience, with emphasis on accurate, persuasive description writing. Must have completed six hours of freshman English.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

ENGL 144 Introduction to Writing Fiction 4 Credits
Instruction in the craft of writing fiction. Practice in and classroom criticism of stories written by students taking the course. Must have completed six hours of freshman English.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

ENGL 155 The Novel 4 Credits
Selected novels, with attention to such matters as narrative, characterization, and cultural context. Must have completed six hours of freshman English. Cannot be taken pass/fail.
Attribute/Distribution: HU

ENGL 157 Poetry 4 Credits
Selected traditional and modern poetry, with attention to voice, form, and cultural context. Must have completed six hours of freshman English. Cannot be taken pass/fail.
Attribute/Distribution: HU
ENGL 163 Topics in Film Studies 4 Credits
History and aesthetics of narrative film. May be repeated for credit as subject varies. Must have completed six hours of freshman English. Cannot be taken pass/fail.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 166 (THTR 166) The Playwright as Traveler 4 Credits
This class will read and analyze plays and critical essays to discern how playwrights navigate the tricky ethical and artistic enterprise that is travel. The material is challenging and will require students to utilize analytic tools culled from various disciplines including political economy, literary criticism, feminism and queer studies. We will focus on aesthetic devices that either foreground or obscure questions of politics, power, race, gender and class. Concepts such as ideology, orientalism, interpelation and hegemony will be covered.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 170 Amaranth 1 Credit
Amaranth editorial staff. Students can earn one credit by serving as editors (literary, production, or art) of Lehigh's literary magazine. Work includes soliciting and reviewing manuscripts, planning a winter supplement and spring issue, and guiding the magazine through all phases of production. Editors attend weekly meetings with the faculty advisor. Consent of department chair required.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

ENGL 171 Writing for Audiences 4 Credits
Practice in writing in a variety of discourse modes for different audiences. Consideration of the role of style, clarity, and careful observation in writing. Must have completed six hours of freshman English.
Attribute/Distribution: ND

ENGL 175 Individual Authors 4 Credits
Intensive study of the works of one or more literary artists, such as Austen, Hemingway, and Kerouac. May be repeated for credit as artists and works vary. Must have completed six hours of freshman English. Cannot be taken pass/fail.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 177 Individual Works 4 Credits
Intensive study of one or more literary works, such as Moby Dick, and study of other major texts such as the Bible with attention to literary form. Must have completed six hours of freshman English. Cannot be taken pass/fail.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 183 Independent Study 1-4 Credits
Individually supervised study of a topic in literature, film, or writing not covered in regularly listed courses. Consent of department chair required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 187 Themes in Literature 4 Credits
Study of a theme as it appears in several works of literature, such as Love in the Middle Ages. Must have completed six hours of freshman English. Cannot be taken pass/fail.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 189 Popular Literature 4 Credits
The form of literature that has been designated in one way or another as "popular," such as folklore and detective fiction. Must have completed six hours of freshman English. Cannot be taken pass/fail.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 191 Special Topics 1-4 Credits
A topic, genre, or approach in literature or writing not covered in other courses. Must have completed six hours of freshman English.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 192 Special Topics 1-4 Credits
A topic, genre, or approach in literature or writing not covered in other courses. Individual projects.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

ENGL 201 Special Topics in Writing 1-4 Credits
Approaches not covered in other writing courses. Individual projects.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

ENGL 202 (GS 202, LAS 202, MLL 202) Latin American In Fact, In Fiction 4 Credits
This class couples a survey of Latin American literature in translation with an interdisciplinary approach to the study of Latin America. Departing initially from readings of literary and cinematographic works, our analyses will engage methodologies from multiple disciplines including history, sociology, and cultural studies. Accordingly, this course will examine critical developments in Latin American aesthetics along with the cultural climates in which they matured. This course assumes no prior study of Spanish, Portuguese, or Latin American culture.
Attribute/Distribution: HU

ENGL 222 (THTR 222) Readings in Non-Realism 4 Credits
Through close readings and analysis of a variety of non-realistic play scripts, this class catalogs what a grammar of non-realism might look like. Students will conduct close readings of non-realistic scripts that make use of the grammar available to the writer writing for the stage.
Attribute/Distribution: HU

ENGL 255 (THTR 255) The Collectively Devised Text 4 Credits
This class explores theater as a vehicle for civic engagement. Theater artists as varied as Moises Kaufman, the Civilians, Cornerstone, Culture Clash and Caryl Churchill have worked on scripts that were devised either in whole or in part collectively. Students will outline a plan for choosing a theme, identifying stakeholders, generating text and either writing or shepherding a full-length script to completion. Instructor approval required.
Attribute/Distribution: HU

ENGL 258 Professional Internship 1-4 Credits
Individualized work experience, on- or off-campus, in a field that a student of English wishes to explore as a career. Before registering, a student must meet with the internship adviser and obtain departmental approval. Internship credits do not count toward major in English. Sophomore standing and departmental approval required.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

ENGL 291 Special Topics 1-4 Credits
A topic, genre, or approach in literature or writing not covered in other courses.

ENGL 300 Apprentice Teaching 1-4 Credits
Repeat Status: Course may be repeated.

ENGL 301 Topics in Literature 3-4 Credits
A theme, topic, or genre in literature, such as autobiography as literature and the gothic novel.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 302 (GS 302, LAS 302, MLL 302) Travel and Adventure in Latin American Fiction 4 Credits
Centering on a corpus of works presenting tales of travel and adventure, this class offers an overview of Latin American narrative genres (including “fantastic” narrative, magical realism, and postmodern fiction) from the mid 20th century to present day. Through close readings of works by Adolfo Bioy Casares and Roberto Bolaño, among others, and the analysis of filmic representations of travel in Latin America, we will examine differing modes of perceiving the region defined as Latin America.
Attribute/Distribution: HU
ENGL 303 Grimms’ Fairy Tales: Folklore, Feminism, Film 3-4 Credits
This intercultural history of the Grimms’ fairy tales investigates how folktales and gender stereotypes developed and became models for children and adults. The course covers the literary fairy tale in Germany as well as Europe and America. Versions of "Little Red Riding Hood", "Cinderella", or "Sleeping Beauty" exist not only in the Grimms’ collection but in films and many forms of world literature. Modern authors have rewritten fairy tales in feminist ways, promoting social change. Taught in English. German language students may receive a German component.
Attribute/Distribution: HU

ENGL 304 (WGSS 304) Special Topics in Gender Studies II 3,4 Credits
This course will involve extended study in a sub-area of English language, culture, and literature with a focus on gender, sexuality, and/or race/ethnicity.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 305 Creative Writing Thesis Proposal 1 Credit
Preparation to write creative thesis. Requirements include writing a proposal and bibliography.
Attribute/Distribution: ND

ENGL 306 Creative Writing Thesis 3 Credits
Portfolio of original creative work in poetry, fiction, or creative non-fiction, plus introductory researched essay. Required for concentration in creative writing.
Attribute/Distribution: ND

ENGL 307 Undergraduate Thesis Proposal 1 Credit
to be enrolled by senior honors students preparing to write honors thesis. requirements include conducting preliminary research for the thesis and writing a detailed thesis proposal and bibliography. May not be rostered concurrently with English 308.
Attribute/Distribution: HU

ENGL 308 Undergraduate Thesis 3 Credits
Open to advanced undergraduates who wish to submit theses in English. Consent of department chair required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 309 Interpretation: Critical Theory and Practice 3-4 Credits
Introduction to recent literary and cultural theory, such as New Criticism, Structuralism, Marxism, Psychoanalytic approaches, Reader-response Criticism, Deconstruction, Feminist Theory, New Historicism, and Cultural Criticism.
Attribute/Distribution: HU

ENGL 310 Introduction to Methods of English as a Second Language Instruction 3,4 Credits
An introduction to teaching English as a second language including the theory and principles of second language acquisition, ESL methods, materials, and current trends such as computer assisted language instruction. With sufficient effort, students will learn to plan and teach an ESL/EFL class in the four areas of Writing, Reading, Speaking and Listening, choose appropriate materials for varying age and proficiency levels, and most importantly, have a concrete approach to teaching ESL/EFL. Required classroom observing and tutoring hours that can be completed in Lehigh’s ESL classes, in Lehigh’s ELLC language lab, or in the local public school ESL classes. restricted to upperclass and graduate students.
Attribute/Distribution: HU

ENGL 311 (WGSS 311) Gender and Literature 3-4 Credits
This course explores constructions of gender and sexuality in literature from different historical periods, traditions, and nationalities. How do female and male writers envision what it means to be a “woman” or to be a “man” at various moments in history and from various places around the world? How have gendered (and sexed) identities been shaped in various constraining and empowering ways in the literary imagination? What specifically gendered issues (such as love and violence) have been represented in literature? Content changes each semester.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 312 Studies in Literary and Cultural Theory 3,4 Credits
Study of a particular contemporary theoretical approach to literature, film, or other cultural texts.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 314 Teaching English as a Second Language: A Practicum 1-4 Credits
Companion to English 310 (Intro to Methods of English as a Second Language). This course will include class meetings that focus on guided discussions of the practical application of principles and practices of ESL pedagogy in a real-world environment. Supervised ESL classroom student teaching required.
Prerequisites: ENGL 310
Attribute/Distribution: ND

ENGL 315 (HMS 315) Topics in Literature, Medicine, and Health 3-4 Credits
Analyzing the stories people tell about health, illness and disability, this course engages cultural studies approaches in order to explore the way those stories are told. Topics may include: illness and the graphic novel, the changing image of the healer in literature, collaborative storytelling with Alzheimer’s patients, end of life narratives, tales from the ER, narrative ethics.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 316 Native American Literature 3-4 Credits
This course is a survey of the literary texts written by the indigenous inhabitants of what is now the United States, beginning with the myths and legends of the era before European contact and ending with the novels, poems, and films produced by Native Americans in the twentieth- and twenty-first centuries.
Attribute/Distribution: HU

ENGL 317 (REL 317) Topics in Jewish Literature 3-4 Credits
Selected topics in Jewish literature, which may include: Contemporary Jewish Literature, Philip Roth’s Complaint, and Jewish Women Writers.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 318 (AAS 318) African-American Literature and Culture 3,4 Credits
Topics in African-American culture and/or the cultures of the African diaspora. Topics may be focused by period, genre, thematic interest or interdisciplinary method including, for example, Nineteenth-century African-American Literature and Politics; African-American Folklore; Black Atlantic Literature; The Harlem Renaissance; and African-American Women Writers.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 319 Advanced Studies in the Horror Film 3-4 Credits
Examination of the horror film from its beginnings to the present, including classic horror of the 1930s, the emergence of the slasher film in the 1970s, the self-reflexive horror of the 1990s, the faux-documentary horror at the end of the 20th century, and the virulent renaissance of the genre in our post 9/11 world, notably so-called “torture porn” and the return of the “possession” film. The will ask fundamental questions about what we find horrifying, as well as particular questions about the changing shape of horror through the decades. The course will focus on U.S. film but will sometimes include the highly influential horror traditions of other countries (for example, Germany, Japan, and Spain).
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 321 History of the English Language 3-4 Credits
The phonology, grammar, and lexicon of English from its Anglo-Saxon beginnings to current World dialects, with a focus on the expressive literary effects of linguistic change.
Attribute/Distribution: HU

ENGL 323 Anglo-Saxon Language and Literature 3-4 Credits
An introduction to Anglo-Saxon language and culture, through Anglo-Saxon prose and short poetry, with special attention to the range of Anglo-Saxon genres and the problems of translation and interpretation.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU
ENGL 324 Anglo-Saxon Poetry 4 Credits
A study of Anglo-Saxon poetry, including discussion of the critical tradition and manuscript production. Special attention to the epic poem Beowulf. Open only to students who have completed ENGL 323 or who show proficiency in Anglo-Saxon.
Repeat Status: Course may be repeated.
Prerequisites: ENGL 323
Attribute/Distribution: HU

ENGL 327 Major Medieval Writers 3-4 Credits
Study of major medieval writers. Titles include The Canterbury Tales; Early Chaucer and the Continental Tradition, and Langland's Piers Plowman.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 328 (THTR 328) Shakespeare, 3,4 Credits
An introduction to Shakespearean drama including comedies, histories, tragedies, and romances. Emphasis on textual study, cultural contexts, and performance strategies.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 331 Milton 3-4 Credits
An introduction to John Milton's poetry and prose emphasizing close reading and cultural contexts. Half of the course will be devoted to Paradise Lost, and particular attention will be paid to politics, religion, and gender.
Attribute/Distribution: HU

ENGL 342 Advanced Poetry Writing 3-4 Credits
An intensive writing workshop in which student poems and related literary texts receive close reading and analysis.
Repeat Status: Course may be repeated.
Prerequisites: ENGL 142
Attribute/Distribution: ND

ENGL 343 Advanced Creative Non-Fiction 3,4 Credits
Practice of the essay, including such forms as the personal, academic, or argumentative essay. Emphasis on developing a strong personal voice and learning to use other voices. Intensive revision. Permission of writing minor advisor.
Repeat Status: Course may be repeated.
Prerequisites: ENGL 143
Attribute/Distribution: ND

ENGL 344 Advanced Fiction Writing 3-4 Credits
An intensive writing workshop in which student stories and related literary texts receive close reading and analysis. Consent of writing minor advisor.
Repeat Status: Course may be repeated.
Prerequisites: ENGL 144
Attribute/Distribution: ND

ENGL 360 Middle English Literature 3-4 Credits
Major literary works of the Middle English period by authors other than Chaucer. Emphasis on Chaucer, The Gawain/ Pearl Poet, and the metrical romances.
Attribute/Distribution: HU

ENGL 362 The Sixteenth Century 3-4 Credits
Humanist, Petrarchan and dramatic traditions in the literature of renaissance England. Readings from such authors as Erasmus, More, Wyatt, Sidney, Spenser, and Marlowe.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 364 Advanced Creative Non-Fiction 3,4 Credits
Practice of the essay, including such forms as the personal, academic, or argumentative essay. Emphasis on developing a strong personal voice and learning to use other voices. Intensive revision. Permission of writing minor advisor.
Repeat Status: Course may be repeated.
Prerequisites: ENGL 143
Attribute/Distribution: ND

ENGL 366 British Eighteenth-Century Literature 3-4 Credits
The poetry, drama, fiction, and non-fictional prose of the long eighteenth century (1660-1800), with particular attention to how writers are shaped by and engage with the cultural issues of their time.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 367 Transatlantic Eighteenth-Century Literature 3-4 Credits
The poetry, drama, fiction, and non-fictional prose written in Britain and the Americas during the long eighteenth century (1660-1800), with particular attention to the transatlantic circulation of texts and ideas.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 369 Romantic-Era Literature 3-4 Credits
This study of British Literature and Culture of the Romantic Era (1780-1830) will address specific questions of genre, theme or historical developments. Readings may cover issues such as slavery and abolition, the effect of the French Revolution on British Literature, the rights of women, scientific innovation, ethics, landscape aesthetics, and the gothic.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 371 British Victorian Literature: Prose and Poetry 3-4 Credits
Poetry and prose of Tennyson, Browning, Arnold, Swinburne, Carlyle, Mill, Newman, and Ruskin within the contemporary political, religious, and social contexts.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 372 Victorian Literature 3-4 Credits
This study of British Literature and Culture of the Victorian Age (1830-1901), including the Empire, will address specific questions of genre, theme, or historical developments. Readings may cover issues such as industry, imperialism, the cult of domesticity, aesthetics, the Woman Question, the Reform Acts, the place of the art and the artist, and modern nationalism.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 374 Literature of Contact in the Americas 3,4 Credits
The literature of exploration, discovery, and the early years of first settlement in contact zones from the Caribbean to Newfoundland.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 375 Major Authors 1-4 Credits
The works of one or more major literary figures studied in depth.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 376 Early American Literature 3-4 Credits
American literature from settlement until the 1820s, emphasizing fiction, poetry, and non-fiction that helped form and contest American identities and national consciousness.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 377 American Romanticism 3-4 Credits
Literature from the antebellum United States viewed through the literary practices of sentimentalism (an ethos that values sympathy, empathy, and human contact) and the sublime (an aesthetic that attempts to create within readers a sense of the awe-inspiring, otherworldly, and terrifying aspects of life), as well as social conflicts over race, class, and gender.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ENGL 378 American Realism 3-4 Credits
Topics in American literature from the Civil War to the early twentieth century. Topics may include the evolution of literary genres and movements, including realism and naturalism. Authors may include Twain, Davis, Howells, Harper, James, Chesnutt, Jewett, Chopin, Norris, Crane, Du Bois, Gilman, Wharton, Cahan, Olsen and Wright.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU
ENGL 379 Modern American Literature 3-4 Credits
Topics in American literature before World War II. Topics may be focused by genre, thematic interest, mode of theoretical inquiry or interdisciplinary method, including, for example, Modernism and Mourning; The Harlem Renaissance; Modernism and Social Justice. Repeat Status: Course may be repeated. Attribute/Distribution: HU

ENGL 380 Contemporary American Literature 3-4 Credits
Topics in American literature since World War II. Lectures and class discussions of new writers and of recent works of established writers organized around various themes of import for the contemporary period. Repeat Status: Course may be repeated. Attribute/Distribution: HU

ENGL 382 Themes in American Literature 3,4 Credits
Intensive study of one topic in American literature. Readings from the colonial period to the present. Repeat Status: Course may be repeated. Attribute/Distribution: HU

ENGL 383 Modernism and Post-Modernism in Fiction 3,4 Credits
Topics in 20th and 21st century literature with a focus on the defining features of modernism and/or postmodernism. Repeat Status: Course may be repeated. Attribute/Distribution: HU

ENGL 384 Contemporary World and Postcolonial Literature 3,4 Credits
Topics in contemporary world literature after 1960, engaging the history and legacy of European colonialism. Topics might include: African Literature; South Asian Literature; Caribbean Literature; and Literature of Globalization. Repeat Status: Course may be repeated. Attribute/Distribution: HU

ENGL 385 Modern British and Irish Literature 3-4 Credits
Topics in British and Irish literature before World War II. Topics might include: British Modernism; James Joyce; Virginia Woolf and Bloomsbury; Modern Irish literature; East Meets West: British and Colonial Travel Writing; and Gender and Sexuality. Repeat Status: Course may be repeated. Attribute/Distribution: HU

ENGL 386 Contemporary British Literature 3-4 Credits
Topics in post-1945 British literature, including postmodernism and multicultural writing. Topics may include Black British Writing; Immigrant Literature; Gender and Sexuality; Travel Writing; and British Postmodernism. Repeat Status: Course may be repeated. Attribute/Distribution: HU

ENGL 387 Film History, Theory, and Criticism 3-4 Credits
Study of film with the focus on particular genres, directors, theories, periods, or topics. Weekly film screenings. Cannot be taken pass/fail. Repeat Status: Course may be repeated. Attribute/Distribution: HU

ENGL 388 Independent Study 1-4 Credits
Individually supervised study of a topic in literature, film, or writing not covered in regularly listed courses. Consent of department chair required. Repeat Status: Course may be repeated. Attribute/Distribution: HU

ENGL 389 Honors Project 1-8 Credits
Repeat Status: Course may be repeated. Attribute/Distribution: HU

ENGL 391 Special Topics 1-4 Credits
A topic, genre, or approach in literature or writing not covered in other courses. Repeat Status: Course may be repeated. Attribute/Distribution: HU

ENGL 400 Supervised Teaching 1 Credit
Practical experience in teaching through assisting a faculty teacher in conduct of a regularly scheduled undergraduate course. Open only to graduate students with at least one semester of graduate course work at Lehigh University and a GPA of at least 3.5. Usually rostered in conjunction with 485. Consent of department required.

ENGL 411 (WGSS 411) Gender and Literature 3 Credits
This seminar explores constructions of gender and sexuality in literature from different historical periods, traditions, and nationalities. Content changes each semester. Repeat Status: Course may be repeated.

ENGL 433 Medieval Genres and Authors 3 Credits
This course examines major Middle English authors (Chaucer, Langland, the Pearl-poet) or genres of Middle English writing (romance, dream vision, drama) in their historical and literary contexts. Individual titles include: Medieval Drama, Chaucer's Literary Circles, Langland: Tradition and Afterlife, and Dream Visions and Revelations. Repeat Status: Course may be repeated.

ENGL 435 Topics in Medieval Literature 3 Credits
This course explores thematic topics in medieval literature. Typically, this course challenges traditional conceptions of literary historical periods by spanning Anglo-Saxon and late-medieval texts or late-medieval and early modern texts. Individual titles include: Writing, Rebellion, and Reform: Medieval Literature of Dissent; Poverty and Property, 1350-1650; Sex, Gender, and Sexuality in the Middle Ages; Imagining this Island: Nation and Identity, 800-1400. Repeat Status: Course may be repeated.

ENGL 439 Early Modern Genres and Authors 3 Credits
Examination of major sixteenth- and seventeenth-century authors or distinctive Renaissance genres in their historical and cultural contexts. Individual courses may focus on authors such as Shakespeare, Milton, Spenser, or Jonson, or genres such as utopian fiction, psalms and sonnets, or city comedy. Repeat Status: Course may be repeated.

ENGL 441 Early Modern Literature 3 Credits
This course explores a thematic topic in sixteenth- and seventeenth-century English literature. Individual titles may include: Dealing with Difference in Early Modern England; Gender and Catholicism in Early Modern England; Literature of City and Court; Poetry, Politics, and Prophecy: Writing of the English Civil War. Repeat Status: Course may be repeated.

ENGL 442 British Eighteenth-Century Literature 3 Credits
This course explores British poetry, drama, fiction, and non-fiction prose written during the long eighteenth century (1660-1800). Topics may be organized by period, genre, thematic interest or interdisciplinary method. Individual titles may include: Money, Sex, and Selves: The Rise of the Novel; Witchcraft and History; Conspiracy Theory and Eighteenth-Century Literature. Repeat Status: Course may be repeated.

ENGL 443 Transatlantic Eighteenth-Century Literature 3 Credits
This course explores the transatlantic circulation of texts and ideas during the long eighteenth century (1660-1800). Topics may be organized by period, genre, thematic interest or interdisciplinary method. Individual titles may include: The Colonial Rise of the Novel; Writing for a Cause; Transatlantic Eighteenth-Century Paranoia. Repeat Status: Course may be repeated.

ENGL 445 British Romantic-Era Literature 3 Credits
The seminar will explore a focused topic in British Literature and Culture of the Romantic Era (1780-1830) taking into account larger historical, aesthetic, and theoretical concerns. Topics may include slavery and abolition, the cult of childhood, women's writing, imperialism, the gothic, the Jacobin novel, poetic innovation, the Shelley circle, and travel literature. Repeat Status: Course may be repeated.
ENGL 447 British Victorian Literature 3 Credits
The seminar will explore a focused topic in British Literature and Culture of the Victorian Age (1830-1901), including the Empire, taking into account larger historical, aesthetic, and theoretical concerns. Topics may include industry, imperialism, the cult of domesticity, aesthetics, the Woman Question, new sexual cultures, the Reform Acts, the emergence of photography and mass visual culture, the place of art and the artist, and modern nationalism.

Repeat Status: Course may be repeated.

ENGL 449 Modern British and Irish Literature 3 Credits
Topics in British and Irish literature before World War II. Topics may be organized by genre, theoretical mode of inquiry, or author. Topics might include: British Modernism; James Joyce and Modern Ireland; Virginia Woolf and Bloomsbury; East Meets West: British and Colonial Travel Writing; and Gender and Sexuality.

Repeat Status: Course may be repeated.

ENGL 451 Contemporary British Literature 3 Credits
Topics in post-1945 British literature, including postmodernism and multicultural writing. Topics may be organized by genre, theoretical mode of inquiry, or interdisciplinary method. Topics might include Black British Writing; Immigrant Literature; Gender and Sexuality; Travel Writing; and British Postmodernism.

Repeat Status: Course may be repeated.

ENGL 477 Modernism 3 Credits
This seminar will explore topics in literary modernism, including the formal innovations, political implications, historical configurations, and critical and theoretical approaches to the literatures of the early twentieth century. Topics may be organized around national literatures or transnational formations. Topics might include Modernism and Mourning; Transatlantic Modernism; The Harlem Renaissance; Modernism and Social Justice.

Repeat Status: Course may be repeated.

ENGL 478 Contemporary American Literature 3 Credits
This course explores a topic in American literature after 1960, engaging the history and legacy of European colonialism. Topics may be organized by genre, theoretical mode of inquiry, or interdisciplinary method. Topics might include: African Literature; South Asian Literature; Caribbean Literature; and Literature of Globalization.

Repeat Status: Course may be repeated.

ENGL 480 Composition and Rhetoric 3 Credits
This course explores a topic in composition studies or rhetoric. Topics may be historical, pedagogical, theoretical, or thematic.

Repeat Status: Course may be repeated.

ENGL 481 Theory and Criticism 3 Credits
This course introduces students to theories of literature and social justice, addressing the following broad (and frequently overlapping) questions: What is social justice? How are literary forms (and literary criticism) distinctive in the ways in which they grapple with questions of social justice? How do literary forms reinforce or challenge dominant ideologies? In what ways does literature critique social injustice and imagine new models of more perfect human flourishing?

ENGL 483 Creative Writing and Literary Studies 3 Credits
From the Inside: Creative Writing and Reading. A combination of seminar and workshop, this course uses instruction and practice in the techniques and genres of creative writing (prosody, narratology, characterization, etc.) to develop tools for studying literary texts. Consent of instructor required.

Repeat Status: Course may be repeated.

ENGL 485 Introduction to Writing Theory 2 Credits
Survey of major approaches and theoretical issues in the field of composition and rhetoric. Required of all new teaching assistants in the department. Usually rostered in conjunction with 400 or 486.

ENGL 487 Teaching with Technology: A Practicum 1 Credit
Introduction to teaching writing at Lehigh. Bi-weekly discussions of practical issues and problems in the teaching of freshman composition. Required of all new teaching assistants in the department. Usually rostered in conjunction with English 485.

ENGL 488 Teaching with Technology: A Practicum 1 Credit
Hands-on introduction to the tools and skills necessary to teach with the computer, along with some attention to appropriate pedagogy. Consent of the graduate program coordinator required.

ENGL 490 (ECO 490) Master’s Thesis 3 Credits
Writing master's thesis papers.

ENGL 491 Special Topics 1-3 Credits
A topic, genre, or approach in literature or writing not covered in other courses. Consent of graduate program coordinator required.

Repeat Status: Course may be repeated.

ENGL 493 Graduate Seminar 3 Credits
Intensive study of the works of one or more authors, or of a type of literature.

Repeat Status: Course may be repeated.

ENGL 495 Independent Study 3 Credits
Individually supervised course in an area of literature, film or writing not covered in regularly listed courses. Consent of graduate program coordinator required.

ENGL 499 Dissertation 1-9 Credits
Research and study for comprehension exams.

Entrepreneurship
Entrepreneurship-related programs and activities are university-wide, and coordinated by the Baker Institute for Entrepreneurship, Creativity and Innovation. Entrepreneurship curriculum is overseen by a joint committee of faculty from CBE, CAS and RCEAS.

MINOR IN ENTREPRENEURSHIP
Open to all undergraduate students, from any major.

The purpose is to enable students in any major to supplement their major with a creative entrepreneurial mindset and skills that increase their ability to identify opportunities for innovation, to challenge the status quo in any field, and to implement sustainable change, whether in emerging or established companies or non-profit enterprises. The program is designed to be accessible to students from all disciplines with an emphasis upon innovation, entrepreneurial thinking and creative
processes, cross-functional integration, and hands-on experiential practice. The minor leverages the resources and support of the Baker Institute for Entrepreneurship, Creativity, and Innovation, as well as a broad array of related programs and infrastructure across the university.

We encourage participation by those interested in all types of entrepreneurship, including business and technical entrepreneurship but also not-for-profit contexts aiming for social, cultural and environmental change. Throughout the multi-disciplinary, team-based curriculum, students are encouraged to work either on their own entrepreneurial projects, projects related to Lehigh University intellectual property, or on ideas brought in by outside entrepreneurs.

**Recommended Tracks**

Students may select any set of courses that fulfill the minor requirements. However, students are encouraged to consult with the minor director to design a focused track, such as Technology Entrepreneurship, Social & Non-profit Entrepreneurship, Arts Entrepreneurship, Green Entrepreneurship, Health & Biomedical Entrepreneurship, Service-sector Entrepreneurship, or others. The recommended approach for a focused track begins with the introductory ENTP 101 and closes with in-depth hands-on capstone entrepreneurial experiences, sandwiched around a flexible package of courses selected by each student as needed to foster their particular entrepreneurial interests and goals.

**Requirements**

The minor has a prerequisite of ECO 001 (4 credit hours) and then requires at least 14 credit hours of ENTP and capstone courses.

**Prerequisite Course**

| ECO 001 | Principles of Economics 1 |

**Required Courses**

| ENTP 101 | Introduction to Entrepreneurship | 3 |
| Select at least 6 additional credit hours in other ENTP courses 2 | 6 |
| Select at least two (minimum 5 credit hours) of the following experiential Capstone courses: | 5 |
| ENTP 311 | The Garage: Launching Entrepreneurial Ventures I |
| ENTP 312 | The Garage: Launching Entrepreneurial Ventures II |
| ENTP/IR/SDEV 307 | International Social Entrepreneurship |
| IBE 380 | Integrated Business and Engineering Capstone Project I |
| IBE 385 | Integrated Business and Engineering Capstone Project II |
| ENTP 314 | Small Business Consulting |
| CSB 312 | Design of Integrated Business Applications I |
| CSB 313 | Design of Integrated Business Applications II |
| TE 211 | Capstone Design Projects-1 (formally BUS/ENGR 211) |
| TE 212 | Capstone Design Projects-2 (formally BUS/ENGR 212) |

**Total Credits**

14

1. ECO 001 Principles of Economics (4 credit hours) must be completed prior to enrolling in the minor. Students may enroll in ENTP 101 without ECO 001, but may not sign up for the minor until completing ECO 001.

2. Or alternatives approved by the minor director in consultation with the student.

3. Or alternatives approved by the minor director.

Students must complete the minor with an average GPA of at least 2.0 in those courses to qualify.

Course descriptions for the Entrepreneurship graduate courses can be located under Master of Engineering in Technical Entrepreneurship.

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**Courses**

**ENTP 040 (COMM 040) Entrepreneurial Communication for Creative Industries 3 Credits**

Explores the evolving culture of social media and related communication strategies and analysis. In depth discussion of tools, technique and tone; digital identity, content, voice and audience; and of managing social media blended with traditional platforms. Practical applications and best practices for multiple methods. Covers all the leading social media platforms, crowdfunding, guerilla marketing, as well as evolving new emerging platforms. Case discussions with external nonprofit, nonprofit and government practitioners. Students design, execute and evaluate a communication campaign strategy.

**Attribute/Distribution:** SS

**ENTP 101 Introduction to Entrepreneurship 3 Credits**

Introduction to the nature of entrepreneurship and the entrepreneurial mindset. Emphasis on identifying opportunities, generating creative ideas, and the process of scaling up sustainable organizations. Topics include: alternative concepts of entrepreneurship and social entrepreneurship; personal attributes of entrepreneurs; steps in new venture creation; introduction to entrepreneurial finance and marketing; new venture planning for both emerging and existing enterprises. Uses case studies, hands-on experiential teams, and exposure through guest speakers to successful entrepreneurs and to Lehigh and community resources for entrepreneurs.

**Attribute/Distribution:** ND

**ENTP 123 Art Entrepreneurship Community 3 Credits**

Focus on art as an economic driver in community building. Topics: understanding community art districts; entrepreneurial contributions to venues & networks; new arts venture creation; management approaches inherent in the entrepreneurial mindset. Activities: positioning of events; determining target audiences; marketing; arts based business models & resource needs; development of preliminary action plans to execute arts related events. Note: "arts" activities here broadly conceived, including visual, performing, technical & literary arts. Previous ENTP101 encouraged but not required.

**Attribute/Distribution:** ND

**ENTP 201 Entrepreneurship & Enterprise 3 Credits**

Investigates skills & steps for entrepreneurial success: mindset; opportunity scouting; informal networking; finding resources; managing risk; marketing plans; investors; debt & venture capital; horizontal management; developing a leadership team & creative culture; technology cycles; structuring; managing change; ethics; exit strategies. Case studies & projects. Guest entrepreneurs. Consent of minor director.

**Prerequisites:** ENTP 101

**ENTP 205 Leadership and the Entrepreneurial Mindset 3 Credits**

Explores issues and develops skills in leading entrepreneurial organizations, in both profit and non-profit contexts. Examines characteristics of the entrepreneurial mindset and leadership styles in different types of ventures and growth stages. Focuses on founders’ challenges such as who to found with, selecting the team, leading others, managing change and failure, emotional intelligence, and issues of control and governance. Includes self-assessment of leadership and entrepreneurial skills and strengths, motivation, risk profile, ethical decision making, life/work balance, and definitions of success.

**Prerequisites:** ENTP 101

**ENTP 232 (WGSS 232) Gender Issues in Entrepreneurship 4 Credits**

Explores role of women entrepreneurs in society & economic development; impacts of women’s entrepreneurship in different economic and cultural contexts; research on why women still represent a minority or entrepreneurs; gender differences in patterns of entrepreneurship; related policy challenges. Also addresses pragmatic and personal life choices facing women entrepreneurs, including identifying key characteristics of entrepreneurial opportunities and mapping those against values, skills, ethics and definitions of success; and planning for professional and personal development.

**Attribute/Distribution:** SS
ENTP 250 (TE 250) Systematic Creativity Techniques 3 Credits
ENTP 250/TE 250 -- Systematic creativity methods including anthropological research, painstorming, biosociation, the Kano model, trimming technique, DeBono’s Six Hats technique, biomimicry, lateral benchmarking, Blue Ocean Strategy, & the art of tinkering, along with other innovation methods. This course includes hands-on labs, individual & team projects, & the creation of a creativity portfolio. Open to students in any college and major. (ND).
Attribute/Distribution: ND

ENTP 304 (CSB 304, TE 304) Software Ventures 3 Credits
Designed from the perspective of a functional leader, this course provides students with a holistic perspective of developing a successful software venture in an interdisciplinary and experiential environment. Students will develop a software-oriented idea concurrent with module delivery that will contain best practices, case studies, and subject-matter experts. Examination will include business model fundamentals, customer discovery, translating requirements to a minimum viable product, agile development, user acquisition, and traction. Prior programming experience preferred, but, not required. Open to any major.
Prerequisites: ENGR 010 or CSE 002 or BIS 111

ENTP 306 (MGT 306) Decision Making in Small Business and Non-Profit Enterprise 3 Credits
Formulation of strategies, policies and decisions unique to family owned businesses, nonprofit organizations, startup ventures and organizations experiencing rapid growth. Lectures and case studies.
Prerequisites: FIN 125 and MKT 111

ENTP 307 (IR 307, SDEV 307) International Social Entrepreneurship 4 Credits
International social entrepreneurship aims to change the world through innovation in solving social problems. Focus on the nexus between social entrepreneurship and development practice, especially in relation to NGOs. Emphasis on acquiring tools and conceptual frameworks to launch new social ventures through real hands-on international fieldwork and team-oriented learning by doing. Exposure to best practices of how to affect meaningful social change in poor countries, to generate and evaluate innovative ideas, and to develop them into concrete on-the-ground startups.
Attribute/Distribution: SS

ENTP 308 Creating and Sustaining a Non-Profit 3 Credits
Non-profit organizations can be effective institutional agents of change, if you know what you are doing. This class will make sure you do. Students will learn the nuts and bolts of creating and sustaining a non-profit, including recruiting and managing a board of directors, fundraising, marketing, program planning and evaluation. We will also explore the ethics, values and drive necessary to be an effective leader of a non-profit (SS).
Attribute/Distribution: SS

ENTP 309 (POLS 309) Nonprofit Administration 4 Credits
Key questions in nonprofit sector research, policy, & management and factors that make the nonprofit sector distinct. Scope & character of nonprofit activity in the U.S. & abroad. Current debates in nonprofit policy and critical challenges facing management.
Attribute/Distribution: SS

ENTP 310 (POLS 310) Social Entrepreneurship: How to Change the World 4 Credits
The marketplace does not always have to be harsh. Social entrepreneurship uses market-based approaches to address needs and solve problems in our society. Students in this seminar-style course will learn how to identify community problems, convince the community that it is a problem worth solving, design the response, and implement it. Hands-on projects. Must have junior standing or higher.
Prerequisites: ECO 001
Attribute/Distribution: SS

ENTP 311 The Garage: Launching Entrepreneurial Ventures I 3 Credits
Students work in cross-disciplinary teams with faculty advisors and alumni mentors on marketing, financial planning, and economic and technical feasibility of entrepreneurial product- or service-based new ventures, commercial or non-profit. Students may elect to work either on their own entrepreneurial projects, on projects related to Lehigh University intellectual property, or on ideas brought in by outside entrepreneurs. Oral presentations, written new venture plans and discussions with guest speakers are integral parts of the course. Consent of minor director.
Prerequisites: ENTP 101
Attribute/Distribution: ND

ENTP 312 The Garage: Launching Entrepreneurial Ventures II 3 Credits
Continuation of ENTP 311. Investigates and pursues in detail the critical steps and activities necessary when entrepreneurs seriously pursue launching new ventures. Consent of minor director.
Prerequisites: ENTP 311

ENTP 314 (MGT 314) Small Business Consulting 3 Credits
A field studies course providing management assistance to small businesses in the Lehigh Valley. Students work in small groups under faculty supervision on a direct basis with owners. Problem solving and experience in applying marketing, accounting, finance, and/or management concepts to business.
Attribute/Distribution: ND

ENTP 315 Lehigh Silicon Valley 1-4 Credits
Immersion study-abroad-like program about the creation of venture capital-backed companies. Offered in the hub of entrepreneurship, Silicon Valley, where countless ventures emerge, particularly in disruptive technologies. Nextgen software and Internet, “Live cases” draw on seasoned practitioners from all reaches of the venture community. Students encounter a highly charged learning environment focused on real companies, real players, and real situations in real time. Offered January winter term. Includes pre-trip sessions and pre-and post-trip assignments. Admission by competitive application. Program fees.
Attribute/Distribution: ND

ENTP 320 (BIOS 320) The Business of Life Science 3 Credits
An examination of business process in startup, early stage and developing bioscience companies. Technology assessment, business plan and proposal preparation, financial strategies, resource management, intellectual property, and legal as well as regulatory issues. Cannot be used to fulfill major requirements in BIOS.
Prerequisites: BIOS 121
Attribute/Distribution: NS

ENTP 371 Independent Study in Entrepreneurship or Social Ventures 1-4 Credits
Study and projects in entrepreneurship or social ventures; designed for the student who has a special interest in a subject not included in the regular course schedule or interested in pursuing a significant supervised project in entrepreneurship. Interested students should seek agreement from a willing faculty adviser prior to enrolling. Consent of minor director required, This course may count towards the ENTP minor only once.
Repeat Status: Course may be repeated.

ENTP 372 Special Topics in Entrepreneurship or Social Ventures 1-4 Credits
Special problems and issues in entrepreneurship or social ventures for which no regularly scheduled course exists. Coverage will vary according to the interests of the instructor and students. Consent of minor director required.
Repeat Status: Course may be repeated.

ENTP 389 Honors Project 1-4 Credits
Opportunity for Eckardt Scholars to pursue an extended project for senior honors. Transcript will identify department in which project was completed. Consent of department required.

Environmental Initiative

Program Directors:
Core Faculty:
Benjamin Felzer, Ph.D. (Department of Earth and Environmental Science); Sharon Friedman, Ph.D. (Department of Journalism and Communication); John Gatewood, Ph.D. (Department of Sociology and Anthropology); Donald Morris, Ph.D. (Department of Earth and Environmental Science); Mark Ors, Ph.D. (Department of Political Science) and Director, Sustainable Development Program; Joan Ramage Macdonald, Ph.D. (Department of Earth and Environmental Science); Cameron Wesson, Ph.D. (Department of Sociology and Anthropology); A.J. Wurth, Ph.D. (Department of Political Science)

Affiliated Faculty:
Kelly Austin, Ph.D. (Department of Sociology and Anthropology); Alec Bodzin, Ph.D. (Department of Education and Human Services); Derick Brown, Ph.D. (Department of Civil & Environmental Engineering); Kristen Jellison, Ph.D. (Department of Civil & Environmental Engineering); Frank Pazzaglia, Ph.D. (Department of Earth & Environmental Sciences); Arup SenGupta, Ph.D. (Department of Civil & Environmental Engineering); Tara Troy, Ph.D. (Department of Civil & Environmental Engineering); Todd Watkins, Ph.D. (Department of Economics); Richard Weisman, Ph.D. (Department of Civil & Environmental Engineering)

The Environmental Initiative is a broadly interdisciplinary program of education, research, and outreach. The curricula include courses in four colleges and 10 departments in social sciences, humanities, education, science, mathematics and engineering. Earth and Environmental Sciences (http://www.ees.lehigh.edu) and Civil and Environmental Engineering (http://www.lehigh.edu/~incee) are core Departments in the program.

UNDERGRADUATE STUDIES
The Environmental Studies BA program examines the cultural, economic, historical, communication, political and social factors that influence local, national, international and global environmental issues and policies. Investigating a wide range of perspectives, it includes a broad exposure to many factors confronting humans as they struggle with complex problems and possible solutions to environmental questions.

The program has been designed so students will develop a broad understanding of social science environmental concerns, along with a basic familiarity with environmental science, statistics and research methods. Of benefit to all students interested in environmental issues, this B.A. degree complements existing B.A. and B.S. programs in Earth and Environmental Sciences and the B.S. program in Environmental Engineering. The B.A. program is intended for students who are interested in environmental affairs from the perspective of the social sciences and humanities. This degree will prepare students for a variety of career options including positions in policy agencies at the federal, state and local government levels, corporate management, nonprofit organizations, environmental journalism, environmental education or environmental law. It also will prepare students for graduate studies in a number of environmental policy and social science fields. The B.A. is specified designed to be broadly inclusive yet flexible enough to allow for double majors and minors in other fields. Double majors or minors in social science fields such as anthropology, communication, history, international relations, journalism, political science, psychology, science and environmental writing or sociology could easily be accomplished. Minors in the sciences, such as Earth and Environmental Sciences, also can be completed. If students are not pursuing a double major, a minor in another field to complement the Environmental Studies major is highly recommended but not required.

The major consists of five required and a choice of three core courses, plus three elective courses chosen from a list that follows. The B.A. is considered a social science major and most of its courses fulfill college social science distribution requirements. Its collateral requirements, which include a social science research methods course, one course in statistics and two science courses, can be used to fulfill college math and science distribution requirements.

Program Honors
To graduate with honors, a major in Environmental Studies must maintain a 3.2 overall average, attain a 3.5 average in the courses constituting the major program, and complete an honors thesis in the senior year.

ENVIROMENTAL STUDIES MAJOR

Required Courses
ES 001 Introduction to Environmental Studies 4
ES/EES 002 Introduction to Environmental Science 3
ES/EES 004 The Science of Environmental Issues 1
ES/POLS 105 Environmental Policy and Planning 4
ES 381 Senior Seminar: Issues in Environmental Studies 4

Core Courses
Select at least three of the following: 10-12
ES/POLS 106 Environmental Values and Ethics
ES/ANTH 121 Environment and Culture
ES/JOUR 125 Environment, the Public and the Mass Media
CEE 272 Environmental Risk Assessment
ES/HIST 315 American Environmental History

Electives
Select 12 credits from the elective list below or in consultation with the program director. 1 2

Collateral Requirements
MATH 012 Basic Statistics 3 4
SOAN 111 Research Methods and Data Analysis 4

Select at least one EES and one other science course (6-8) 6-8 credits OR a minor in EES (see EES program descriptions)

Total Credits 52-56

1 2 credits including 1 course at the 200 level or above. Additional core courses can be used to fulfill this requirement.
2 At least 2 courses from the major electives courses must be applied towards the major electives requirement. In addition, new courses may be offered annually. Students should check with the program director for an updated list.
3 A calculus course may be substituted with permission of the program director.

ELECTIVE COURSES

Major Electives
ANTH 145 Human Evolution 4
ANTH 305 Anthropology Of Fishing 4

Undergraduate Coordinator:
Albert Wurth, Ph.D. (North Carolina) (http://ei.cas2.lehigh.edu/casweb/default.aspx?id=169)

Graduate Coordinator:
Karen Beck-Pooley, Ph.D. (Penn)

Email: kbp213@lehigh.edu # Phone: 610-758-3340

Website: http://ei.cas2.lehigh.edu/
MINOR IN ENVIRONMENTAL STUDIES

A minor in Environmental Studies consists of four 4-credit courses, for a total of 16 credits. At least one course must be at the 300-level. To declare a minor in Environmental Studies, students must complete a minor declaration form.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECO 211</td>
<td>Introduction to Environmental Economics</td>
<td>3</td>
</tr>
<tr>
<td>ECO 311</td>
<td>Environmental Economics</td>
<td>3</td>
</tr>
<tr>
<td>EES 089</td>
<td>Geographic Analysis of our Changing World</td>
<td>3</td>
</tr>
<tr>
<td>EES/CEE 379</td>
<td>Environmental Case Studies</td>
<td>3-4</td>
</tr>
<tr>
<td>EES 386</td>
<td>Wetland Ecology</td>
<td>3,4</td>
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<tr>
<td>ES 010</td>
<td>Environment and the Consumer Society</td>
<td>4</td>
</tr>
<tr>
<td>ES 104</td>
<td>Political and Environmental Geography</td>
<td>4</td>
</tr>
<tr>
<td>ES/POLS 107</td>
<td>The Politics of the Environment</td>
<td>4</td>
</tr>
<tr>
<td>ES/JOUR 115</td>
<td>Communicating about the Environment</td>
<td>4</td>
</tr>
<tr>
<td>ES/JOUR/HMS 117</td>
<td>Environmental Health Risks and the Media</td>
<td>4</td>
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<tr>
<td>ES/EMC/CEE 171</td>
<td>Fundamentals of Environmental Technology</td>
<td>4</td>
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<tr>
<td>ES/REL/ASIA 254</td>
<td>Buddhism and Ecology</td>
<td>4</td>
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<tr>
<td>ES/POLS 305</td>
<td>Seminar: Urban Policy and Planning</td>
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<tr>
<td>ES/POLS 311</td>
<td>Environmental Valuation for Policy Design</td>
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<tr>
<td>ES/POLS 312</td>
<td>Urban Environmental Policy Workshop</td>
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<tr>
<td>ES/SOC 321</td>
<td>Information Ecology</td>
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<tr>
<td>ES/JOUR/STS/HMS 323</td>
<td>Health and Environmental Controversies</td>
<td>4</td>
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<tr>
<td>ES/POLS 328</td>
<td>U.S. Politics and the Environment</td>
<td>4</td>
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<tr>
<td>ES 331</td>
<td>Environmental Law I: Pollution &amp; Risk Abatement</td>
<td>4</td>
</tr>
<tr>
<td>ES/IR 333</td>
<td>International Environmental Law &amp; Policy</td>
<td>4</td>
</tr>
<tr>
<td>ES 338</td>
<td>Environmental Risk</td>
<td>4</td>
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<tr>
<td>ES/IR 342</td>
<td>International Law and Policy Design</td>
<td>4</td>
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<tr>
<td>ES/IR 343</td>
<td>Comparative Environmental Law &amp; Policy</td>
<td>3,4</td>
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<tr>
<td>ES/ANTH 352</td>
<td>Environmental Archaeology</td>
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<tr>
<td>ES/POLS 355</td>
<td>Environmental Justice and the Law</td>
<td>4</td>
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<tr>
<td>ES/TLT 367</td>
<td>Educational Environment</td>
<td>3</td>
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<tr>
<td>ES/TLT 368</td>
<td>Teaching and Learning with Geospatial Tools</td>
<td>3</td>
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<tr>
<td>ES/SOC/GS 370</td>
<td>Globalization and the Environment</td>
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<td>ES/POLS 375</td>
<td>Seminar: Green Polity</td>
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<tr>
<td>ES 391</td>
<td>Honors Thesis</td>
<td>1-4</td>
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<tr>
<td>IR 344</td>
<td>International Politics of Oil</td>
<td>4</td>
</tr>
<tr>
<td>JOUR 123</td>
<td>Basic Science and Technical Writing</td>
<td>4</td>
</tr>
<tr>
<td>POLS 338</td>
<td>Markets, Justice, And Law</td>
<td>3,4</td>
</tr>
<tr>
<td>POLS 348</td>
<td>Land Use, Growth Management, and the Politics of Sprawl</td>
<td>3-4</td>
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<tr>
<td>REL 006</td>
<td>Religion and Ecological Crisis</td>
<td>4</td>
</tr>
<tr>
<td>SDEV 010</td>
<td>Challenges of Sustainable Development</td>
<td>4</td>
</tr>
</tbody>
</table>

ES 131 Internship 1-2
ES 181 Independent Study 1-4
ES 223 Advanced Sustainability in Action I 1-4
ES 224 Advanced Sustainability in Action II 1-4
ES 293 Supervised Internship in the Environmental Initiative 1-4
ES/SDEV 310 Foundations of Sustainable Development Practice 4
ES/POLS 314 Urban Agriculture Policy, Planning and Practice 4
ES 371 Special Topics 1-4
POLS 321 Research In Political Science 4
POLS/GS/WGSS 342 Gender and Third World Development 3-4
POLS 363 Public Opinion Research 4
SDEV 122 Sustainable Dev:CR Experience 3
SDEV 201 Sustainable Development Solutions, I 3
SDEV 202 Sustainable Development Solutions, II 2-4
SDEV 203 Research in Sustainable Development 2-4
SDEV 372 Independent Study in Sustainable Development 1-4
SOC/GS 319 The Political Economy of Globalization 4
SOC/HMS/GS 322 Global Health Issues 4

MINOR IN SUSTAINABLE DEVELOPMENT

The minor in Sustainable Development (http://catalog.lehigh.edu/courses/programsandcurricula/interdisciplinaryundergraduatestudy/sustainabledevelopment) consists of a minimum of at least 15 hours of study that includes a combination of core courses and approved electives. Minors are required to complete a total of 8 core credits (SDEV 010 Challenges of Sustainable Development, and SDEV 202 Sustainable Development Solutions, II) or (SDEV 010 Challenges of Sustainable Development and SDEV 203 Research in Sustainable Development). The remaining 7 credits may be selected from the Additional Course Electives listed below or in consultation with the Program Director. Completion of ECO 001 Principles of Economics is a prerequisite for enrollment in the Sustainable Development minor, except for those for whom the program director waives the prerequisite.

To declare a minor in Sustainable Development, students must complete a minor declaration form.

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tr>
<td>SDEV 010</td>
<td>Challenges of Sustainable Development</td>
<td>4</td>
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<tr>
<td>&amp; SDEV 201</td>
<td>and Sustainable Development Solutions, I</td>
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<td>&amp; SDEV 203</td>
<td>and Research in Sustainable Development</td>
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Additional Electives that may be used to fulfill the major elective requirement

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<tr>
<td>ANTH/GS/AAS 324</td>
<td>Globalization and Development in Africa</td>
<td>4</td>
</tr>
<tr>
<td>ECO 303</td>
<td>Economic Development</td>
<td>3</td>
</tr>
<tr>
<td>EES 318</td>
<td>Geographic Analysis in EES</td>
<td>3,4</td>
</tr>
<tr>
<td>EES 325</td>
<td>Remote Sensing of Terrestrial and Aquatic Environments</td>
<td>3,4</td>
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<tr>
<td>ENTP/SDEV/IR 307</td>
<td>International Social Entrepreneurship</td>
<td>4</td>
</tr>
<tr>
<td>ENTP/POLS 310</td>
<td>Social Entrepreneurship: How to Change the World</td>
<td>4</td>
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<tr>
<td>ES 093</td>
<td>Freshmen Supervised Internship in the Environmental Initiative</td>
<td>1-2</td>
</tr>
<tr>
<td>ES 123</td>
<td>Sustainability in Action I</td>
<td>1-4</td>
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<tr>
<td>ES 124</td>
<td>Sustainability in Action II</td>
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<tr>
<td>ECO 203</td>
<td>Microfinance: Financial Inclusion for the Poor</td>
<td>4</td>
</tr>
<tr>
<td>ENTP/IR 307</td>
<td>International Social Entrepreneurship</td>
<td>4</td>
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Sustainable Dev:CR Experience
SDEV 122

Environmental Risk Assessment
SDEV/ES 310 Foundations of Sustainable Development Practice
SDEV 372 Independent Study in Sustainable Development
ANTH 305 Anthropology Of Fishing
ANTH 324 Globalization and Development in Africa
SOC/GS 328 Global Food Systems

M.A. ENVIRONMENTAL POLICY DESIGN
The graduate Environmental Policy Design (EPD) Program at Lehigh University provides an intensive study of policy design and analysis. It continues to offer the concentration in Environmental Policy and Law that has been the centerpiece of the program since its inception, but two new concentrations in Sustainable Development and Urban Environmental Policy have been added. These new concentrations recognize activities that have already been underway in the EPD program and take advantage of the expertise of new faculty who have recently joined the College of Arts and Sciences. Students graduating from the EPD program with the MA degree will have the opportunity to earn a graduate certificate in one of these three sub-disciplines: Environmental Policy & Law, Urban Environmental Policy, and Sustainable Development.

The EPD program has established three separate tracks through the master's degree. These include the traditional thesis track, the Community Fellows track (coursework only) and the internship track (coursework only). The new internship track was developed to better prepare our graduates for careers in the discipline, and takes advantage of our relationship with a number of government and non-government organizations, including the UN's Division for Sustainable Development where we have placed a number of EPD students. Financial aid is available.

Applicants for the MAEPD will be placed into one of three tracks (Thesis, Internship or Community Fellows).

Core Courses
- ES 401 Philosophical-Policy and Environmental Legal Design
- ES/EES 402 Scientific Foundations for Environmental Policy Design
- ES/SOC 404 Socio-cultural Foundations of Environmental Policy Design

Skills/Methods Course Requirement
- 3-6
- CEE 471 Environmental Risk Assessment
- EDUC 405 Qualitative Research Methods
- EES 318 Geographic Analysis in EES
- EES 325 Remote Sensing of Terrestrial and Aquatic Environments
- ES/TLT 368 Teaching and Learning with Geospatial Tools
- POLS 321 Research In Political Science
- POLS 363 Public Opinion Research
- POLS 402 Methods Of Policy Analysis
- POLS 421 Research Methods
- SOC 410 Statistics for Sociological Inquiry
- SOC 411 Advanced Research Methods, Part I: Quantitative
- SOC 412 Adv Research Methods, Part II, Qualitative

Elective Courses
- 15
- ANTH/AAS/GS 324 Globalization and Development in Africa
- ECO 303 Economic Development
- SDEV/ENTP/IR 307 International Social Entrepreneurship
- ES/POLS 405 Seminar: Urban Policy and Planning
- ES 410 Foundations of Sustainable Development Practice
- ES/POLS 411 Environmental Valuation for Policy Design
- ES/POLS 412 Urban Environmental Policy Workshop
- ES/POLS 414 Urban Agriculture Policy, Planning and Practice
- ES/SOC 421 U.S. Environmental Law I: Pollution and Risk Abatement
- ES 433 International Environmental Law & Policy
- ES 442 International Law and Policy Design
- ES 443 Comparative Environmental Law & Policy
- ES/POLS 455 Environmental Justice & The Law
- ES/POLS 475 Seminar: Green Polity
- POLS/ENTP 310 Social Entrepreneurship: How to Change the World
- POLS/GS/WGSS 342 Gender and Third World Development
- POLS 348 Land Use, Growth Management, and the Politics of Sprawl
- POLS 416 American Environmental Policy
- POLS 468 Political Economy
- SOC/GS 319 The Political Economy of Globalization
- SOC/GS/HMS 322 Global Health Issues
- SOC 419 Global Food Systems
- SOC/WGSS 441 Women and Health

Tracks
- 3-6
- Thesis track  
  ES 490 Thesis
- Internship Track  
  ES 480 Internship in Environmental Policy
- Community Fellows Track  
  A one year Master's Program in which students work for 15 hours a week in a nonprofit organization as part of their academic experience. Please see the program website at www.lehigh.edu/communityfellows.
  POLS 464 Community Fellowship I
  POLS 465 Community Fellowship II

CONCENTRATIONS WITHIN MAEPD
The MAEPD program provides students the opportunity to concentrate in a variety of areas of academic and/or professional interest. In the table below are examples of three possible concentrations that are especially suited to faculty expertise and program resources. A total of 12-15 credits of electives comprise each concentration, plus a related internship experience or thesis topic. The EPD graduate would be eligible to receive a "Graduate Certificate" in one of these concentration areas (see certificate program below).

Concentration in Urban Environmental Policy and Planning
- ES/POLS 405 Seminar: Urban Policy and Planning
- ES/POLS 412 Urban Environmental Policy Workshop
- ES/POLS 414 Urban Agriculture Policy, Planning and Practice
- ES/POLS 455 Environmental Justice & The Law
POLS 348  Land Use, Growth Management, and the Politics of Sprawl
POLS 416  American Environmental Policy

Concentration in Environmental Law and Policy
Domestic and International)
ES/POLS 411  Environmental Valuation for Policy Design
ES/POLS 431  U.S. Environmental Law I: Pollution and Risk Abatement
ES 433  International Environmental Law & Policy
ES 442  International Law and Policy Design
ES/POLS 455  Environmental Justice & The Law
ES/POLS 475  Seminar: Green Polity
POLS 416  American Environmental Policy
POLS 468  Political Economy

Concentration in Sustainable Development
ANTH 324  Globalization and Development in Africa
ECO 303  Economic Development
ES 410  Foundations of Sustainable Development Practice
ES/POLS 414  Urban Agriculture Policy, Planning and Practice
POLS/ENTP 310  Social Entrepreneurship: How to Change the World
POLS/GS/WGSS 342  Gender and Third World Development
POLS 348  Land Use, Growth Management, and the Politics of Sprawl
SDEV/ENTP/IR 307  International Social Entrepreneurship
SOC/GS 319  The Political Economy of Globalization
SOC/GS/HMS 322  Global Health Issues
SOC 419  Global Food Systems
SOC/WGSS 441  Gender and Health

GRADUATE CERTIFICATE PROGRAMS
Each certificate requires a minimum of 12 credit hours (4 courses) from the elective list specific to each area of study. A graduate of the EPD program is only eligible to receive ONE of the following certificates. Certificate courses can be counted towards MAEPD, as appropriate and must be completed in a maximum of 3 years.

Environmental Law and Policy
Core Course
ES 401  Philosophical-Policy and Environmental Legal Design
or ES 404  Socio-cultural Foundations of Environmental Policy Design

Elective Courses
Select any three of the following:
ES/POLS 411  Environmental Valuation for Policy Design
ES/POLS 431  U.S. Environmental Law I: Pollution and Risk Abatement
ES 433/333  International Environmental Law & Policy
ES 442  International Law and Policy Design
ES 443  Comparative Environmental Law & Policy
ES/POLS 455  Environmental Justice & The Law
ES/POLS 475  Seminar: Green Polity
POLS 416  American Environmental Policy

POLS 468  Political Economy

Total Credits 12
1 Additional courses selected in consultation with the program adviser may fulfill program requirements. No more than 6 credits can be taken at the 300 level.

Urban Environmental Policy and Planning
Core Course
ES/SOC 404  Socio-cultural Foundations of Environmental Policy Design

Elective Courses 1
ES/POLS 412  Urban Environmental Policy Workshop
ES/POLS 414  Urban Agriculture Policy, Planning and Practice
ES/POLS 455  Environmental Justice & The Law
POLS 348  Land Use, Growth Management, and the Politics of Sprawl
POLS 416  American Environmental Policy

Total Credits 12
1 Additional courses selected in consultation with the program adviser may fulfill program requirements. No more than 6 credits can be taken at the 300 level.

Sustainable Development
Core Courses
ES 404  Socio-cultural Foundations of Environmental Policy Design
or SOC 404  Socio-cultural Foundations of Environmental Policy Design
ES 410  Foundations of Sustainable Development Practice

Elective Courses 1
ANTH/GS/AAS 324  Globalization and Development in Africa
ECO 303  Economic Development
ES/POLS 414  Urban Agriculture Policy, Planning and Practice
SDEV/ENTP/IR 307  International Social Entrepreneurship
SOC/POLS 410  Social Entrepreneurship: How to Change the World
POLS/GS/WGSS 342  Gender and Third World Development
POLS 348  Land Use, Growth Management, and the Politics of Sprawl
SOC/GS/HMS 322  Global Health Issues
SOC/GS 319  The Political Economy of Globalization
SOC 419  Global Food Systems
SOC/WGSS 441  Women and Health

1 Additional courses selected in consultation with the program adviser may fulfill program requirements. No more than 6 credits can be taken at the 300 level.

Courses
ES 001 Introduction to Environmental Studies 4 Credits
Gateway to the field of Environmental Studies, the course surveys central issues and themes confronting humanity in the natural world on a national and global basis. Topics include humankind’s role in environmental change; society’s response to the dynamism of nature; cultural evaluations of nature; population dynamics; resource availability and pollution sinks; land use patterns; sustainability and consumerism; environmental justice and ethics; policy and planning. This course fulfills a social science credit requirement. Please select ES 002 to fulfill the natural science requirement.

Attribute/Distribution: SS
ES 002 (EES 002) Introduction to Environmental Science 3 Credits
Focusing on natural and human-induced drivers and consequences of environmental change. Exploring options for mitigating and adapting to environmental change in ecosystems, physical and social systems, we will examine such topics as biogeochemical cycles, population pressure, ecosystem diversity, productivity and food security, energy, water resources, climate change, pollution, ozone, urban issues and sustainability. Stresses interactions and interrelationships, using a series of case studies. Intended for any student with an interest in the environment. May be combined with EES 022.
Attribute/Distribution: NS

ES 004 The Science of Environmental Issues 1 Credit
Analysis of current environmental issues from a scientific perspective. The focus on the course will be weekly discussions based on assigned readings.
Attribute/Distribution: SS

Prerequisites: EES 002 or EES 028 or ECP 002 or EES 011 or EES 012 or EES 014 or EES 015 or EES 016 or EES 021 or EES 024 or EES 025 or EES 026 or EES 027 or GCP 027 or GCP 028 or EES 089 or EES 090 or EES 022

Can be taken Concurrently: EES 002, EES 028, EES 028, EES 011, EES 012, EES 014, EES 015, EES 016, IR 016, EES 021, EES 024, EES 025, EES 026, GCP 026, GCP 027, GCP 028, EES 089, EES 090, EES 022

Attribute/Distribution: NS

ES 010 Environment and the Consumer Society 4 Credits
Is there such a thing as sustainable consumption, or will life on Earth become increasingly imbalanced? Will our grandchildren accuse us of “devouring” their future? This multidisciplinary course investigates these issues, both locally and globally from the perspectives of anthropology, history, communication and politics. Topics include cultural causes of and responses to past environmental disasters; biological and cultural limits to growth; overfishing the commons; resources and land use issues; communication in a consumer culture; and politics and governmental regulations. Team projects researching the environmental impacts of campus consumption will be included.
Attribute/Distribution: SS

ES 093 Freshmen Supervised Internship in the Environmental Initiative 1-2 Credits
Experiential learning opportunities supervised by E1 faculty including fieldwork, data collection or analysis, literature review, and information management. Consent of supervising faculty is required. The experience may be related to either environmental studies or environmental science depending upon the discipline of supervising faculty member.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU, NS, SS

ES 100 Earth Systems Science 4 Credits
Examination of the Earth as an integrated system. Study of interactions and feedbacks between key components such as the atmosphere, geo-sphere, and hydrosphere to permit better understanding of the behavior of the system as a whole. Response of the Earth system to human perturbations such as land use and emissions are explored in the context of predictions of future environmental conditions and their projected impacts back on human systems. Lectures, class discussions, and recitation.
Prerequisites: EES 022
Attribute/Distribution: NS

ES 104 Political and Environmental Geography 4 Credits
Geographical foundations of political phenomena and human impacts on the environment. Global focus on geographic influences on growth and development of states and empires, the nature and impact of borders, how people have altered pattern of climate, hydrology, land forms soils, and biota.
Attribute/Distribution: SS

ES 105 (POLS 105) Environmental Policy and Planning 4 Credits
Analysis of the framework that has been established to protect the environment and promote sustainable growth. Focus on the roles of the different branches of the U.S. government and the relative responsibilities of state and local governments within this framework. Consideration of the political nature of environmental issues and the social forces influencing environmental protection in different areas of domestic environmental policy, such as climate change, toxic waste disposal and natural resources conservation.
Attribute/Distribution: SS

ES 106 (POLS 106) Environmental Values and Ethics 4 Credits
An introduction to the ethical perspectives and values that shape human relationships to the natural environment in contemporary society. What are the moral implications of these relationships for justice and human collective action? Given these implications, what policy responses to environmental problems are morally or politically justifiable? In answering these questions, the course explores ethical ideas developed in different schools of environmental thought, such as deep ecology and eco-feminism, in addition to ideas that emerge from social movements, such as environmental justice and bioregionalism.
Attribute/Distribution: SS

ES 107 The Politics of the Environment 4 Credits
A survey of the major environmental, resource, energy and population problems of modern society, focusing on the United States. The politics of people’s relationship with nature, the political problems of ecological scarcity and public goods, and the response of the American political system to environmental issues.
Attribute/Distribution: SS

ES 108 (HMS 117, JOUR 117) Environmental Health Risks and the Media 4 Credits
Course may be repeated.
Attribute/Distribution: SS

ES 111 Introduction to Environmental Economics 4 Credits
An examination of the interactions between our economic systems and the environment. Pollution as a consequence of human activity within a framework for analyzing the relationships between environmental quality, scarcity of resources and economic growth. How to develop appropriate public policies to deal with these issues.
Attribute/Distribution: SS

ES 115 (JOUR 115) Communicating about the Environment 4 Credits
Introduction to the need for and ways to communicate about environmental issues to laypersons, government officials, journalists, members of the judiciary and technical experts. Explores case studies of good and bad communication about environmental issues. Internet communication, including the efficacy of placing governmental reports and databases on the Web for public consumption, will be evaluated.
Attribute/Distribution: SS

ES 117 (HMS 117, JOUR 117) Environmental Health Risks and the Media 4 Credits
This course explores the risks and effects of environmental contamination on human health and behavior as well as the role of the mass media in alerting citizens to potential environmental health risks. Environmental topics vary but usually include air and water pollution, endocrine disrupters and radioactive waste.
Attribute/Distribution: SS

ES 121 (ANTH 121) Environment and Culture 4 Credits
Impact of environment upon cultural variability and change. Comparative study of modern and past cultures and their environments as well as current theories of human/environmental interaction.
Attribute/Distribution: SS

ES 123 Sustainability in Action 1-4 Credits
First half of a year-long experiential learning program for students to engage with sustainability in both general theory and applied practices. Students will learn the political, economic and social effects of changing earth systems through a global, national and local lens. Students will explore the multitude of challenges posed by increasing natural resource consumption, inequitable distribution of wealth and rapid uneven globalization. Most importantly, students will engage the Lehigh community and broader community in developing and implementing practical solutions to creating a more sustainable and just world. Offered in coordination with the Campus Eco-Reps program. Instructor permission required.
Repeat Status: Course may be repeated.
ES 124 Sustainability in Action II 1-4 Credits
Continuation of ES 123 Sustainability in Action I; second half of a year-long experiential learning program for students to engage with sustainability in both general theory and applied practices. Students will learn the political, economic and social effects of changing earth systems through a global, national and local lens. Students will explore the multitude of challenges posed by increasing natural resource consumption, inequitable distribution of wealth and rapid uneven globalization. Most importantly, students will engage the Lehigh community and broader community in developing and implementing practical solutions to creating a more sustainable and just world. Students in ES 124 expand the scope and scale of sustainability projects and activities piloted in ES 123. Offered in coordination with the Campus Eco-Reps program. Instructor permission required. Repeat Status: Course may be repeated.

ES 125 (JOUR 125) Environment, the Public and the Mass Media 4 Credits
Extensive exploration of local, national and international environmental problems and their social, political and economic impacts. Analysis of mass media coverage of complex environmental issues and the media’s effects on public opinion and government environmental policies. Examination of environmental journalism principles and practices in the United States and around the world. Attribute/Distribution: SS

ES 131 Internship 1-2 Credits
Practical experience in the application of environmental studies for both on- and off-campus organizations. Is designed to provide credit for supervised experiential learning experiences. Consent of program director required. Repeat Status: Course may be repeated. Attribute/Distribution: ND

ES 171 (CEE 171, CHE 171, EMC 171) Fundamentals of Environmental Technology 4 Credits
Pollution control technologies and how they work for water, air and solid wastes. Assessment and management of risk as applied to remediation of contaminated wastes. Role of life cycle analysis of products in risk reduction. Emphasis on technologies leading to sustainable environment. Government policies and regulations, including litigation and Best Engineering Practices. Must have completed a course designated as NS. Not available to students in RCEAS. Attribute/Distribution: HU

ES 181 Independent Study 1-4 Credits
Directed readings or research on an Environmental Studies topic. Consent of program director required. Repeat Status: Course may be repeated. Attribute/Distribution: HU, SS

ES 223 Advanced Sustainability in Action I 1-4 Credits
Leadership and coordination of Sustainability in Action projects and activities for students in ES 123. Experienced students who have completed the year-long Sustainability in Action sequence (ES 123 and ES 124) continue in course coordination role. Offered in coordination with the Campus Eco-Reps Program. Consent of instructor required. Repeat Status: Course may be repeated. Prerequisites: ES 123 and ES 124

ES 224 Advanced Sustainability in Action II 1-4 Credits
Continuation of ES 223. Leadership and coordination of Sustainability in Action projects and activities for students in ES 124. Experienced students who have completed the year-long Sustainability in Action sequence (ES 123 and ES 124) continue in course coordination role. Offered in coordination with the Campus Eco-Reps Program. Consent of instructor required. Repeat Status: Course may be repeated. Prerequisites: ES 123 and ES 124 and ES 223

ES 254 (ASIA 254, REL 254) Buddhism and Ecology 4 Credits
Buddhism's intellectual, ethical, and spiritual resources and reexamined in light of contemporary environmental problems. Is Buddhism the most green of the major world religions? What are the moral implications of actions that affect the environment? Attribute/Distribution: HU

ES 293 Supervised Internship in the Environmental Initiative 1-4 Credits
Experiential learning opportunities supervised by EI faculty including fieldwork, data collection or analysis, literature review, and information management. The experience may be related to either environmental studies or environmental science depending upon the discipline of supervising faculty member. The students should collaborate with faculty to develop a work plan that describes the credits requested as well as the activities included in the internship and expected outcomes. Consent of supervising faculty is required. Repeat Status: Course may be repeated. Prerequisites: ES 093 Attribute/Distribution: HU, NS, SS

ES 305 (POLS 305) Seminar: Urban Policy and Planning 4 Credits
This course is an introductory planning course, with an emphasis on housing and community development policy. It will examine historical and contemporary aspects of urban politics; the economic, demographic, and spatial evolution of American cities; and various urban problems, such as the spatial mismatch between people and jobs, housing quality and affordability, and residential segregation. Finally, the course will review how planners have addressed conditions in cities and regions over time. Attribute/Distribution: SS

ES 310 (SDEV 310) Foundations of Sustainable Development Practice 4 Credits
The broad goal of this course is to introduce students to the foundations of key sectoral and thematic knowledge for important challenges to sustainable development: food and nutritional security, social service delivery, energy policy, water resource management, urbanization, infrastructure, human rights, biodiversity, adaptation to climate change, mitigating GHGs, sustainable business, good governance, and more. Through the Global Classroom we will do this together virtually with academic partners from around the world. Attribute/Distribution: SS

ES 311 (POLS 311) Environmental Valuation for Policy Design 4 Credits
Seminar on how to value the environment for the purpose of designing and analyzing environmental policies. Review of the "contingent valuation method" currently used to price environmental resources, and assessment of this method's empirical and normative strengths and weaknesses. Evaluation of "deliberative monetary valuation" as an improved method for environmental assessment. Consideration of non-monetary approaches to environmental valuation as alternatives to understanding the environment's relationship to human well-being in policy contexts. Attribute/Distribution: SS

ES 312 (POLS 312) Urban Environmental Policy Workshop 4 Credits
An urban environmental planning and policy course in which students explore an issue affecting the local community, evaluate current policy responses and possible alternatives, and present recommendations to public officials, local organizations, and community members. Student research and analysis will draw on primary and secondary data, as well as feedback from conducting individual interviews, focus groups, and community meetings. Prior projects include determining how Bethlehem's new City Revitalization Improvement Zone (CRIZ) might best benefit the South Side of Bethlehem, PA. Attribute/Distribution: SS

ES 314 (POLS 314) Urban Agriculture Policy, Planning and Practice 4 Credits
Experiential urban agriculture and greening programs in growing social movement to strengthen neighborhoods, promote healthier living, and create localized and sustainable food economies. Students consider these programs in relation to national farm policy and develop urban agriculture projects with community partners. Case studies illustrate how improving food access, beautifying vacant land, and reducing farm-to-table distances, are creatively and successfully combined. Students will receive hands-on gardening and farming experience at a community garden. Attribute/Distribution: SS
ES 315 (HIST 315) American Environmental History 3,4 Credits
Relationship between Americans and their natural environment from the colonial period to the present: impact of European settlement, attributes toward wilderness, role of technological development, rise of preservation and conservation movements, establishment of national parks, recent environmental protection legislation.
Attribute/Distribution: SS

ES 321 (SOC 321) Information Ecology 4 Credits
Information theory, critical social theory, and ecological principles are combined to model how information organizes human ecosystems. These concepts are applied to environmental policy analysis using base studies.

ES 323 (HMS 323, JOUR 323, STS 323) Health and Environmental Controversies 4 Credits
Exploration of health and environmental controversies from the perspectives of scientific uncertainty and mass media coverage. Examines genetic engineering, biotechnology, environmental health risks, and nanotechnology. Includes discussion of ethical and social responsibilities and interactions with the public.
Attribute/Distribution: SS

ES 331 Environmental Law I: Pollution & Risk Abatement 4 Credits
This course studies the practical reality of environmental regulation as codified law. It also aims at understanding the law’s foundation in argument and justification as both existing law and proposed policy through the use of cases, statutes, and regulations on air, water, risk, waste and environmental impact. Utilizing two legal paradigms for charting the relationship between humanity and nature, it examines a wide range of environmental law as well as ethical, political, economic, scientific, and policy dimensions.
Attribute/Distribution: SS

ES 333 (IR 333) International Environmental Law & Policy 4 Credits
This course examines the basic international legal setting for the protection and management of the global environment. It examines how international law concerning nature is made and applied, the role of international environmental regimes or institutions, enforcement strategies, and compliance mechanisms. Emphasis will be placed on a review of various regulatory regimes for the protection of the global commons, including the history and legal sources of the Global Climate Change Convention.
Attribute/Distribution: SS

ES 338 Environmental Risk 4 Credits
Starting with the distinction between traditional pollution problems and environmental risk, this course examines the policy and legal implications of its unique characteristics.
Attribute/Distribution: SS

ES 342 (IR 342) International Law and Policy Design 4 Credits
Beginning in the 13th Century, this course traces the various philosophical, historical, and policy design arguments that have been used to explain, justify, and influence the evolution of the rule of law between states (ius gentium).
Attribute/Distribution: SS

ES 343 (IR 343) Comparative Environmental Law & Policy 3,4 Credits
This course studies the different ways in which domestic legal systems handle the regulation of humanity’s relationship to the natural world. The first part of the course concentrates on comparative law that examines the evolution of distinct types of legal systems from their origins in the ancient world. The second part of the course specifically and comparatively examines environmental law as it has developed in Canada, China, the European Union and the United States. Ranges of alternatives for environmental law and policy as practiced in various parts of the world will be explored.
Attribute/Distribution: SS

ES 352 (ANTH 352) Environmental Archaeology 4 Credits
This course reviews the various categories of archaeological data used to examine the nature of past human-environmental relationships. We will explore how archaeologists use data to recognize anthropogenic and natural environmental changes, as well as cultural adaptations to local environments.
Attribute/Distribution: SS

ES 355 (POLS 355) Environmental Justice and the Law 4 Credits
This course explores the various ways in which environmental law and policy can have discriminatory effects. It examines the rise and evolution of the environmental justice movement, and the impact of environmental justice claims on administrative rulemaking at both the state and federal level. Reviewing the history of case law concerning environmental justice suits filed under the 1964 Civil Rights Act, it also examines the future of environmental justice in environmental law and policy.
Prerequisites: POLS 105 or ES 105
Attribute/Distribution: SS

ES 367 (TLT 367) Environmental Education 3 Credits
Introductory environmental education course designed to prepare students to implement environmental education opportunities in formal and non-formal education settings. Topics include history and philosophy of environmental education, environmental laws and regulations, GIS, environmental issues and decision making, curriculum integration and environmental education teaching methodologies. This is a Web enhanced containing both online and fieldwork components.

ES 368 (TLT 368) Teaching and Learning with Geospatial Tools 3 Credits
Exploration of geospatial tools, including but not limited to global positioning systems (GPS), geographic information systems (GIS), and related visualization tools (e.g., Google Earth). Application of these tools and techniques to instructional settings, including appropriate pedagogy and assessment.

ES 370 (GS 370, SOC 370) Globalization and the Environment 4 Credits
This course investigates globalization and the environment including how globalization has influenced society-nature relationships, as well as how environmental conditions influence the globalization processes. A key focus will be on the rapidly evolving global economic and political systems that characterize global development dynamics therefore resource use. Particular attention is paid to the role of multi-national corporations, international trade, and finance patterns and agreements. Questions related to consumption, population, global climate change, toxic wastes, and food production/distribution represent key themes.
Attribute/Distribution: SS

ES 371 Special Topics 1-4 Credits
Intensive, research-oriented study of a subject or issue in Environmental Studies not covered in other courses. For students of demonstrated ability and adequate preparation. Consent of program director required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU, SS

ES 375 (POLS 375) Seminar: Green Polity 4 Credits
Development of guidelines and applications for public policy and political action directed toward environmental sustainability and political feasibility. Focus on problem-solving and policy design, connecting sustainable environmental goals with workable and responsive institutional designs.
Attribute/Distribution: SS

ES 381 Senior Seminar: Issues in Environmental Studies 4 Credits
Advanced seminar focusing on discussion and research on specialized subjects in Environmental Studies. Subject matter varies from semester to semester. Intended for Environmental Studies majors and minors but open to others. Consent of program director.
Prerequisites: ES 001 or ES 002
Attribute/Distribution: SS

ES 391 Honors Thesis 1-4 Credits
Directed undergraduate research thesis required of students who apply and qualify for graduation with program honors. Consent of program director required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU, SS
ES 401 Philosophical-Policy and Environmental Legal Design 3 Credits
A basic class for graduate students on the idea of policy design, as opposed to standard economic analysis of public policy and its application to various domestic and international environmental dilemmas. The course will also introduce the idea of Philosophical-Policy, or the use of integrated philosophical systems to justify specific policy design arguments, through the use of two distinct theoretical paradigms that focus on, specifically, the integrity of the natural environment and the capabilities of humans in relation to ecosystems.

ES 402 (EES 402) Scientific Foundations for Environmental Policy Design 3 Credits
This course explores the science behind the environmental issues that bear on the policy process at local, national and global scales. It delves into the science of selected environmental issues that have either arisen from anthropogenic activities, or that impact social systems, or that help policy makers understand the consequences of different policy options. The course will consist of readings and discussions of timely topics and one major project.

Attribute/Distribution: NS

ES 404 (SOC 404) Socio-cultural Foundations of Environmental Policy Design 3 Credits
This course is based on the premise that social and ecological sustainability require new policy approaches. Drawing on social, organizational, and behavioral theory, students will learn techniques for analyzing and critiquing existing environmental policies and designing more effective policies. Case studies highlight how cultural values, social norms, public opinion and politics shape policies and their outcomes. We examine the entire policy process from how environmental problems are defined, to how organizations implement policies and how policies are evaluated.

ES 405 (POLS 405) Seminar: Urban Policy and Planning 3 Credits
This course is an introductory planning course, with an emphasis on housing and community development policy. It will examine historical and contemporary aspects of urban politics; the economic, demographic, and spatial evolution of American cities; and various urban problems, such as the spatial mismatch between people and jobs, housing quality and affordability, and residential segregation. Finally, the course will review how planners have addressed conditions in cities and regions over time.

ES 410 Foundations of Sustainable Development Practice 3 Credits
The broad goal of this course is to introduce students to the foundations of key sectoral and thematic knowledge for important challenges to sustainable development: food and nutritional security, social service delivery, energy policy, water resource management, urbanization, infrastructure, human rights, biodiversity, adaption to climate change, mitigating GHGs, sustainable business, good governance, and more. Through the Global Classroom, an approach pioneered by Columbia University and the Global Masters of Development Practice Association (http://globalmdp.org/), we will do this together virtually with.

ES 411 (POLS 411) Environmental Valuation for Policy Design 3 Credits
Seminar on how to value the environment for the purpose of designing and analyzing environmental policies. Review of the "contingent valuation method" currently used to price environmental resources, and assessment of this method's empirical and normative strengths and weaknesses. Evaluation of "deliberative monetary valuation" as an improved method for environmental assessment. Consideration of non-monetary approaches to environmental valuation as alternatives to understanding the environment's relationship to human well-being in policy contexts.

ES 412 (POLS 412) Urban Environmental Policy Workshop 3 Credits
An urban environmental planning and policy course in which students explore an issue affecting the local community, evaluate current policy responses and possible alternatives, and present recommendations to public officials, local organizations, and community members. Student research and analysis will draw on primary and secondary data, as well as feedback from conducting individual interviews, focus groups, and community meetings. Prior projects include determining how Bethlehem's new City Revitalization improvement Zone (CRIZ) might best benefit the South Side of Bethlehem, PA.

ES 414 (POLS 414) Urban Agriculture Policy, Planning and Practice 3 Credits
Review of urban agriculture and greening programs in growing social movement to strengthen neighborhoods, promote healthier living, and create localized and sustainable food economies. Students consider these programs in relation to national farm policy and develop urban agriculture projects with community partners. Case studies illustrate how improving food access, beautifying vacant land, and reducing farm-to-table distances, are creatively and successfully combined. Students will receive hands-on gardening and farming experience at a community garden.

ES 421 (SOC 421) Information Ecology 3 Credits
Information theory, critical social theory, and ecological principles are combined to model how information organizes human ecosystems. These concepts are applied to environmental policy analysis using case studies.

ES 431 (POLS 431) U.S. Environmental Law I: Pollution and Risk Abatement 3 Credits
The study of bureaucracy and problems of public and nonprofit organization and management; executive leadership; personnel management systems and regulatory administration.

ES 433 International Environmental Law & Policy 3 Credits
This course examines the basic international legal setting for the protection and management of the global environment. It examines how international law concerning nature is made and applied, the role of international environmental regimes or institutions, enforcement strategies, and compliance mechanisms. Emphasis will be placed on a review of various regulatory regimes for the protection of the global commons, including the history and legal sources of the Global Climate Change Convention.

Attribute/Distribution: SS

ES 435 Environmental Valuation for Policy Design & Legal Analysis 3 Credits
Reviewing the history and legal context that gave rise to the current use of the "contingent valuation method" for pricing environmental resources, this course assesses empirical and normative strengths of this method, as well as the weaknesses that challenge its effectiveness and political legitimacy. Students will evaluate the recent turn to "deliberative" methods of resource valuation and consider empirical and normative problems that deliberative methods address.

ES 442 International Law and Policy Design 3 Credits
Beginning in the 13th Century, this course traces the various philosophical, historical, and policy design arguments that have been used to explain, justify, and influence the evolution of the rule of law between states (ius gentium).

ES 443 Comparative Environmental Law & Policy 3 Credits
This course studies the different ways in which domestic legal systems handle the regulation of humanity's relationship to the natural world. The first part of the course concentrates on comparative law that examines the evolution of distinct types of legal systems from their origins in the ancient world. The second part of the course specifically and comparatively examines environmental law as it has developed in Canada, China, the European Union and the United States. Ranges of alternatives for environmental law and policy as practiced in various parts of the world will be explored.

Attribute/Distribution: SS
ES 455 (POLS 455) Environmental Justice & The Law 3 Credits
This course is an in-depth exploration of the various ways in which environmental law and policy can have discriminatory effects. It examines the rise and evolution of the environmental justice movement, and the impact of environmental justice claims on administrative rulemaking at both the state and federal level. Reviewing the history of case law concerning environmental justice suits filed under the 1964 Civil Rights Act, it also examines the future of environmental justice in environmental law and policy.

Attribute/Distribution: SS

ES 475 (POLS 475) Seminar: Green Polity 3 Credits
Development of guidelines and applications for public policy and political action directed toward environmental sustainability and political feasibility. Focus on problem-solving and policy design, connecting sustainable environmental goals with workable and responsive institutional designs.

ES 480 Internship in Environmental Policy 3 Credits
Students will gain practical experience working with governmental or non-governmental organizations or public officials formulating and/or implementing environmental policies at local, regional, national or international levels. Requires submission of a formal proposal drafted in collaboration with a faculty advisor and the professional mentor who will oversee the student's internship. Upon completion of the internship, students will report project outcomes in oral presentation, written, or digital media format.

Repeat Status: Course may be repeated.

ES 483 Independent Study 1-3 Credits
Repeat Status: Course may be repeated.

ES 490 Thesis 1-6 Credits
Thesis.

Environmental Policy Design

The M.A. in Environmental Policy Design trains scholars and practitioners alike for the demanding task of designing environmental policy that can protect or restore an increasingly degraded natural environment while sustaining the benefits of economic growth and providing for the needs of an ever-more-vulnerable (and growing) human population. Achieving this goal will require policy professionals to understand and analyze environmental problems amidst multiple systems and levels of law and in the context of rapidly globalizing governance structures, institutions, and regimes that cut across geographical and political boundaries.

For more information visit Environmental Initiative

Finance

In the era of a growing competitive global economy, finance has become increasingly important and complex. This has led to an expansion of career opportunities within corporations, investment firms, and financial institutions worldwide. These opportunities are varied and often overlap with other disciplines such as accounting, economics, marketing, and mathematics. It is also important that students engage in extracurricular activities that might complement their academic studies.

The domestic financial services industry has been at the forefront of global finance and will remain as one of our relative strengths within a global economy. Lehigh, in turn, enjoys a relative advantage in this regard as Lehigh alumni are well respected in all areas of finance. Our program has also been able to take advantage of our proximity to many financial institutions.

Professors. Paul Brockman, PhD (Louisiana State University); Stephen G. Buell, PhD (Lehigh University); Kathleen W. Hanley, PhD (University of Florida); Richard J. Kish, PhD (University of Florida); Matthew A. Melone, JD (University of Pennsylvania); George A. Nation, III, JD (Villanova University); Nandkumar Nayar, PhD (University of Iowa); Georgette C. Phillips, JD (Harvard Law School)

Associate Professors. Anne-Marie Anderson, PhD (University of Arizona); Steven McKay Price, PhD (Florida State University); Jesus M. Salas, PhD (University of Oklahoma); Stephen F. Thode, DBA (Indiana University Bloomington); Ke Yang, PhD (University of Iowa)

Assistant Professors. Michael B Imerman, PhD (Rutgers University); Yung-Yu Ma, PhD (University of Utah); Haibei Zhao, PhD (Georgia State University)

Professors Of Practice. David H. Myers, PhD (University of Washington); Samuel C. Weaver, PhD (Lehigh University)

Emeritus. Carl R. Beidlerman, PhD (University of Pennsylvania)

The finance major offered by the Perella Department of Finance requires at least 18 credit hours beyond the core requirements. Each finance major must successfully complete the 2-course foundation requirement; the 3-course depth requirement; and a minimum 2-course breadth requirement as outlined below.

2-Course Foundation Requirement
FIN 323 Investments 3
FIN 328 Corporate Financial Policy 3

3-Course Depth Requirement
Select three of the following:
FIN 324 Security Analysis and Portfolio Management
FIN 330 Financial Markets and Institutions
FIN 333 Global Finance
FIN 334 Derivatives and Management of Risk
FIN 335 Advanced Topics – Financial Management (Various Topics can be offered under this course listing)
FIN 336 Real Estate Finance (recommended for Real Estate Valuation Track)
FIN 377 Advanced Topics--Investments (Various topics can be offered under this course listing)

2-Course Breadth Requirement
Select 2 breadth electives within one of the following six breadth tracks.*

Track 1: Financial Analysis
ACCT 315 Intermediate Accounting I
ACCT 316 Intermediate Accounting II

Track 2: Financial Marketing
MKT 312 Marketing Research
MKT 319 Development and Marketing of New Products
MKT 320 Global Marketing
MKT/ECO 325 Consumer Insights through Data Analysis
MKT 332 Sales Management

Track 3: Analytical Finance
ISE 316 Optimization Models and Applications
ISE 339 Stochastic Models and Applications
or MATH 310 Random Processes and Applications
MATH 205 Linear Methods
or MATH 242 Linear Algebra
MATH 231 Probability and Statistics
or MATH 309 Theory of Probability

Track 4: Financial Economics
ECO 209 Comparative Economic Systems
or ECO 322 Competitor and Market Analysis
or ECO 328 Electricity Systems
or ECO 333 The Economics of Business Decisions
or ECO 336 Business and Government
or ECO 353 Public Finance: Federal
ECO 203 Microfinance: Financial Inclusion for the Poor
or ECO 303 Economic Development
or ECO 339 International Trade

*3 breadth electives for the Real Estate Valuation track.
FIN 328 Corporate Financial Policy 3 Credits
The study of management issues related to capital budgeting, working
capital, leasing, mergers, and financing.
Prerequisites: (FIN 125 or FIN 225) and (ECO 146)

FIN 330 Financial Markets and Institutions 3 Credits
Functions and portfolios of financial intermediaries. Sectional demand
and supply of funds, nature and role of interest rates, term structure and
forecasting, impact of inflation and regulation on financial intermediaries
and markets, and current developments in the financial system.
Management of assets and liabilities within the U.S. financial institution’s
legal and economic constraints.
Prerequisites: (FIN 323 and FIN 328)

FIN 333 Global Finance 3 Credits
Issues that underlie the investment, financing, and dividend decisions of
multinational firms from both the buyer’s and seller’s viewpoints. Current
transactions in foreign currencies, direct and portfolio investment and
associated risk management when dealing in foreign countries.
Prerequisites: (FIN 328 and FIN 323)

FIN 334 Derivatives and Management of Risk 3 Credits
Theoretical and practical aspects of various instruments and markets
that involve financial derivative instruments. Emphasis on the
management of risk for corporate managers and portfolio managers.
Prerequisites: (FIN 323 and FIN 328)

FIN 335 Advanced Topics – Financial Management 3 Credits
Advanced topics relating to specific areas of corporate finance such as:
bond refunding, asset valuation and capital budgeting including the role
of uncertainty, imprecise forecasts, risk preferences, inflation, market
conditions, and the global marketplace; working capital management,
leasing, mergers, and financing. The course content may vary between
instructors and over time, therefore, the course descriptor is subject to
change each time the is offered.
Repeat Status: Course may be repeated.
Prerequisites: (FIN 328 and FIN 323)

FIN 336 Real Estate Finance 3 Credits
An advanced survey of modern residential and commercial real estate
financing techniques from the perspective of the borrower and the
lender. Topics include: the principles of financing decisions; financing
methods and techniques, institutional sources of funds for real estate,
and real estate financing decision-making. The course includes lectures,
demonstrations, spreadsheet software exercises, and guest speakers.
Prerequisites: (FIN 328 and FIN 323)

FIN 371 Directed Readings 1-3 Credits
Readings in various fields of finance designed for the student with a
special interest in some field of finance not covered in scheduled
courses. Consent of sponsoring instructor required.
Repeat Status: Course may be repeated.

FIN 372 Special Topics 1-3 Credits
Special problems and issues in finance for which no regularly scheduled
course work exists. When offered as group study, coverage varies
according to interests of instructor and students. Consent of sponsoring
instructor required.
Repeat Status: Course may be repeated.

FIN 373 Finance Internship I 1-3 Credits
Based on a student’s work experience, a sponsoring faculty member
shall direct readings, projects, and other assignments—including a
“capstone report.” It should be noted that the work experience (at least
80 hours), by itself, is not the basis for academic credit. The faculty
directed activity must be provided concurrent with the work. Course
registration and related arrangements must be made in advance of the
work engagement. This course must be taken Pass/Fail and cannot be
used to satisfy finance major requirements. Declaration of a finance
major. Consent of department required.
Prerequisites: (ECO 129 or ECO 029 and ACCT 151) and (ECO 145 or
ECO 045 or MATH 231 or ISE 111 or IE 111 or SR 111) and (MATH 021
or MATH 031 or MATH 076 or MATH 097 or MATH 081)

FIN 273 Finance Internship I 1-3 Credits
Based on a student’s work experience, a sponsoring faculty member
shall direct readings, projects, and other assignments—including a
“capstone report.” It should be noted that the work experience (at least
80 hours), by itself, is not the basis for academic credit. The faculty
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Prerequisites: (ECO 129 or ECO 029 and ACCT 151) and (ECO 145 or
ECO 045 or MATH 231 or ISE 111 or IE 111 or SR 111) and (MATH 021
or MATH 031 or MATH 076 or MATH 097 or MATH 081)

FIN 300 Apprentice Teaching 1-3 Credits
Repeat Status: Course may be repeated.

FIN 323 Investments 3 Credits
The nature of risk and the form of returns on financial assets from the
viewpoint of various constituents. Investor objectives, attitudes, and
constraints are considered within the risk-return matrix within the context
of valuation.
Prerequisites: (FIN 125 or FIN 225) and ECO 146

FIN 324 Security Analysis and Portfolio Management 3 Credits
Valuation of equity and debt instruments factoring in the influence
earnings forecasts and expectations, uncertainty, required returns,
supply and demand for securities and funds, and investor attitudes.
Portfolio management concepts include the implications of market
factors, technical analysis, timing, and screening of securities.
Prerequisites: FIN 323 and FIN 328

FIN 328 Corporate Financial Policy 3 Credits
The study of management issues related to capital budgeting, working
capital, leasing, mergers, and financing.
Prerequisites: (FIN 125 or FIN 225) and (ECO 146)

FIN 330 Financial Markets and Institutions 3 Credits
Functions and portfolios of financial intermediaries. Sectional demand
and supply of funds, nature and role of interest rates, term structure and
forecasting, impact of inflation and regulation on financial intermediaries
and markets, and current developments in the financial system.
Management of assets and liabilities within the U.S. financial institution’s
legal and economic constraints.
Prerequisites: (FIN 323 and FIN 328)

FIN 333 Global Finance 3 Credits
Issues that underlie the investment, financing, and dividend decisions of
multinational firms from both the buyer’s and seller’s viewpoints. Current
transactions in foreign currencies, direct and portfolio investment and
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used to satisfy finance major requirements. Declaration of a finance
major. Consent of department required.
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ECO 045 or MATH 231 or ISE 111 or IE 111 or SR 111) and (MATH 021
or MATH 031 or MATH 076 or MATH 097 or MATH 081)

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major. Consent of department required.
Prerequisites: (ECO 129 or ECO 029 and ACCT 151) and (ECO 145 or
ECO 045 or MATH 231 or ISE 111 or IE 111 or SR 111) and (MATH 021
or MATH 031 or MATH 076 or MATH 097 or MATH 081)
GLOBAL CITIZENSHIP PROGRAM

**Core Courses**

**GCP 010** Introduction to Global Citizenship  
**GCP 185** Cosmopolitanism and Culture I  
**GCP 186** Cosmopolitanism and Culture II  
**GCP 285** The Citizen and the City  
**GCP 385** Global Citizenship Capstone Course

**Electives**

Two electives approved by the program director/adviser and each at a minimum of 3 credits.

**International Experience**

12-14 day faculty-led intersession trip abroad  
Additional international experience at least 4 weeks in length and approved by the program director/adviser

**Total Credits** 19

**Courses**

**GCP 010 Introduction to Global Citizenship 3 Credits**

An interdisciplinary approach introduces the contested notion of global citizenship. Readings explore the meaning of citizenship in the global era; the viability of nationalism and cosmopolitanism; the efficacy of social change initiatives in transnational context; the impact of economic globalization on vulnerable populations; the role of the United Nations; the discourse of human rights; and the relation between global and local justice. Addressing topics of urgent concern, students’ assignments consider global citizenship practice in relation to their area of study.

**Attribute/Distribution:** HU, SS

**GCP 026 (EES 026) Energy – Origins, Impacts, and Options 3 Credits**

Critical assessment of current and predicted energy resources used by humans, including their origins, distribution, environmental impacts, and feasibility. Lectures, discussion, field trips. May be combined with EES 022 or EES 004 for 4 credits.

**Attribute/Distribution:** NS

**GCP 185 Cosmopolitanism and Culture I 2 Credits**

This multidisciplinary practicum approaches the themes and questions of global citizenship through the lens of a particular region. Participants explore that area’s geography, history, politics, economy, and social change initiatives in transnational context. Special attention is given to cultural expectations and relevant social issues, especially in light of their global consequence. Classroom discussion and assignments prompt students to reflect on the ethical issues surrounding travel, service, and study abroad.

**Prerequisites:** GCP 010

**Attribute/Distribution:** HU, SS

**GCP 186 Cosmopolitanism and Culture II 2 Credits**

This post-trip seminar analyzes the cohort’s experiences abroad and articulates their implication for global citizenship practice. While examining philosophical, religious, and artistic traditions associated with the intersession trip destination, students revisit their travel, think critically about their personal interaction with foreign places and people, and make informed decisions regarding their future practice as citizens. Classroom discussion emphasizes responsible cross-cultural engagement and critical reflection, with attention paid to the traditions of cosmopolitan thinking and action native to the region of travel.

**Prerequisites:** GCP 010 and GCP 185

**Attribute/Distribution:** HU, SS

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**Global Citizenship**

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**GCP 010** Introduction to Global Citizenship 3 Credits

Readings, projects and papers designed to complement the leadership and analytical activities associated with the management of the Student Investment Club or Thompson portfolios and similar activities. Consent of instructor required.

**Repeat Status:** Course may be repeated.

**Prerequisites:** FIN 323

**GCP 010** Introduction to Global Citizenship 3 Credits

Advanced topics to specific areas of Investments such as: valuation/security analysis; portfolio/risk management; fixed income securities; mutual funds; hedge funds; microstructure; and trading.

**Repeat Status:** Course may be repeated.

**Prerequisites:** FIN 323 and FIN 328

**GCP 010** Introduction to Global Citizenship 3 Credits

This course is designed to help prepare students for ‘real’ world problems by exposing them to a variety of career opportunities. The purpose of this seminar is to give students the opportunity to network with successful professionals in the Financial Services industry, connecting students and practitioners across places and generations to build community around shared work-as-service interests. For future professionals, this seminar advances co-curricular programming to the “pro-curricular” level – linking classroom study of finance to the dynamic world of the practicing financial professionals.

**Repeat Status:** Course may be repeated.

**FIN 389 Honors Project 1-8 Credits**

**Repeat Status:** Course may be repeated.

**FIN 418 Principles of Corporate Finance and Investments 3 Credits**

Course provides students with a basic foundational knowledge of finance principles, working knowledge of various aspects of corporate finance, and the principles of investments. Short-term financial decisions will be discussed. Long-term capital investment will be explored starting with the basics of time value of money and capital investment techniques. Topics include the determination of the appropriate investment discount rate, the organization’s cost of capital and hurdle rates, the risk-reward tradeoff, and specific financial instruments.

**Global Citizenship**

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**GLOBAL CITIZENSHIP PROGRAM**

**Director:** Sarah Stanlick, Ph.D. (Lehigh University) (https://socanthro.cas2.lehigh.edu/content/sarah-stanlick)

**Email:** ses409@lehigh.edu  
**Phone:** 610-758-1081

**Website:** http://globalcitizenship.cas2.lehigh.edu/

Supported by the Office of Interdisciplinary Programs 610-758-3996; incasp@lehigh.edu

Williams Hall, 31 Williams Drive

As the world becomes increasingly interdependent in commerce, technology, and popular culture, people of different cultures must reconcile diametrically opposed views of fairness, equity, and conduct. Religious extremism, trade policies, human rights abuses, and gender inequity are but a few examples of controversies born out of belief systems colliding on the global stage. How will individuals from different national, religious, and cultural traditions understand their personal responsibilities in a world increasingly strained by resurging nationalism and the pressures of globalization?

The Global Citizenship Program prepares students for engaged living in a culturally diverse and rapidly changing world. Emphasizing critical analysis and value reflection, the program structures educational experiences through which students learn to negotiate international boundaries and develop their own sense of personal, social, and corporate responsibility to the global community. The program is designed to be flexible so that undergraduate students in any college may participate. Students bring perspectives of their own disciplines to the foreground as the group explores questions of what it means to be a global citizen as an engineer, or a businessperson, or an artist or a social or natural scientist. To participate, interested students should enroll in GCP 010 - which is a pre-requisite for application to the program - during the Spring term of their first year at Lehigh.

**Professor Of Practice.** Mark Orrs, PhD (Columbia University)
GCP 285 The Citizen and the City 2 Credits
With a focus on Bethlehem’s South Side, this community-engaged practicum provides participants with a theoretical framework and practical skills for efficacious civic action. Course readings address local citizenship, urbanization, the built environment, diversity, and inclusion; assignments ask students to make connections, in theory and practice, to Bethlehem’s history and people. In cooperation with the Center for Community Engagement, all participants will complete 10-15 hours of engaged learning in the Lehigh Valley.
Prerequisites: GCP 010 and GCP 185 and GCP 186

GCP 385 Global Citizenship Capstone Course 2-4 Credits
This year-long, project-based seminar assesses globalization and social change through the lens of cosmopolitanism. Readings examine issues of power, privilege, and aid, especially as they affect the local community. Special attention is paid to the difference between sympathetic feeling and political action. Assignments encourage critical reflection on the Global Citizenship Program and ask students to articulate a personal definition of global citizenship. In teams, students propose and execute a capstone project that puts their understanding of global citizenship into practice.
Repeat Status: Course may be repeated.
Prerequisites: GCP 010 or GCP 185 or GCP 186 or GCP 285
Can be taken Concurrently: GCP 285

Global Studies
Program Director: Bruce Whitehouse, Ph.D. (Brown)
Email: bruce.whitehouse@lehigh.edu  #  Phone: 610-758-4821
Website: http://global.cas2.lehigh.edu/
Supported by the Office of Interdisciplinary Programs 610-758-3996; incasip@lehigh.edu
Williams Hall, 31 Williams Drive

Core Faculty
Kelly Austin, Ph.D. (Department of Sociology and Anthropology); William Bulman, Ph.D. (Department of History); Marie-Hélène Chabut, Ph.D. (Department of Modern Languages and Literatures); Vera Fennell, Ph.D. (Department of Political Science); Jack Lule, Ph.D. (Department of Journalism and Communication); Ageliki Nichopoulou, Ph.D. (Department of Psychology); Rob Roheknal, Ph.D. (Department of Religion Studies); John Savage, Ph.D. (Department of History); Bruce Whitehouse, Ph.D. (Department of Sociology and Anthropology)

Almost every aspect of human existence has been touched by the dynamic of globalization, which may be the defining characteristic of the 21st Century.
Yet, the origins, history, evolution, and impact of globalization – even its very definition – are subject to intense debate. We can surely say, however, that every student leaving college and entering the workforce – the world – should have a fundamental understanding of globalization.

Such understanding will give students crucial knowledge and skills that will set them apart in this new world and help them succeed in an increasingly globalized context. It will help them anticipate the social, cultural, economic and political changes brought about by globalization — and the resistance to globalization. It will better prepare students to draw connections in an interdependent and interconnected world.

Global Studies is a relatively new and increasingly popular major at universities worldwide, including Yale, UCLA, the London School of Economics and others. Different from study in an individual department, Global Studies is emphatically interdisciplinary, with professors from anthropology, journalism, sociology, modern languages and literature, religion studies, political science, history, international relations, and others. Increasingly, the most important questions cannot be answered by one discipline but by the combined efforts of multiple disciplines.
Although study of globalization has been conducted at Lehigh for years, the University formally created the Globalization and Social Change Initiative in Fall 2006, and the major in Global Studies followed soon after.
The Initiative’s three main areas of focus are Global Communication, Culture and Identity, and Politics and Social Structures. Rooted in these areas of interest, the major examines how the forces of globalization shape and are shaped by history, culture, economics, art, politics, communication, and other fundamental aspects of the human condition.
In many Global Studies programs, students choose from a sprawling array of courses tied together by virtue of international content. Global Studies at Lehigh directs students in a more focused manner to core courses that confront, from the perspectives of multiple disciplines, perhaps the single, central force shaping the world today – globalization.
The program requires a total of 40 credits, advanced language proficiency, a semester of study abroad, and a senior seminar.
The program also takes advantage of Lehigh’s NGO (non-government organization) status at the United Nations. Students have the opportunity to meet and work with UN officials. A number of Global students become delegates to the UN for international NGOs while they are still at Lehigh.

Careers in Global Studies
Career opportunities are numerous for graduates of Global Studies. Professions in the 21st century increasingly are demanding global understanding and expertise as well as the ability to take on interdisciplinary work across boundaries. People trained in the interdisciplinary field of Global Studies have increasing advantages over those trained in a single discipline.

Through the Global Studies major, students acquire a strong grounding in global affairs and an understanding of the complex phenomenon of globalization. They engage in problem-solving across boundaries and cultures. They are able to critically and analytically evaluate information from a comparative perspective. They learn to be effective communicators and learn to argue and defend complex views in writing, such as policy papers, and public speaking, such as individual and group presentations, to a variety of global audiences.

Lehigh’s Global Studies graduates have gone on to work for employers in the areas of business and finance (Credit Suisse First Boston, Edward Jones, Goldman Sachs, IBM Consulting, JP Morgan), media (A&E Networks, Getty Images, Hearst Magazines, News China, Viacom New Media), and nonprofits and the public sector (Habitat for Humanity, Israel Teaching Fellows, Peace Corps, Teach for America). Others have established careers with governmental, non-governmental, and for-profit organizations in the fields of public policy, energy consulting, public relations, and health care.

Professor. John F. Lule, PhD (University Georgia Athens)

GLOBAL STUDIES MAJOR
Introductory Course 4
GS 001 Introduction to Global Studies

Core Courses 20
Select one course from each core area that explores how globalization shapes and is shaped by social, cultural, economic, and political factors.

Arts and Humanities Core
GS/MLL 128 World Stories Literary Expressions
GS/REL 140 Globalization and Religion

History Core
GS/HIST 101 Histories of Globalization

Culture Core
ANTH 011 Cultural Diversity and Human Nature
GS/ANTH 106 Cultural Studies and Globalization

Political Economy Core
GS/SOC 319 The Political Economy of Globalization

Politics Core
IR 010 Introduction to World Politics
GS/POLS 003 Comparative Politics
GS/POLS/PHIL 100 Introduction to Political Thought
Elective Coursework
Select four elective courses (see list below).  

Senior Seminar
A 300-level writing intensive Global Studies course designated as a senior seminar.

Collateral Requirements

Language Study
Global Studies majors are required to complete the equivalent of six semesters of language study in a language taught at Lehigh other than the student's native language. This requirement can be fulfilled using credits from high school AP language tests reported to Lehigh's registrar, from courses taken at Lehigh, from courses taken elsewhere, or some combination of these. It may be fulfilled all in one language (advanced level), or by studying the equivalent of four semesters of one language and an additional two semesters of a second language.

Study abroad
12 credits of study abroad. A lower number of study abroad credits and/or coursework can be substituted, with the guidance of an adviser, if student is financially or academically unable to fulfill the requirement. Courses taken during study abroad may be counted toward satisfaction of major requirements with adviser approval.

Total Credits

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</table>

1 In consultation with the Global Studies adviser, students can choose from a wide variety of Global Studies courses each semester, including but not limited to the courses listed.
2 At least two electives must be 200-level or above.

GLOBAL STUDIES MINOR
A minor in Global Studies consists of four courses with at least one core course and at least one class at the 200 level or above. Visits to the UN as well as study abroad or Lehigh Abroad are strongly recommended. To declare a minor in Global Studies, students must complete a minor declaration (http://catalog.lehigh.edu/coursesprogramsandcurricula/artsandsciences/globalstudies/2015-16_Global_Studies_minor_declaration_form.pdf) form.

GS 001 Introduction to Global Studies 4
Select one course from the list of core courses.  
Select two courses from the list of elective courses.  

Total Credits

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<tbody>
<tr>
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</table>

1 One class must be 200 level or above.
2 Core courses may substitute for elective courses.
3 With the approval of the program director, Global Studies minors may identify other courses not included on the elective list to satisfy the elective requirement.

ELECTIVE COURSES
Students choose from a wide variety of courses each semester that can satisfy the Global Studies major's requirement for elective courses. The following list shows the courses that have satisfied this requirement in the past. Note that some of these courses are offered infrequently. With the approval of their major advisor, Global Studies majors may identify other courses not included on this list to satisfy the elective requirement. Additionally, special topics courses offered by departments or programs may satisfy the elective requirement. Click here for a printable list of Global Studies approved electives. (http://catalog.lehigh.edu/coursesprogramsandcurricula/artsandsciences/globalstudies/Global_Studies_2016-17_elective_list.pdf)

000 and 100 LEVEL ELECTIVES

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<tr>
<th>Africana Studies</th>
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<tr>
<td>AAS 003 Introduction to Africana Studies</td>
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<tr>
<td>AAS/HIST 005 African Civilization</td>
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<tr>
<td>AAS/REL 025 Introduction to Black Religions and Hip-Hop</td>
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<tr>
<td>AAS/LAS/SOC 106 Race and Ethnicity in Latin America and the Spanish Speaking Caribbean</td>
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<td>AAS/ENGL 120 Literature from Developing Nations</td>
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<td>AAS/GS/ART 125 Art and Architecture of Africa from Colonial to Contemporary Times</td>
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<td>AAS/MLL/POLS/LAS/FREN/HIST 133 Lehigh in Martinique: Globalization and Local Identity</td>
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<td>ANTH/WGSS 123 Anthropology of Gender</td>
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<td>ASIA/REL/GS 166 Religious Nationalism in South Asia</td>
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<td>ASIA/REL 167 Engaged Buddhism</td>
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Global Studies

ES 104          Political and Environmental Geography
ES/POLS 106     Environmental Values and Ethics
ES/POLS 107     The Politics of the Environment
ES/ANTH 121     Environment and Culture

English
ENGL/AAS 120    Literature from Developing Nations
ENGL/THTR 166   The Playwright as Traveler

German
GERM 163        German Civilization and Culture

Global Studies
GS/MLL 006      Globalization and Cultures
GS/REL 013      Religion and Food
GS/REL 044      Religious Fundamentalism in Global Perspective
GS/REL 062      Explorations in Dialogue
GS/REL/ASIA 077 The Islamic Tradition
GS/HIST 107     Technology and World History
GS/SOC/JST 116  Jewish Community and Identity
GS/REL/ASIA 119 The Podcast and the Lotus
GS/ART/AAS 124  Arts of the Black World 16th-20th Centuries
GS/ART/AAS 125  Art and Architecture of Africa from Colonial to Contemporary Times
GS/REL 140      Globalization and Religion
GS/REL 143      Religious Nationalism in a Global Perspective
GS/REL/ASIA 145 Islam and the Modern World
GS/REL/ASIA 147 Pilgrims, Bandits, Traders, Nuns: Traveling Religious Identities in Asia
GS/REL 148      Islam Across Cultures
GS/REL/ASIA 166 Religious Nationalism in South Asia
GS/HIST/ART 183 France from Medieval to Modern: Soc., Pol. & Art

Health, Medicine and Society
HMS/STS/HIST 118 History of Modern Medicine
HMS/ANTH 155    Medical Anthropology
HMS 170         Medical Humanities

History
HIST/AAS 005    African Civilization
HIST 012        Inventing the Modern World: Europe in Global Perspective, 1648-present
HIST 025        Pirates of the Caribbean and Other Rogues of the Atlantic World
HIST 050        History of Latin America
HIST/ASIA/MLL 075 Chinese Civilization
HIST/ASIA/MLL 076 Understanding Contemporary China
HIST/GS 107     Technology and World History
HIST/HMS/STS 118 History of Modern Medicine
HIST/MLL/FREN/ POLS/LAS/AAS 133 Lehigh in Martinique: Globalization and Local Identity
HIST/REL 154    The Holocaust: History and Meaning
HIST 160        Europe in the Age of Total War, 1870-1945
HIST 162        Contemporary Europe
HIST/ASIA 170   The Last Samurai
HIST/ART/GS 183 France from Medieval to Modern: Soc., Pol. & Art

International Relations
IR/ASIA 061     East Asian International Relations
IR/ASIA 063     U.S.-China Relations
IR/ASIA 163     U.S.-China Relations
IR/ASIA 164     Japan in a Changing World

Jewish Studies
JST/SOC/GS 116  Jewish Community and Identity

Journalism and Communication
JOUR 101        Media, Sports and Society

Latin American Studies
LAS/AAS/SOC 106  Race and Ethnicity in Latin America and the Spanish Speaking Caribbean
LAS/AAS/POLS/ FREN/MLL/HIST 133 Lehigh in Martinique: Globalization and Local Identity
LAS/SPAN 152    Cultural Evolution of Latin America
LAS/AAS/SOC 155 Afro-Latino Social Movements in Latin America & the Caribbean
LAS/AAS/SOC 177 Cuba: Race, Revolution and Culture
LAS/ANTH 184    Indigenous Cultures of Latin America

Modern Languages and Literatures
MLL/GS 006      Globalization and Cultures
MLL 027         Russian Classics
MLL/ASIA/WGSS 073 Film, Fiction, and Gender in Modern China
MLL/ASIA/HIST 075 Chinese Civilization
MLL/ASIA/HIST 076 Understanding Contemporary China
MLL 100         Introduction to International Film
MLL/ASIA 127    ORIENTations: Approaches to Modern Asia
MLL/FREN/AAS/ HIST/POLS/LAS 133 Lehigh in Martinique: Globalization and Local Identity
MLL/ASIA 165    Love and Revolution in Shanghai
MLL/ASIA 177    China Enters the Modern Age

Philosophy
PHIL 008        Intro: Ethics In Global Perspectives
PHIL/AAS 117    Race, Racism, and Philosophy

Political Science
POLS/ES 106     Environmental Values and Ethics
POLS/ES 107     The Politics of the Environment
POLS 108        Global Citizenship and its Discontents
POLS/FREN/AAS/ HIST/LAS/MLL 133 Lehigh in Martinique: Globalization and Local Identity

Religion Studies
REL 009         Spiritual Journeys
REL/ASIA 012    Mountains, Buddhhas, Ancestors: Introduction to East Asian Religions
REL/GS 013      Religion and Food
REL/AAS 025     Introduction to Black Religions and Hip-Hop
REL/GS 044      Religious Fundamentalism in Global Perspective
REL/ASIA 060    Religions of South Asia
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REL/HIST 154    The Holocaust: History and Meaning
REL/ASIA/GS 166 Religious Nationalism in South Asia
REL/ASIA 167    Engaged Buddhism
REL/ASIA 168    Buddhism in the Modern World

Sociology
SOC 105         Social Origins Of Terrorism
SOC/LAS/AAS 106 Race and Ethnicity in the Americas
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<td>SOC/ASIA 114</td>
<td>Social Issues in Contemporary China</td>
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<td>Paris: Plan of Metropolis</td>
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<td>Latino Visual Arts and Culture in American Art</td>
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<td>Poet, Mediator, King: Classics of East Asian Religion</td>
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<td>The Outsider In French Fiction</td>
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<td>GS/COMM 248</td>
<td>Global Communication</td>
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<tr>
<td>GS/ARCH/HIST 253</td>
<td>Paris: Plan of Metropolis</td>
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### Courses

**GS 001 Introduction to Global Studies 4 Credits**  
Globalization - the historical and continuing integration of peoples, cultures, markets and nations - is the defining characteristic of our century. It brings with it advantages and disadvantages, surfeit and suffering. In this interdisciplinary course, the foundation of the Global Studies major, students will be introduced to a variety of historical, critical and analytical perspectives, methods and vocabularies for continued study of globalization and social change. Priority given to CAS freshmen and sophomores.  
Attribute/Distribution: SS  

**GS 003 (POLS 003) Comparative Politics 4 Credits**  
The political systems of foreign countries; approaches to the study of comparative politics.  
Attribute/Distribution: SS  

**GS 006 (MLL 006) Globalization and Cultures 4 Credits**  
This course is a reflection on the processes of globalization and their consequences, both good and bad, on the world’s societies and on our concepts of culture and identity. It provides a multidisciplinary examination of what cultures gain and lose from their interaction with the rest of the world and what it means to be a citizen of a globalized yet diverse world.  
Attribute/Distribution: SS  

**GS 013 (REL 013) Religion and Food 4 Credits**  
This course explores the complex connections between religion and food. We will examine food-related rituals, including Jewish Passover seder, Christian communion, and Hindu puja; the role of gastronomy in forming religious and ethnic identity; and the global ethics of food and sustainability. We will also probe the notion of food itself as sacred. Are “foodies” engaging in their own sort of sacred actions? How does food connect with the sublime? The class will include tastings and outings as scheduling permits.  
Attribute/Distribution: SS  

**GS 044 (REL 044) Religious Fundamentalism in Global Perspective 4 Credits**  
This course will explore the rise of fundamentalist religious movements and their involvement in violent conflicts. Topics to be considered will include the relationship between fundamentalist religious ideologies and terrorism, and the kinds of responses that fundamentalist religious movements present to the development of a global marketplace and the spread of secular nationalism.  
Attribute/Distribution: SS  

**GS 062 (REL 062) Explorations in Dialogue 4 Credits**  
Course critically investigates inter-religious dialogue, an important issue in the contemporary academic study of religion. Focus will be on the problem of inter-religious encounter; religion and globalization; different models of dialogue; and the questions of power and identity. At least two traditions will be put into conversation for any proposed offering (e.g., Christian-Buddhist, Jewish-Muslim, Jewish-Christian).  
Attribute/Distribution: SS  

**GS 077 (ASIA 077, REL 077) The Islamic Tradition 4 Credits**  
A thematic introduction to Islamic history, doctrine and practice. Topics include: Qur'an; prophecy and sacred history; ritual practices; community life; legal interpretation; art and aesthetics; mysticism; politics and polemics.  
Attribute/Distribution: SS  

**GS 100 (PHIL 100, POLS 100) Introduction to Political Thought 4 Credits**  
A critical examination of political ideologies: Liberalism, Marxism, Fascism, and Islamism.  
Attribute/Distribution: ND

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GS 101 (HIST 101) Histories of Globalization 4 Credits
Critical historical perspectives on current debates around “globalization” and the varied paths and responses to modernity, using recent scholarship associated with the New Global History. The “Rise of the West” paradigm, Industrial Revolution and modernization theory; creation of global financial markets, nation-building and New Imperialism; Great Depression and World Wars as global historical events; postwar decolonization, Cold War and emergence of North-South relations; impact of consumerism, movements for women’s rights, ethnic nationalism and religious fundamentalist movements in tradition-bound societies.
Attribute/Distribution: HU

GS 106 (ANTH 106) Cultural Studies and Globalization 4 Credits
This course closely examines the complex relationship between culture and globalization. The impact of globalization on local culture is an essential topic. But the interaction of globalization and culture is not a one-way process. People around the world adapt globalization to their own uses, merging global cultural flows with local practices in transformative ways. The course will study the interaction of local culture with globalizing forces; immigration and culture; the localization of mass culture; cultures of diasporic and migratory groups; and globalization, gender and identity.
Attribute/Distribution: SS

GS 107 (HIST 107) Technology and World History 4 Credits
Development of technology and its relationship to political, economic, military, and cultural aspects of world civilization from pyramids to the present century.
Attribute/Distribution: SS

GS 116 (JST 116, SOC 116) Jewish Community and Identity 4 Credits
A century ago, large Jewish communities existed throughout the world, including North Africa, Europe, the Middle East, and South America. Today, over 80% of all Jews live in North America or Israel. This course focuses on these historical changes in Jewish communities and the transformation of Jewish identities and social life in recent years, particularly in the U.S. and in Israel.
Attribute/Distribution: SS

GS 119 (ASIA 119, REL 119) The Podcast and the Lotus 4 Credits
Buddhism is increasingly a global phenomenon. Contemporary Buddhist teachers stay in touch with students via podcasts, WeChat, Twitter and Facebook. Buddhist from Singapore, Tibet, Japan, Mexico, Taiwan or Pennsylvania now meet via new technology. This class asks, how is Buddhism now a global religion? what effect has this had? How is Buddhism a “modern” religion? Students explore issues of conversion, modernity, globalization, new technology, migration and travel. Sources include autobiography, film, travel writing, political essays, interviews, social media, ethnography.
Attribute/Distribution: HU

GS 124 (AAS 124, ART 124) Arts of the Black World 16th-20th Centuries 4 Credits
This course covers artistic practices originating in Africa that subsequently influenced countless world cultures. The material covers artistic production and theory of arts of the enslaved populations in the AnteBellum South, early African American painting through the Harlem Renaissance, the religious arts of Haiti (Vodou) and Cuba (Santeria), and contemporary production from Black Brazilian, American and European artists. Students should be prepared to attend Museums/galleries during the semester.
Attribute/Distribution: HU

GS 125 (AAS 125, ART 125) Art and Architecture of Africa from Colonial to Contemporary Times 4 Credits
This course is structured around case studies of art and architecture from early traditions up through the present. The focus is on cultural production, religious art and architecture (local as well as Christian and Muslim traditions), craftsmanship, style, materials, trade, and international exhibition of art objects in Museums. The literature draws from art historical, anthropological, and historical analyses as well as museum studies. Students should be prepared to attend Museums/galleries during the semester.
Attribute/Distribution: HU

GS 126 The Political Economy of Globalization 4 Credits
This course studies the relationship among economic, political and cultural forces in an era of globalization. Focus is on how global capitalism, the world market and local economics shape and are shaped by social, cultural and historical forces. Topics include political and cultural determinants of trade and investment; culture and the global economy; global capitalism, especially studied through the lens of culture; globalization and patterns of economic growth; cross-cultural study of consumerism; poverty and inequality; the interplay of foreign and domestic economic policy; international economic organizations, such as the World Trade Organization, the International Monetary Fund, and the World Bank, and globalization and national development.
Attribute/Distribution: SS

GS 128 (MLL 128) Literature and Globalization 4 Credits
An introduction to fiction as it reflects and discusses major issues related to globalization. The readings will include a selection of fiction from a diversity of world regions and will introduce the students to a theoretical reflection on the role of literary writing in a globalizing world. Students will be able to gain appreciation for the written fictional text as it takes on a diversity of issues related to globalization in a variety of world regions and cultural perspectives.

GS 140 (REL 140) Globalization and Religion 4 Credits
This course examines the complexity of globalization and its multi-layered impact on religious identity and piety. Though comparative in methodology and historical framework, the class will give special attention to Islam and Hinduism in South Asia. Topics include: European colonialism; Orientalism and its legacy; religious nationalism; Islamophobia; and the Internet and mass media.
Attribute/Distribution: HU

GS 143 (REL 143) Religious Nationalism in a Global Perspective 4 Credits
Religion has become a renewed political force on the world stage in recent years. This course will focus on how religion has often provided both the ideological language and the organizing principles for many modern nationalisms. Our exploration of this topic will take the form of case studies from various parts of the world, including but not limited to Pakistan, Israel, No. Ireland, India, Iran and USA.
Attribute/Distribution: HU

GS 145 (ASIA 145, REL 145) Islam and the Modern World 4 Credits
Examines how numerous Muslim thinkers-religious scholars, modernists, and Islamist-have responded to the changes and challenges of the colonial and post-colonial eras. Special emphasis is placed on the public debates over Islamic authority and authenticity in contemporary South Asia.
Attribute/Distribution: HU

GS 147 (ASIA 147, REL 147) Pilgrims, Bandits, Traders, Nuns: Traveling Religious Identities in Asia 4 Credits
This course examines religious networks linking Chinese, Tibetan, Himalayan, and Inner Asian people, places, and institutions to Asia and the world. We explore examples of 19th, 20th century and present day transnational religious identities, emerging from trade, religious travel and pilgrimage, refugee migrations, labor migrations, and modern day leisure travel. We consider religious identity, nationalism, transnationalism, and globalization, using literary, historical, and ethnographic sources, and film, video, and popular media.
Attribute/Distribution: HU

GS 148 (REL 148) Islam Across Cultures 4 Credits
Explores the Muslim world’s diversity and dynamism in multiple cultural contexts-from the Middle East and North Africa, to Asia and America-through literature, ethnography, and films. Topics include: travel and trade networks; education; women and gender; Islam and cultural pluralism; colonialism; and identity politics.
Attribute/Distribution: HU
GS 166 (ASIA 166, REL 166) Religious Nationalism in South Asia 4 Credits
This course explores the conflation and conflict of religion and politics in one of the most complex, dynamic and volatile regions on the planet (South Asia). Through literature, film and scholarly writings, students will examine the history of cooperation and conflict between the Muslim and Hindu communities in South Asia—from the movements for national independence to twenty-first century identity politics.
Attribute/Distribution: HU

GS 183 (ART 183, HIST 183) France from Medieval to Modern: Soc., Pol. & Art 3 Credits
France's artistic, cultural, social, artistic and political development from early kingship and dominance of the Church in the Middle Ages to the grandeur of Versailles in the Age of Absolutism; radical transformations of culture and society during the French Revolution and advent of the Modern Nation-State; to twentieth century developments including the two World Wars, imperialism and impact of post-war globalization. Offered in summer only through Lehigh Study Abroad Office as part of Lehigh in Paris program.
Attribute/Distribution: HU

GS 201 (ASIA 201, POLS 201) Democracy and Dictatorship in South Asia 4 Credits
Theories of democracy and democratization explored in the South Asian context. Relationship of democracy to economic development and identity considered. How do historical legacies of colonialism and conflict shape contemporary outcomes.
Attribute/Distribution: SS

GS 202 (ENGL 202, LAS 202, MLL 202) Latin American In Fact, In Fiction 4 Credits
This class couples a survey of Latin American literature in translation with an interdisciplinary approach to the study of Latin America. Departing initially from readings of literary and cinematographic works, our analyses will engage methodologies from multiple disciplines including history, sociology, and cultural studies. Accordingly, this course will examine critical developments in Latin American aesthetics along with the cultural climates in which they matured. This course assumes no prior study of Spanish, Portuguese, or Latin American culture.
Attribute/Distribution: HU

GS 221 (AAS 221, ART 221) Global Contemporary: Recent Art Movements Around the World 4 Credits
This course introduces contemporary artworks from around the world and artists that produce them. Topics include movements emerging in the last 40 years, some of which are: Revolutionary arts, Globalism, EcoArt, Postcolonial arts, phenomenological, experiential and new media arts. Global feminist projects, design/build production, graffiti and popular arts will be covered regularly. The Dakar, Venice and Sāo Paulo Art Biennials as well as Documenta are explored as vectors for international artistic exchange and dissemination. Rotating case studies on the international on international built environment (e.g.: Qatar, Dubai, Singapore, Dakar) will be featured. Art Theory will be explored through iconographic, formal and contextual (political, social, financial) analysis. Movements will be situated against their historical frameworks as well as explored for their international scope and value.
Attribute/Distribution: HU

GS 246 (JOUR 246) International Communication 4 Credits
The subject matter is crucial to understanding modern life: the role of international news media in world affairs. The class studies the social, political and economic contexts that frame the reporting of international events by U.S. news media, such as politics, war, disasters, and other crises, as well as U.S. reporting on international issues, such as poverty, disease, and environmental change. The course also surveys reporting practices in nations around the world, including the varying systems of journalism and mass media and the brutal censorship and repression facing many foreign journalists.
Attribute/Distribution: SS

GS 247 (ASIA 247, REL 247) Islamic Mysticism 4 Credits
Sufism, the inner or ‘mystical’ dimension of Islam, has deep historical roots and diverse expressions throughout the Muslim world. Students examine Sufi doctrine and ritual, the master-disciple relationship, and the tradition's impact on art and music, poetry and prose.
Attribute/Distribution: HU

GS 248 (COMM 248) Global Communication 4 Credits
This class studies, from an historical and cultural perspective, how globalization shapes and is shaped by communication and media structures and processes, with special emphasis on transnational media corporations and their interaction with cultures around the globe. Topics include: globalization, media and culture; mass media and development; the flow of entertainment programs and debates on cultural imperialism; media and migration; the imbalanced flow of information in the world; the debate on the New World Information Order; and forms of resistance to transnational media from world governance institutions, such as UNESCO, state regulatory responses, and alternative media, such as citizen blogs and pirate radio.
Attribute/Distribution: SS

GS 253 (ARCH 253, HIST 253) Paris: Plan of Metropolis 3 Credits
The splendor of modern Paris is due in large part to bold, large scale modernization and changes in the city's patterns during the 19th century. This course, which is part of the Lehigh in Paris summer program, will cover a century of change and focus on the major accomplishments of its visionary planners.
Attribute/Distribution: HU

GS 300 Apprentice Teaching 1-4 Credits
Repeat Status: Course may be repeated.

GS 302 (ENGL 302, LAS 302, MLL 302) Travel and Adventure in Latin American Fiction 4 Credits
Centering on a corpus of works presenting tales of travel and adventure, this class offers an overview of Latin American narrative genres (including “fantastic” narrative, magical realism, and postmodern fiction) from the mid 20th century to present day. Through close readings of works by Adolfo Bioy Casares and Roberto Bolaño, among others, and the analysis of filmic representations of travel in Latin America, we will examine differing modes of perceiving the region defined as Latin America.
Attribute/Distribution: HU

GS 315 Seminar in Globalization and Culture 4 Credits
Advanced seminar that focuses on research and discussion of specialized topics in globalization and culture. Subjects vary by semester. Junior or senior standing and departmental Permission required.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS

GS 318 Seminar in Globalization and Communication 4 Credits
Advanced seminar that focuses on research and discussion of specialized topics in globalization and communication. Subjects vary by semester. Junior or senior standing and departmental Permission required.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS

GS 319 (SOC 319) The Political Economy of Globalization 4 Credits
This course studies the relationship among economic, political and cultural forces in an era of globalization. Focus is on how global capitalism, the world market and local economies shape and are shaped by social, cultural and historical forces. Topics include political and cultural determinants of trade and investment; culture and the global economy; global capitalism, especially studied through the lens of culture; globalization and patterns of economic growth; cross-cultural study of consumerism; and poverty and inequality.
Attribute/Distribution: SS
GS 320 (ANTH 320) Global Capitalism 4 Credits
Anthropological approach to the forms and effects of global capitalism. Topics include the structure of contemporary global capitalism, including the growth of multinational corporations, flexible corporate strategies, overseas manufacturing, and global branding and marketing; the impact of global capitalism on the environment and on the lives of people in "Third World" countries; consumer culture and the diversity of non-Western consumption practices; alternative capitalist systems.
Attribute/Distribution: SS

GS 321 (MLL 321) Intercultural Communication 4 Credits
Language is ambiguous by nature and discourse is interpreted in cultural and linguistic contexts. This course covers different cultural and linguistic strategies individuals use to communicate with each other, essential concepts for interacting with individuals from other cultural and linguistic backgrounds, and different strategies of communication as defined by specific cultures. Covering the theory and practice of intercultural interaction, this examines assumptions about language and culture, and includes practical advice to help students develop the cultural sensitivity essential for communication today.
Attribute/Distribution: HU

GS 322 (HMS 322, SOC 322) Global Health Issues 4 Credits
Sociological dimensions of health, illness, and healing as they appear in different parts of the world. Focus on patterns of disease and mortality around the world; the relative importance of ‘traditional’ and ‘modern’ beliefs and practices with regard to disease and treatment in different societies; the organization of national health care systems in different countries; and the role of international organizations and social movements in promoting health.
Attribute/Distribution: SS

GS 324 (AAS 324, ANTH 324) Globalization and Development in Africa 4 Credits
Examines the challenges Africa presents to expectations of modernization and development. It poses these questions: Have African societies been left behind by globalization, shut out from it, or do they reflect an unexpected side of globalization processes? What is Africa’s place in the neo-liberal world order? What role does “African culture” play in generating or blocking social change? How can anthropology illuminate prospects for change on what has long been regarded as the “dark continent”?
Attribute/Distribution: SS

GS 325 (POLS 325) Nationalism in Comparative Perspective 4 Credits
Examination of major theoretical and policy debates in contemporary studies of nationalism. Focus on the emergence and endurance of nationalist movements in the modern era. Discussion of efforts to evaluate the legitimacy of nationalist claims and to resolve nationalist conflict.

GS 326 (SOC 328) Global Food Systems 4 Credits
Where does our food come from? How does it get to our tables? Why are there famines in some parts of the world and obesity epidemics in other parts of the world? This course will investigate these questions by focusing on food systems—the chains of social action that link food producers to food consumers. We will also explore a range of alternatives to global food systems that emphasize food democracy, security, and sustainability.
Attribute/Distribution: SS

GS 329 (SOC 329) Global Migration 4 Credits
International migration is transforming societies at both the global and national levels, and in both origin and destination areas. Why do people move? What are the consequences of these movements? We will investigate the political and economic explanations for international migration and explore how each act of migration contributes to the transnationalization of social relations, alters existing livelihoods, transforms economic production and social support arrangements, and recreates racial, ethnic, and national identities.
Attribute/Distribution: SS

GS 331 (SOC 331, WGSS 331) Gendered Experience of Globalization 4 Credits
Women and men experience globalization differently and globalization affects women in different cultural and national contexts. Gender stratification has been intensified by the transnational flow of goods and people, provides students with a survey of new development in feminist theories on globalization and on gender stratification and development, and links these theoretical frameworks to empirical research about gender issues that have become more prominent with globalization.
Attribute/Distribution: SS

GS 339 The Rise of the State in Modern East Asia 4 Credits
An examination of the role of Asian nationalism in the construction of the modern state form in Asia.
Attribute/Distribution: SS

GS 342 (POLS 342, WGSS 342) Gender and Third World Development 3-4 Credits
Focus on gender implications of contemporary strategies for Third World economic growth, neo-liberalism. How do economic theories affect real people? How do economic theories affect men vs. women? What is the role of people who want to ‘help’? Some background in economic theories and/or Third World politics desired, but not required.
Prerequisites: POLS 001 or WGSS 001
Attribute/Distribution: SS

GS 343 (AAS 343, ASIA 343, POLS 343) Global Politics of Race: Asia and Africa 4 Credits
An examination of the concept of “race” and its impact on domestic and international politics.
Attribute/Distribution: SS

GS 348 (HIST 348) The British Empire and the Modern World 3-4 Credits
Examines the empire and its central role in the process of globalization between the 16th and 20th centuries. Topics include exploration, state-building, war, multinational corporations, industry, international finance, missionaries, racism, and independence movements.

GS 351 “The Gangs of New York” 4 Credits
The course will use the Martin Scorsese film “The Gangs of New York” as a window to examine the social economic transformations of New York City in the middle of the nineteenth century. Emphasis will be on immigration, slum gangs and street violence, politics, the Draft Riot of 1863, and the Tweed Ring. A recurrent theme will be to compare the historical record with the film’s depiction of those events. There will be a required evening showing of the film. Not available for pass/fail.
Attribute/Distribution: HU

GS 355 (HIST 355) Destruction and Reconstruction of Europe, 1879-1950 3 Credits
An analysis of the decline and disintegration of European civilization through two world wars and Europe’s reintegration in the era of the European Union. Emphasis on the development of the European state system, international conflict, and political thought.
Attribute/Distribution: SS

GS 365 (PSYC 365) Human Development in Cross-Cultural Perspective 4 Credits
The formation of mind and personality is shaped in profound ways by the sociocultural contexts within which individuals develop. This course introduces students to basic theoretical and methodological issues and explores important examples of cross-cultural variation and diversity, using comparisons between different societies and between different subcultures within American society. Topics include cognition, language, personality, moral development, socio-emotional development, identity, attachment, and socialization. Materials drawn from anthropology, sociology, and education in addition to psychology.
Prerequisites: PSYC 107 or PSYC 109 or PSYC 121
Attribute/Distribution: SS
GS 370 (ES 370, SOC 370) Globalization and the Environment 4 Credits
This course investigates globalization and the environment including how globalization has influenced society-nature relationships, as well as how environmental conditions influence the globalization processes. A key focus will be on the rapidly evolving global economic and political systems that characterize global development dynamics therefore resource use. Particular attention is paid to the role of multi-national corporations, international trade, and finance patterns and agreements. Questions related to consumption, population, global climate change, toxic wastes, and food production/distribution represent key themes.

Attribute/Distribution: SS

GS 375 Senior Seminar in Global Studies 4 Credits
Advanced seminar with readings, in-depth discussion, and independent research. The goal of the seminar is for each student to produce a research project that might prepare him or her for the first steps after graduation. For example, students interested in global culture industries might do research on issues or organizations in that area. Students interested in human justice might do research on issues or organizations on that area.

Attribute/Distribution: SS

GS 390 Readings in Global Studies 1-4 Credits
Directed course of readings for students with interests in Global Studies not fully explored in regular offerings. Junior or senior standing required. Departmental permission required.

Repeat Status: Course may be repeated.

Attribute/Distribution: SS

GS 391 Directed Research in Global Studies 1-4 Credits
Research and study for students with interests in Global Studies not fully explored in regular course offerings. Junior or senior standing required. Departmental permission required.

Repeat Status: Course may be repeated.

Attribute/Distribution: SS

GS 392 Internship in Global Studies 1-4 Credits
Supervised work relevant to global studies, including internships at the United Nations, nongovernment organizations (NGOs), government organizations, and other public and private agencies. Department permission required.

Repeat Status: Course may be repeated.

Attribute/Distribution: SS

GS 394 Honors Thesis 1-4 Credits
To graduate with honors in Global Studies, students need to attain a 3.5 grade point average in Global Studies classes; a 3.5 grade point average overall, and complete 4 credits of GS 394 Honors Thesis at the time of graduation. The four credits may be taken in one semester or split over two semesters. The honors thesis is an intensive project of original research, undertaken under the direct supervision of a faculty adviser. Senior standing required. Departmental permission required.

Repeat Status: Course may be repeated.

Attribute/Distribution: SS

Graduate Certificates in Arts and Sciences

CERTIFICATE IN ANALYTICAL PRINCIPLES OF PHARMACEUTICAL SCIENCE
(for details see distance education (http://distance.lehigh.edu/programs))

CERTIFICATE IN BIOORGANIC PRINCIPLES OF PHARMACEUTICAL SCIENCE
(for details see distance education (http://distance.lehigh.edu/programs))

CERTIFICATE IN COGNITIVE SCIENCE
(For details see "Cognitive Science (p. 159")

CERTIFICATE IN DOCUMENTARY FILM
(For details see "American Studies (p. 70")

CERTIFICATE IN ENVIRONMENTAL LAW AND POLICY
(For details see "Environmental Initiative (p. 231")

CERTIFICATE IN NANOTECHNOLOGY
(for details see materials science and engineering (http://www.lehigh.edu/~inmatsci/graduate/certificate.htm))

CERTIFICATE IN REGULATORY AFFAIRS IN A TECHNICAL ENVIRONMENT
(for details see distance education (http://distance.lehigh.edu/programs))

CERTIFICATE IN STEREOTYPES, PREJUDICE, DISCRIMINATION, AND INTERGROUP RELATION
(For details see "Psychology (p. 375")

CERTIFICATE IN SUSTAINABLE DEVELOPMENT
(For details see "Environmental Initiative (p. 231")

CERTIFICATE IN URBAN ENVIRONMENTAL POLICY AND PLANNING
(For details see "Environmental Initiative (p. 231")

CERTIFICATE IN WOMEN, GENDER AND SEXUALITY STUDIES
(For details see "Women, Gender and Sexuality Studies (p. 422")

Graduate Certificates in Engineering

Certificate in Healthcare Systems Engineering
(For details see healthcare systems engineering (http://hse.lehigh.edu/curriculum/certificate-healthcare-systems-engineering))

Certificate in Management Science & Engineering
(For details see industrial and systems engineering (https://mse.lehigh.edu/curriculum/certificate-management-science-engineering))

Certificate in Nanotechnology
(For details see materials science and engineering (http://www.lehigh.edu/~inmatsci/graduate/certificate.htm))

Certificate in Polymer Science & Engineering
(For details see materials science and engineering (http://www.lehigh.edu/~inmatsci/graduate/certificate.htm))

Certificate in Quality Engineering
(For details see industrial and systems engineering (https://mse.lehigh.edu/curriculum/certificate-quality-engineering))

Health, Medicine, and Society

Program Director: Kelly Austin, Ph.D (North Carolina State) (http://socanthro.cas2.lehigh.edu/content/kelly-austin-0)

Email: kellyaustin@lehigh.edu (kellyaustin@lehigh.edu) # Phone: 610-758-2103

Website: http://hms.cas2.lehigh.edu/

Supported by the Office of Interdisciplinary Programs 610-758-3996; incasip@lehigh.edu (incasip@lehigh.edu)

Williams Hall, 31 Williams Drive

Core Faculty
Sirry Alang, Ph.D. (Department of Sociology and Anthropology); Kelly Austin, Ph.D. (Department of Sociology and Anthropology); Christopher Burke, Ph.D. (Department of Psychology); Stephen Cutcliffe, Ph.D. (Department of History); Dena Davis, Ph.D. (Department of Religion Studies); Elizabeth Dolan, Ph.D. (Department of English); Judith Lasker, Ph.D., (Department of Sociology and Anthropology); Julia Lechuga, Ph.D., (College of Education); Linda Lowe-Krentz, Ph.D. (Department of Biological Sciences); Jessecah Marsh, Ph.D. (Department of Psychology); and Lucy Napper, Ph.D. (Department of Psychology)

An interdisciplinary Health, Medicine, and Society minor is offered in the College of Arts and Sciences. A committee composed of faculty from several departments across the college developed and participate in the program. Students interested in declaring a minor in Health, Medicine, and Society should contact the Office of Interdisciplinary Programs (incasip@lehigh.edu).

The challenge of meeting the increasingly complex health needs of growing and aging populations is moving to the forefront of national and international concerns in the 21st century. The Health, Medicine, and Society field focuses on the social scientific and humanistic
dimensions of health and medical care to develop an understanding of the impact of health, illness, and medical care on individuals, families, and societies. This minor is intended to serve students who wish to be involved in some aspect of the health care industry or health policy and also students who are interested in communications, the pharmaceutical industry, law, business, agency work, and other careers where understanding health care is essential.

**Minor in Health, Medicine, and Society**

The minor in HMS consists of one core course and three elective courses for a total of 16 credits. To declare a minor in HMS, students must complete a minor declaration form. (http://catalog.lehigh.edu/coursesprogramsandcurricula/artsandsciences/healthmedicineandsociety/2016-17_hms_minor_declaration_form.pdf) Each semester, a complete list of HMS course offerings can be found on the web site or in the Office of Interdisciplinary Programs, Williams Hall, Suite 101.

### Required Core Course (select one) ¹

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>HMS/SOC 160</td>
<td>Medicine and Society (fall)</td>
</tr>
<tr>
<td>HMS 170</td>
<td>Medical Humanities (summer)</td>
</tr>
<tr>
<td>HMS 180</td>
<td>Introduction to Public Health (spring)</td>
</tr>
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</table>

### Electives (select three) ²

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>HMS/ENGL 115</td>
<td>Topics in Literature, Medicine, and Health</td>
</tr>
<tr>
<td>HMS/PHIL/REL 116</td>
<td>Bioethics</td>
</tr>
<tr>
<td>HMS/JOUR/ES 117</td>
<td>Environmental Health Risks and the Media</td>
</tr>
<tr>
<td>HMS/STS/HIST 118</td>
<td>History of Modern Medicine</td>
</tr>
<tr>
<td>HMS/PSYC 138</td>
<td>Abnormal Psychology</td>
</tr>
<tr>
<td>HMS/SOC 152</td>
<td>Alcohol, Science, and Society</td>
</tr>
<tr>
<td>HMS/ANTH 155</td>
<td>Medical Anthropology</td>
</tr>
<tr>
<td>HMS/SOC 162</td>
<td>AIDS and Society</td>
</tr>
<tr>
<td>HMS 211</td>
<td>Peer Health Adviser Training</td>
</tr>
<tr>
<td>HMS/REL 226</td>
<td>From Black Death to AIDS: Plague, Pandemic, Ethics and Religion</td>
</tr>
<tr>
<td>HMS 291</td>
<td>Independent Study</td>
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<tr>
<td>HMS 292</td>
<td>Supervised Research</td>
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<tr>
<td>HMS 293</td>
<td>Internship</td>
</tr>
<tr>
<td>HMS/ENGL 315</td>
<td>Topics in Literature, Medicine, and Health</td>
</tr>
<tr>
<td>HMS/SOC 316</td>
<td>Social Epidemiology</td>
</tr>
<tr>
<td>HMS/SOC/GS/GCP 322</td>
<td>Global Health Issues</td>
</tr>
<tr>
<td>HMS/JOUR/ES 323</td>
<td>Health and Environmental Controversies</td>
</tr>
<tr>
<td>HMS/PSYC 327</td>
<td>Health Psychology</td>
</tr>
<tr>
<td>HMS/PSYC/WGSS 334</td>
<td>The Psychology of Body Image and Eating Disorders</td>
</tr>
<tr>
<td>HMS/SOC/WGSS 341</td>
<td>Women and Health</td>
</tr>
<tr>
<td>HMS/PSYC 344</td>
<td>Health Care Reasoning and Decision-Making</td>
</tr>
<tr>
<td>HMS/POLS 349</td>
<td>Participatory and Action Research in Psychology</td>
</tr>
<tr>
<td>HMS/POLS 354</td>
<td>U.S. Health Care Politics</td>
</tr>
<tr>
<td>HMS/PSYC 386</td>
<td>Child and Adolescent Health Psychology</td>
</tr>
<tr>
<td>BIOS 010</td>
<td>Bioscience in the 21st Century</td>
</tr>
<tr>
<td>ECO 368</td>
<td>Health Economics</td>
</tr>
<tr>
<td>POLS 307</td>
<td>The Politics of Mental Health Policy</td>
</tr>
</tbody>
</table>

| Total Credits | 16 |

¹ If more than one core course is taken, core course may substitute for elective.

² Additional HMS designated courses may be offered each semester, consult with the Office of Interdisciplinary Programs for a complete listing of HMS courses.

### Program Electives

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>HMS/REL 002</td>
<td>Death and Dying: Religious and Ethical Perspectives</td>
</tr>
<tr>
<td>HMS/ENGL 115</td>
<td>Topics in Literature, Medicine, and Health</td>
</tr>
<tr>
<td>HMS/REL/PHIL 116</td>
<td>Bioethics</td>
</tr>
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<td>Internship</td>
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<tr>
<td>HMS/PSYC 302</td>
<td>Stress and Coping</td>
</tr>
<tr>
<td>HMS/ENGL 315</td>
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<td>ECO 368</td>
<td>Health Economics</td>
</tr>
<tr>
<td>HIST/WGSS/SOC 325</td>
<td>History of Sexuality and the Family in the U.S.</td>
</tr>
<tr>
<td>POLS 307</td>
<td>The Politics of Mental Health Policy</td>
</tr>
</tbody>
</table>

### Courses

**HMS 002 (REL 002) Death and Dying: Religious and Ethical Perspectives 4 Credits**

Introduces students to the study of religion, world religious traditions and ethics through an exploration of death and dying. Rituals, practices and texts focused on death provide the basis for comparative study of Asian and Western religious approaches to the meaning and mystery of death as it confronts individuals and communities. Attention will also be given to moral justification for deaths brought about by human actions (i.e., killings). Specific issues include suicide, war deaths, abortion, euthanasia and state-sponsored execution.

**Attribute/Distribution:** HU
HMS 115 (ENGL 115) Topics in Literature, Medicine, and Health 4 Credits
Largely focused on narratives about health, illness and disability, this course will examine individual experiences with attention to social context. Topics may include the physician/patient relationship, illness and deviance, plague literature, gender and medicine, autism, AIDS, mental illness, aging.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

HMS 116 (PHIL 116, REL 116) Bioethics 4 Credits
Moral issues that arise in the context of health care and related biomedical fields in the United States today, examined in the light of the nature and foundation of moral rights and obligations. Topics include: confidentiality, informed consent, euthanasia, medical research and experimentation, genetics, and the distribution of health care.
Attribute/Distribution: HU

HMS 117 (ES 117, JOUR 117) Environmental Health Risks and the Media 4 Credits
This course explores the risks and effects of environmental contamination on human health and behavior as well as the role of the mass media in alerting citizens to potential environmental health risks. Environmental topics vary but usually include air and water pollution, endocrine disrupters and radioactive waste.
Attribute/Distribution: SS

HMS 118 (HIST 118, STS 118) History of Modern Medicine 4 Credits
Introduction to Western medical history from the 18th century to the present day. Students will explore patient/practitioner relationships; examine changing ideas concerning health, sickness, and disease; chart changes in hospital care and medical education; and tackle topics such as eugenics, medical experimentation and health insurance.
Attribute/Distribution: HU

HMS 121 Peer Health Adviser Training 4 Credits
This applied course explores student health at Lehigh University and focuses on the development, implementation and evaluation of prevention strategies designed to make Lehigh a healthy and safe living, learning community by exploring student health-related data, examining campus-wide priority student health issues and developing evidence-based interventions. Peer Health Advisers are trained to provide peer-to-peer support, advice, resources and programming to promote healthy behaviors. Students completing the course are subsequently eligible to serve as Peer Health Advisers.
Attribute/Distribution: SS

HMS 122 (REL 226) From Black Death to AIDS:Plague,Pandemic,Ethics and Religion 4 Credits
An investigation of the role of religion and ethical analysis in constructing meaning around the idea of plague and pandemic. The role of religion in the European bubonic plague epidemic, the influenza pandemic of 1918, and the AIDS crisis will be examined, with attention give to ethical analysis of the institutional response to pandemic disease as distortions have occurred for political, social, and religious reasons.
Attribute/Distribution: HU

HMS 151 (SOC 152) Alcohol, Science, and Society 4 Credits
Alcohol use and abuse, its historical function in society, moral entrepreneurship, status struggles and conflict over alcohol. Current problems with attention to special population groups and strategies for prevention of alcohol abuse.
Attribute/Distribution: SS

HMS 155 (ANTH 155) Medical Anthropology 4 Credits
Medical Anthropology is the study of how conceptions of health, illness, and healing methods vary over time and across cultures. Students will learn how social and cultural factors shape health outcomes in a variety of human contexts, and will study culturally specific approaches to healing, including Western bio-medicine. The course offers a broad understanding of the relationship between culture, health, and healing.
Attribute/Distribution: SS

HMS 160 (SOC 160) Medicine and Society 4 Credits
Sociological perspectives on health, illness, and medical care. Focus on social epidemiology, social psychology of illness, socialization of health professionals, patient-professional relationships, medical care organization and policies.
Attribute/Distribution: SS

HMS 162 (SOC 162) AIDS and Society 4 Credits
Impact of the AIDS epidemic on individuals and on social institutions (medicine, religion, education, politics, etc.); social and health policy responses; international experience; effect on public attitudes and policy on people affected directly by AIDS.
Attribute/Distribution: SS

HMS 170 Medical Humanities 4 Credits
The focus on individual voices and particular historical moments in the humanities disciplines has much to add to our understanding of health and illness. This course will take up ethical, historical, and literary approaches to health. The course can count as the core course for the minor (instead of HMS/SSP160), or it can be taken as one of the three electives.
Attribute/Distribution: HU

HMS 171 Independent Study 1-4 Credits
Independent research and reading with a faculty member. After receiving initial approval from the HMS director, the student must prepare an independent study proposal, with readings and assignments, in consultation with a professor who agrees to direct the independent study. Open only to declared HMS minors who have complete HMS/SSP 160 in a previous term.
Attribute/Distribution: HU, SS

HMS 172 Supervised Research 1-8 Credits
Research project under the direct supervision of an HMS faculty member. Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU, SS

HMS 179 Internship 1-8 Credits
Practical experience in the application of health, medicine and society for both on- and off-campus organizations. Course is designed to provide credit for experiential learning experiences. May be repeated for credit up to eight credits. Prerequisite: consent of the program director.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU, SS

HMS 211 Medical Humanities 4 Credits
The focus on individual voices and particular historical moments in the humanities disciplines has much to add to our understanding of health and illness. This course will take up ethical, historical, and literary approaches to health. The course can count as the core course for the minor (instead of HMS/SSP160), or it can be taken as one of the three electives.
Attribute/Distribution: HU

HMS 222 (REL 226) From Black Death to AIDS:Plague,Pandemic,Ethics and Religion 4 Credits
An investigation of the role of religion and ethical analysis in constructing meaning around the idea of plague and pandemic. The role of religion in the European bubonic plague epidemic, the influenza pandemic of 1918, and the AIDS crisis will be examined, with attention give to ethical analysis of the institutional response to pandemic disease as distortions have occurred for political, social, and religious reasons.
Attribute/Distribution: HU

HMS 291 Independent Study 1-4 Credits
Independent research and reading with a faculty member. After receiving initial approval from the HMS director, the student must prepare an independent study proposal, with readings and assignments, in consultation with a professor who agrees to direct the independent study. Open only to declared HMS minors who have complete HMS/SSP 160 in a previous term.
Attribute/Distribution: HU, SS

HMS 292 Supervised Research 1-8 Credits
Research project under the direct supervision of an HMS faculty member. Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU, SS

HMS 293 Internship 1-8 Credits
Practical experience in the application of health, medicine and society for both on- and off-campus organizations. Course is designed to provide credit for experiential learning experiences. May be repeated for credit up to eight credits. Prerequisite: consent of the program director.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU, SS
HMS 300 Apprentice Teaching 1-4 Credits  
Repeat Status: Course may be repeated.

HMS 302 (PSYC 302) Stress and Coping 4 Credits  
How does stress affect the psychological system, and what psychological mechanisms are in place to help people overcome environmental stressors? This seminar examines classic and contemporary theories and research on stress, coping, and social support.  
Prerequisites: PSYC 121 or PSYC 153 or HMS 160 or HMS 180  
Attribute/Distribution: SS

HMS 315 (ENGL 315) Topics in Literature, Medicine, and Health 3,4 Credits  
Analyzing the stories people tell about health, illness and disability, this course engages cultural studies approaches in order to explore the way those stories are told. Topics may include: illness and the graphic novel, the changing image of the healer in literature, collaborative storytelling with Alzheimer's patients, end of life narratives, tales from the ER, narrative ethics.  
Attribute/Distribution: HU

HMS 316 (SOC 316) Social Epidemiology 4 Credits  
Social epidemiology is the study of the distribution and social determinants of health and disease in human populations. This course introduces the basic principles of epidemiological study design, analysis and interpretation, covering topics such as how a disease spreads across populations and how public health interventions can help control or reduce the spread of disease. This course also reviews epidemiology as a social science by reviewing the social causes and consequences of health.  
Attribute/Distribution: SS

HMS 322 (GS 322, SOC 322) Global Health Issues 4 Credits  
Sociological dimensions of health, illness, and healing as they appear in different parts of the world. Focus on patterns of disease and mortality around the world; the relative importance of 'traditional' and 'modern' beliefs and practices with regard to disease and treatment in different societies; the organization of national health care systems in different countries; and the role of international organizations and social movements in promoting health.  
Attribute/Distribution: SS

HMS 323 (ES 323, JOUR 323, STS 323) Health and Environmental Controversies 4 Credits  
Exploration of health and environmental controversies from the perspectives of scientific uncertainty and mass media coverage. Examines genetic engineering, biotechnology, environmental health risks, and nanotechnology. Includes discussion of ethical and social responsibilities and interactions with the public.  
Attribute/Distribution: SS

HMS 327 (PSYC 327) Health Psychology 4 Credits  
This course provides an overview of the psychological study of health. The course explores psychological theories that aim to explain health behavior (e.g., why do people smoke?) and the role of psychology in understanding the experience of illness. This course also examines how psychological research and theory can be applied to promote health behavior (e.g., how can we design interventions to promote physical activity).  
Prerequisites: PSYC 001  
Attribute/Distribution: SS

HMS 334 (PSYC 334, WGSS 334) The Psychology of Body Image and Eating Disorders 4 Credits  
The course addresses the psychosocial aspects of the development of healthy and unhealthy body image and eating disorders. The roles of personality traits/individual factors, family and interpersonal functioning, and cultural factors will be examined, as will the impact of representations of body image in mass media. Public health and psychological interventions for prevention and treatment will be explored. Personal accounts/memoirs, clinical case presentations, and documentary and dramatic films will be incorporated in the presentation of topics.  
Attribute/Distribution: SS

HMS 341 (SOC 341, WGSS 341) Gender and Health 4 Credits  
Relationships of sex differences and gender norms to disease and longevity in the U.S. and around the world. Influence of medical systems on men’s and women’s lives and the impact of gender-based consumer health movements on health and medical care. Focus on specific topics, e.g. medicalization and commercialization of women's bodies, the politics of reproductive choices, masculinity and health, and gender and mental health.  
Attribute/Distribution: SS

HMS 343 (SOC 343) Race, Ethnicity, and Health 4 Credits  
People who belong to racial and ethnic minority groups are exposed to more health risks, have disproportionately high levels of sickness and excess deaths, and have limited access to good quality healthcare. This course provides students with theoretical and empirical insights into the intersection of race, ethnicity, and health in the U.S. Historical and contemporary patterns in U.S. demography, race relations, residential segregation, environmental justice, and social stratification will be explored in the context of health and health care.  
Attribute/Distribution: SS

HMS 344 (PSYC 344) Health Care Reasoning and Decision Making 4 Credits  
Health care professionals diagnose physical and mental illnesses and create treatment plans to improve their patients’ health. How do these professionals make decisions related to these important issues? We will explore the literature on how medical and mental health professionals reason and make decisions about health care issues. Topics to be covered include diagnosis, treatment decisions, access to care, and how these reasoning processes are swayed. Consideration will be given to patient decision-making as well.  
Prerequisites: PSYC 117 or COGS 117 or COGS 007 or HMS 160 or HMS 180  
Attribute/Distribution: SS

HMS 348 (PSYC 348) Drugs and Behavior 4 Credits  
Why are some people more vulnerable to substance use problems than others? How can we effectively address substance abuse in our society? This course explores theories and research on the complex psychological, social, and biological factors that contribute to substance use and disorders. Topics include theories of addiction, characteristics of illegal and legal drugs, risk and protective factors, and research on substance abuse prevention.  
Prerequisites: PSYC 001 or HMS 160 or HMS 180  
Attribute/Distribution: SS

HMS 349 (PSYC 349) Participatory and Action Research in Psychology 4 Credits  
Action research is used to understand important real-world social problems and promote social action. Participatory research engages community members as equals to help identify areas of focus and to design studies and interventions. This course provides an overview of the rich history of these approaches in psychology, an in-depth look at how they can be used effectively, and an opportunity to gain hands-on experience.  
Prerequisites: PSYC 121 or PSYC 153 or HMS 160 or HMS 180  
Attribute/Distribution: SS

HMS 354 (POLS 354) U.S. Health Care Politics 4 Credits  
Explores a range of health care programs and policies and their impacts on American society. Topics include the development of the U.S. approach to health care; public sector plans (Medicare and Medicaid); the role of managed care; the employer-sponsored system; the situation of the medically uninsured; the health care vested interests and lobbyists; movements for national health care; and options for change.  
Attribute/Distribution: SS

HMS 386 (PSYC 386) Child and Adolescent Health Psychology 4 Credits  
Focuses on developmental research and theory related to health and wellness issues in children and adolescents. Topics include children's understanding of biology and disease, disease management, medical consent, education and policy efforts to promote children's health.  
Prerequisites: PSYC 107  
Attribute/Distribution: SS
Healthcare Systems Engineering

The Masters of Engineering in Healthcare Systems Engineering (HSE) program produces graduates with strong fundamental skills in industrial and systems engineering and a strong background in healthcare delivery systems and processes. Graduates will be ideally positioned for skilled professional management roles aimed at improving quality, streamlining processes and improving efficiency in healthcare systems. This concentrated degree program is designed to prepare graduate students for engineering and management careers in firms engaged in delivering healthcare and health related products and services. The need for professionals in this area is strong and growing due to the aging of the population and a national crisis of rapidly increasing healthcare costs. Graduates will be well positioned for employment in the following types of organizations:

- Healthcare delivery organizations such as hospitals and clinics
- Healthcare finance organizations such as insurance companies and HMOs
- Healthcare product suppliers such as pharmaceutical companies and manufacturers of Healthcare products
- Management and benefits consulting firms
- Policy organizations at various levels of government and trade associations

Students seeking to enroll to the program should have a bachelor’s degree in engineering, mathematics, science, or business. Students should be quantitatively oriented and have completed a calculus based probability and statistics course at the level of ISE 328. A candidate lacking certain background may be required to take background courses.

The program consists of 30 credit hours of course work including a 3-credit HSE capstone project. Full-time in-residence students can complete the program in a fall-spring-summer semester sequence as shown in the table below.

**Recommended sequence of courses in the HSE M.Eng. program**

<table>
<thead>
<tr>
<th>Fall CR</th>
<th>Spring CR</th>
<th>Summer CR</th>
<th>Elective</th>
<th>Total Credits</th>
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<tbody>
<tr>
<td>ISE 470</td>
<td>3 ISE 426</td>
<td>3 ISE 474</td>
<td>3</td>
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<tr>
<td>ISE 471</td>
<td>3 ISE 473</td>
<td>3 Technical Elective</td>
<td>3</td>
<td>12</td>
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<tr>
<td>ISE 410</td>
<td>3 ISE 472</td>
<td>3</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Technical Elective</td>
<td>3 ISE 404 or 339</td>
<td>3</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

**Total Credits: 30**

**Additional Elective Courses**

**ISE 475 Healthcare Systems Project 1-3 Credits**
Intensive study of an area of healthcare systems engineering with emphasis upon design and application. Written report is required.

ISE 328 and ISE 357 are designed to be remedial courses for students in the program. Although a grade earned in those course will appear in the student’s transcript, they will not count toward the 30 credit program requirement. Elective courses come from various sectors of systems and engineering as well as accounting, business, and economics. The pool of elective courses is listed below:

- Accounting Information Systems
- Financial Accounting
- Cost Accounting
- Project Management
- Human Resource Management
- Strategic Supply Management
- Technology, Operations, and Competitive Strategy
- Managerial Economics
- Econometrics
- Health Economics
- Management of Information Systems
- Quality Control
- Data Communications Systems
- Systems Engineering Design
- Queuing Systems
- Advanced Database Analysis and Design
- Advanced Data Communications Systems
- Analysis and Design
- Discrete Event Dynamic Systems
- Financial Optimization
- Game Theory
- Healthcare Systems Project

The HSE Program Director must approve all course work including technical electives. No more than 3 credit hours may be taken from the College of Business and Economics.

Additional information about the program may be obtained by calling the HSE Program at (610) 758-5867 or from the HSE program website: http://lehigh.edu/hsese

**History**

History home page (http://history.cas2.lehigh.edu/node/8)

The history major introduces students to the study of the causes and consequences of change through an examination of political, economic, social, cultural, and intellectual developments and institutions over time. The department's goal is to train its majors to think critically about the events and forces that have shaped the modern world, to analyze and interpret sources and evidence, and to view issues from a variety of perspectives. Those skills have served students well in a wide range of careers. Lehigh history majors have frequently gone on to law school or to work in various areas of education, journalism, public affairs, and business. The major also provides an excellent basis for graduate training in a wide range of public policy fields. The department offers a program of independent honors research under the direction of an individual faculty member (HIST 391, HIST 392). A maximum of six credits may be used toward this project. Normally students pursue their research in the second semester of the junior year and the first semester of their senior year; the project may also be undertaken during the senior year. Students who do well on their research project will graduate with department honors. The writing intensive requirement must be fulfilled by a course in the history department. For advanced placement, please see Section I.

The department recommends that students intending to major in history take MATH 012, Basic Statistics, to fulfill their college math requirement.

**Professors.** Stephen H. Cutcliffe, PhD (Lehigh University); John Pettigrew, PhD (University Wisconsin at Madison); Roger D. Simon, PhD (University Wisconsin at Madison)

**Associate Professors.** William Bulman, PhD (Princeton University); Gail A. Cooper, PhD (University of California Santa Barbara); Nitzan Lebovic, PhD (University of California Los Angeles); Michelle LeMaster, PhD (Johns Hopkins University); Tamara Gene Myers, PhD (McGill University); Monica Najjar, PhD (University Wisconsin at Madison); John Savage, DEA (Ecole des Hautes Etudes en Science Sociales); John Kenly Smith, Jr., PhD (University of Delaware)

**Assistant Professors.** Natanya Duncan, PhD (University of Florida); Kwame Essien, PhD (University Texas, Austin); Maria Barbara Zepeda Cortes, PhD (University of California San Diego)

**Professor Of Practice.** Kimberley Carrell-Smith, PhD (University of Delaware)

**Emeriti.** Michael G. Baylor, PhD (Stanford University); Ian P. Duffy, PhD (Oxford University); Charles Robert Phillips, II, PhD (Brown University); James S. Saeger, PhD (Ohio State University); William R. Scott, PhD (Princeton University); William G. Shade, PhD (Wayne State University); Jean R. Soderlund, PhD (Temple University)

**DEPARTMENT MAJOR REQUIREMENTS**
A history major consists of 35 hours, normally nine courses, as follows:
HIST 011 Survey of Europe to 1648 4
HIST 012 Survey of Europe Since 1648 4
HIST 201 Historical Perspectives 4
HIST 202 Historical Research 4
Select one of the following in the history of Asia, Africa, or Latin America:
  HIST 005 African Civilization 4
  HIST 049 Colonial Latin America 4
  HIST 050 Modern Latin America 4
  HIST 075 Chinese Civilization 4
  HIST 076 Understanding Contemporary China 4
  HIST 134 History and Cultures of Ghana 4
  HIST 330 Africans and the Atlantic World 4
HIST 340 Japanese Industrialization 4
HIST 342
HIST 368 Seminar in Latin American History 3
These provisional courses may be used to fulfill this requirement in accordance with their contents and emphases:
  HIST 104 Themes in History 3
  HIST 303 Topics in History 3
  HIST 331 United States and Africa 3
  HIST 371 Independent Study 3
  HIST 391 Honors Thesis in History 3
  HIST 392 Honors Thesis in History 3
Select a minimum of 12 hours of courses numbered 303 or higher (except HIST 306) 12

Total Credits 39

To graduate with a history major, a minimum 24 hours must be graded course work taken at Lehigh.

REQUIREMENTS FOR HONORS

Students wishing to graduate with honors must have a minimum GPA of 3.40 in history, 39 credits and must have completed HIST 391.

HISTORY MINOR REQUIREMENTS

Each student's minor program is prepared in consultation with the advisor of minors in the history department. Advanced placement credit may not be used for the minor program.

• 15 credits
• at least 4 credits at 200 or 300 level
• maximum of one course (4 credits) of transfer or cross-listed courses may count toward minor.

CONCENTRATION IN PUBLIC HISTORY

History majors may earn a concentration in Public History by completing a total of 16 hours in the following courses:
  HIST 305 Public History (required) 4
  HIST 306 Internship in Public History (required) 4
Select at least two of the following: 8
  ART 175 Introduction to Museum Work
  ART 275 Museums: Research, Collections Management and Exhibition Planning
  ART 370 Special Topics in Museum and Curatorial Studies
  ART 375 Museum Internship
  HIST 336 Bethlehem and the Lehigh Valley
  HIST 338 Techniques in Public History (2-4 credits, may be repeated for up to 8 credits)
HIST 339/370/ANTH 370 Managing Nonprofit Organizations

Total Credits 16

MINOR IN DOCUMENTARY STORYMAKING

The Minor in Documentary Storymaking provides students with an opportunity to enhance their major academic work in a variety of fields with specialization in documentary perspectives and community-based practices. Whatever their academic interests, a foundation in the theory, ethics, and practice of documentary storymaking can serve as an integrating focal point for their studies.

The Minor requires a minimum of five courses. Of those five, three are required:
  DOC 101 Introduction to Documentary Storymaking
  DOC 201 Legal & Ethical Issues in Documentary Practice
  DOC 370 Capstone in Documentary Storymaking

Electives will be chosen with consultation of adviser; electives include:
  HIST 337 History and Community Memory (Lehigh)
  JOUR 024 Visual Communication (Lehigh)
  JOUR 141 Photojournalism (Lehigh)
  JOUR 230 Multimedia Storytelling (Lehigh)
  COM 231. Documentary Research (Muhlenberg)
  COM 344. Documentary Film & Social Justice (Muhlenberg)
  COM 389. Documentary Photography (Muhlenberg)
  COM 431. Documentary Field Work (Muhlenberg)
  FAMS 201: Making Media I (Lafayette)
  FAMS 202: Making Media II (Lafayette)
  FAMS 340: Documentary Film (Lafayette)

GRADUATE WORK IN HISTORY

Lehigh University has been granting advanced degrees in history for more than seventy years. Its graduates have become university and college professors, secondary school teachers and administrators, museum directors, and public servants. The graduate program focuses primarily on the areas in which the department is particularly strong in faculty and resources, notably 1) Atlantic World and Colonial America and 2) Modern America, including industry and technology. The department works closely with the Lawrence Henry Gipson Institute for Eighteenth Century Studies which sponsors yearly symposia and provides research support for both faculty and students. The history of technology program is closely tied to Lehigh's Science, Technology, and Society program.

Lehigh's libraries are especially rich in materials for graduate research in history, particularly in the fields listed above. They have an extensive collection of scholarly periodicals and monographs. Graduate programs provide intensive and specialized study, and the policy of limited enrollment permits close relations between faculty and students.

Admission to graduate study in history is competitive and dependent upon the applicant's undergraduate preparation and record, recommendations, and Graduate Record Examination scores. Besides general requirements for College of Arts and Sciences graduate programs, the following special requirements apply to graduate study in history.

Master of Arts

There are two masters programs. Under Plan I, a candidate may earn the degree by successfully completing 27 hours of approved course work and submitting a thesis of the length and quality that would make it suitable for publication as a scholarly article. The paper may be presented in a graduate research seminar in the program. Candidates continuing toward a doctorate should select Plan I. Candidates declaring Plan II take 30 hours of approved course work and pass examinations in two fields chosen from American, British, European, and Latin American history, and History of Technology. Candidates in either plan are required to maintain a 3.3 average in all graduate work.

M.A. in History with Concentration in Public History

Students may earn through either Plan I or Plan II (see above), an M.A. in History with a concentration in Public History by completing a total of 36 hours of approved course work, including a minimum of 10 credits and maximum of 12 credits in approved Public History courses.

HIST 305 Public History (required) 3
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Attribute/Distribution</th>
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<tbody>
<tr>
<td>HIST 306</td>
<td>Internship in Public History (required but may be waived for equivalent experience)</td>
<td>3</td>
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</tr>
<tr>
<td>ART 370</td>
<td>Special Topics in Museum and Curatorial Studies</td>
<td>1-4</td>
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<tr>
<td>HIST 339</td>
<td>Managing Nonprofit Organizations</td>
<td>3-4</td>
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<tr>
<td>HIST/ANTH 370</td>
<td>Historical Archeology</td>
<td>3-4</td>
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<tr>
<td>HIST 438</td>
<td>Techniques in Public History (2 or 3 credits; may be repeated for up to 8 credits)</td>
<td>2-3</td>
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</tbody>
</table>

**Total Credits** 15-21

**Doctor of Philosophy**

Students in the Ph.D. program in history must maintain a 3.50 average after two semesters of study. During the second semester, doctoral students select one major and three minor fields in which to take comprehensive written and oral examinations. The dissertation will be in the major field. The dissertation advisor will chair a special committee that will oversee the student's graduate program. The other members of the special committee will be those faculty who are examiners in the selected fields and one professor from another department relevant to the candidate's major field. No professor may direct more than one field, but the direction of a field may involve two professors. An original dissertation is required, and it must be successfully defended to the examining committee.

All Ph.D. students must meet the University Concentrated Learning Requirement. They must take Historical Research (401). Students who enter the Ph.D. program with an M.A. from another university must also take either Readings in the History of the Atlantic World (HIST 404) or Readings in the History of Industrial America (HIST 405). Students are encouraged to take both seminars if appropriate to their course of study. All Ph.D. students must take at least 18 hours of directed readings courses (400 series) beyond the M.A.

**Major Fields**

Major fields are Technology, Modern Britain, Colonial America, Nineteenth Century United States, Twentieth Century United States. (The Nineteenth and Twentieth century fields may be divided topically rather than chronologically; for example, a Student may be examined in labor/social history 1800-present, and in political history 1800-present.)

**Minor Fields**

Any of the major fields listed above may also be minor fields. Examples of other minor fields are American Studies; Ancient History; Early Modern Europe; Modern Europe; Latin America; Environmental History; Japan; Public History; Science, Technology and Society studies.

**Language Requirements**

The student's special committee determines whether proficiency in a foreign language or proficiency in statistical methods will be required for the doctoral degree.

**UNDERGRADUATE COURSES IN HISTORY**

Petitions are required for first-year students to take 100-level or higher courses, and for sophomores to take 200-level or higher courses. HU fills humanities distribution requirements; SS fills social science requirements; ND not designated.

**FOR ADVANCED UNDERGRADUATES AND GRADUATE STUDENTS**

Graduate students may take 300 level courses, for which they receive 3 credits. Undergraduates must take them for 4 credits.

**Courses**

**HIST 005 (AAS 005) African Civilization 4 Credits**

SubSaharan Africa through the millennia of the ancient world to the present. Human origins, state and nonstate systems, the external slave trade, colonialism, resistance to European rule, independence movements, and neocolonialism.

**Attribute/Distribution:** SS

**HIST 007 Technology in America's Industrial Age 4 Credits**

Traces the development of American technology from the preindustrial colonial era until America’s emergence as the world’s leading industrial power. The interactions between technology and culture, society, politics, and the economy will also be addressed.

**Attribute/Distribution:** SS

**HIST 008 Technology in Modern America 4 Credits**

Traces the evolution of modern American technology, including automobiles, aircraft, computers, nuclear weapons, television, space, pharmaceuticals, and biotechnology. Includes critiques of technology such as environmentalism. The interactions of technology and culture, society, politics, and the economy will also be addressed.

**Attribute/Distribution:** SS

**HIST 011 Building Traditional Europe: From the Romans to the Fracturing of Christian Culture 4 Credits**

Development of European history from Rome to the 17th century. End of the ancient world, origins and growth of medieval civilization, the Renaissance and Reformation.

**Attribute/Distribution:** SS

**HIST 012 Inventing the Modern World: Europe in Global Perspective, 1648-present 4 Credits**

The rise of modern nation states; the scientific and industrial revolutions; social movements and the French and Russian revolutions; impact of Enlightenment philosophy, nationalism, liberalism, imperialism and fascism; the development of modern class structure and transformations in gender relations, art, popular culture and society.

**Attribute/Distribution:** HU

**HIST 015 Three English Revolutions 4 Credits**

The Protestant Reformation, the Civil Wars, and the Glorious Revolution, from Henry the Eighth to John Locke. Examines how three bloody conflicts gave birth to the first modern society. Explores the origins of capitalism, secularization, nationalism, and democracy.

**Attribute/Distribution:** HU

**HIST 016 The Rise and Fall of Britain and Its Empire 4 Credits**

Charts the rise of the world's first global superpower in the 18th and 19th centuries, and its decline and disintegration in the 20th and 21st. Topics include the Enlightenment, the first party system, the Industrial Revolution, imperialism, globalization, the World Wars, neo-liberalism, and punk rock.

**Attribute/Distribution:** HU

**HIST 021 (CLSS 021) Greek History 4 Credits**

The development of civilization from paleolithic times to the world empire of Alexander the Great. The social, economic, religious, philosophic, artistic, and literary development of the ancient world; the origin of political institutions.

**Attribute/Distribution:** SS

**HIST 022 (CLSS 022) Roman History 4 Credits**

Rome from its origins to A.D. 476. Political, social and religious developments. Transformation of the late Roman Empire to the early medieval period.

**Attribute/Distribution:** SS

**HIST 025 Pirates of the Caribbean and Other Rogues of the Atlantic World 4 Credits**

Introduction to the history of the Atlantic World, through the lens of piracy and seafaring. Interactions between Europe, Africa, and North and South America, 1442-1825.

**Attribute/Distribution:** SS

**HIST 041 The Making and Breaking of the United States 3,4 Credits**

Native American cultures; European settlement; development of slavery and free labor systems; the Revolution; founding of the new nation; 19th century social, economic, cultural, and political development; Civil War.

**Attribute/Distribution:** SS

**HIST 042 Big Dreams, Big Bucks, Big Trouble: United States, 1865-1941 0,4 Credits**

America's transformation into an industrial and global power from Reconstruction after the Civil War to the Great Depression; includes social, political, and cultural developments.

**Attribute/Distribution:** SS
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<th>Course Code</th>
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<tr>
<td>HIST 043</td>
<td>From Pearl Harbor to 9/11: United States Since 1939 4</td>
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<td>World War II; Cold War at home and abroad; Civil Rights movement; the</td>
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<td>1960s: Vietnam, the welfare state and social upheavals; new forms of</td>
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<td>cultural expression; feminism; rise of neoconservatism.</td>
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<td>HIST 049</td>
<td>History of Latin America 4</td>
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<td>Examine the initial encounters of peoples of Iberian and African origins</td>
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<td>with the indigenous civilizations of the Western Hemisphere. Explore the</td>
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<td>development of a colonial economy and its global reach. Focus on the</td>
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<td>birth of a distinctive Latin American society and culture, with attention</td>
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<td>to the Latin American patriots who fought for their freedom. No prior</td>
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<td>knowledge of Latin American history required.</td>
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<td>HIST 050</td>
<td>History of Latin America 4</td>
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<td></td>
<td>Examines the 200-year-long struggle of Latin American peoples to</td>
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<td>gain political representation, economic equality, and social justice.</td>
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<td>Explores key historical events in Latin America from the movement</td>
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<td>for independence led by Simon Bolivar and Father Miguel Hidalgo in the early</td>
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<td>nineteenth century to today's modern societies. Topics include the wars</td>
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<td>of independence, the rule of caudillos, foreign military interventions,</td>
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<td>export economies, populism, social revolutions, the Cold War era, state</td>
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<td>terror and military dictatorships, and the war on drugs.</td>
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<td>HIST 075</td>
<td>(ASIA 075, MLL 075) Chinese Civilization 4</td>
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<td>The development of traditional Chinese thought, beliefs, technology, and</td>
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<td>institutions from a historical perspective.</td>
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<td>HIST 076</td>
<td>(ASIA 076, MLL 076) Understanding Contemporary China 4</td>
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<td>An overview of recent history, politics, economy, religion, problems of</td>
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<td>modernization, popular culture, and attitudes. Contemporary Chinese</td>
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<td>society viewed against the backdrop of tradition and the tumultuous</td>
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<td>history of 20th century China.</td>
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<td>HIST 101</td>
<td>(GS 101) Histories of Globalization 4</td>
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<td></td>
<td>Critical historical perspectives on current debates around “globalization”</td>
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<td>and the varied paths and responses to modernity, using recent scholarship</td>
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<td>associated with the New Global History. The “Rise of the West” paradigm,</td>
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<td>Industrial Revolution and modernization theory; creation of global financial</td>
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<td>markets, nationbuilding and New Imperialism; Great Depression and World</td>
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<td>Wars as global historical events; postwar decolonization, Cold War and</td>
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<td>emergence of North-South relations; impact of consumerism, movements for</td>
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<td>women’s rights, ethnic nationalism and religious fundamentalist movements</td>
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<td>in traditionbound societies.</td>
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<td>HIST 104</td>
<td>Themes in History 2-4</td>
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<td>Seminar on a particular theme or topic not covered by a currently listed</td>
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<td>offering. Repeat Status: Course may be repeated.</td>
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<td>HIST 105</td>
<td>Sports in Modern America 4</td>
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<td></td>
<td>Surveys the social, cultural, and political role of sports in America</td>
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<td>since the Civil War. By addressing the development of sports and its</td>
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<td>relationship with race, class, ethnicity, gender, the media, popular</td>
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<td>culture, and government, this class will examine the impact of sports in</td>
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<td>making the America and Americans of the 20th century.</td>
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<td>HIST 107</td>
<td>(GS 107) Technology and World History 4</td>
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<td></td>
<td>Development of technology and its relationship to political, economic,</td>
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<td>military and cultural aspects of world civilization from pyramids to the</td>
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<td>present.</td>
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<td>HIST 109</td>
<td>The Built Environment of New York: 1624-2001 4</td>
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<td>How the physical environment of New York City, particularly Manhattan, came</td>
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<td>to be. themes include the evolution of land use, housing, changing</td>
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<td>economic functions of the city, immigration, cultural life, social</td>
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<td>communities, and changing technology. Topics include: settlement of</td>
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<td>lower Manhattan, the street system, immigrant neighborhoods and the</td>
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<td>Lower East Side, Greenwich Village, Central Village, Central Park, the</td>
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<td>elevated trains and the subways, the Brooklyn Bridge, apartment living,</td>
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<td>specialized shopping and entertainment districts, skyscrapers, Harlem,</td>
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<td>Rockefeller Center, the automobile and highway system, public housing,</td>
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<td>the World Trade Center. Usually taught in the summer in New York with</td>
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<td>walking tours to many of the locations listed above.</td>
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<td>HIST 110</td>
<td>American Military History 4</td>
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<tr>
<td></td>
<td>The American military tradition from colonial times to the present.</td>
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<td>America’s wars and the development and operation of military institutions</td>
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<td>within the political, economic, ideological, and technological milieu of</td>
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<td>American society.</td>
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<td>HIST 117</td>
<td>(STS 117, WGSS 117) Pioneering Women: Women in Science, Medicine and</td>
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<td>Engineering 4</td>
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<td></td>
<td>This course analyses the careers of professional women in science,</td>
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<td>medicine and engineering, principally in the United States. It examines</td>
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<td>historical barriers to training and entry into these professions; cultural</td>
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<td>stereotypes that shape women’s options; women’s participation in</td>
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<td>innovation in their fields; their concern for work/life balance; and their</td>
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<td>contribution to clients and patients, both male and female. It focuses on</td>
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<td>three locations of professional work: the laboratory, the clinic, and the</td>
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<td>job site.</td>
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<td>HIST 118</td>
<td>(HMS 118, STS 118) History of Modern Medicine 4</td>
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<td></td>
<td>Introduction to Western medical history from the 18th century to the</td>
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<td>present day. Students will explore patient/practitioner relationships,</td>
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<td>examine changing ideas concerning health, sickness, and disease, chart</td>
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<td>changes in hospital care and medical education, and tackle topics such as</td>
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<td>eugenics, medical experimentation, and health insurance.</td>
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<td>HIST 119</td>
<td>History of North American Indians 4</td>
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<td>The history of American Indians from before European contact to the</td>
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<td>present. Emphasis will be placed on the diversity of native peoples of</td>
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<td>eastern North America and how patterns of interaction between native</td>
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<td>Americans and Euro-Americans have changed over time. Discussion format,</td>
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<td>research paper.</td>
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<td>HIST 120</td>
<td>Revolutionary America 4</td>
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<td>Origins and development of the American republic from 1750 through the</td>
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<td></td>
<td>adoption of the Federal Constitution.</td>
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<td>HIST 124</td>
<td>(WGSS 124) Women in America 4</td>
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<td></td>
<td>Roles of women in American society from colonial to present times:</td>
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<td>attitudes toward women, female sexuality, women’s work, and feminism.</td>
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<td>HIST 127</td>
<td>Women, Gender, Sexuality and Race in African Societies 4</td>
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<td>This course explore the various ways in which womanhood, gender,</td>
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<td>sexuality and race are defined, constructed and articulated in African</td>
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<td>societies. The interdisciplinary course draws from historical writings,</td>
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<td>novels, biography, anthropology, political science, health and other fields</td>
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<td>to examine diverse activities and contributions of African women from the</td>
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<td>pre-colonial period to the present.</td>
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<td>HIST 130</td>
<td>(AAS 130) African American History 4</td>
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<td>Blacks in America from the first importation of Africans to the</td>
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<td>implementation of civil rights laws. West African origins, slave trade,</td>
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<td></td>
<td>slavery, free blacks and emancipation and study of Reconstruction,</td>
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<td>segregation, urbanization, and the struggle for racial equality.</td>
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HIST 133 (AAS 133, FREN 133, LAS 133, MLL 133, POLS 133) Lehigh in Martinique: Globalization and Local Identity 3-4 Credits
History, culture and politics of the French Caribbean island of Martinique, from its position as a key site of the 18th century Atlantic world economy to becoming an official French department and outpost of the European Union. Interdisciplinary perspectives on the complex nature of social identity, historical memory and impact of globalization. No French is required. Offered during winter inter-term through Lehigh Study Abroad.

HIST 134 (AAS 134) History and Cultures of Ghana 4 Credits
Overview of Ghana's history and cultures from the fifteenth century, examining diversity among various ethnic groups and covering such themes as religion, literature, art, music/dance, gender, family and anti-colonial movements. The course will also explore how slave castles/forts contributed to the transatlantic slave trade, Pan-Africanism and global tourism.
Attribute/Distribution: HU

HIST 135 Era of Jefferson and Jackson 4 Credits
Colonial beginnings; the Articles of Confederation and the Constitution; the creation of a new nation; the development of American political parties; the antebellum American state.
Attribute/Distribution: SS

HIST 136 Era of the Civil War and Reconstruction 4 Credits
American abolitionism and the origins of the Civil War; the Second American Revolution; Reconstruction and its sequel.
Attribute/Distribution: SS

HIST 145 (STS 145) Introduction to the History of Science 4 Credits
The history of modern science, primarily physical and biological, with emphasis on the development of major theoretical models since the 17th century.
Attribute/Distribution: SS

HIST 150 Medieval Civilization 4 Credits
Formation and development of western culture to about 1400. Rise of universities and towns, legal development and origins of representative government, origins of nationstates, scholasticism and decline of the medieval church.
Attribute/Distribution: SS

HIST 154 (JST 154, REL 154) The Holocaust: History and Meaning 4 Credits
The Nazi Holocaust in its historical, political and religious setting. Emphasis upon the moral, cultural and theological issues raised by the Holocaust.
Attribute/Distribution: HU

HIST 157 (REL 157) Europe in the Age of the Reformation 4 Credits
The breakup of the religious culture of medieval Christian Europe in the reformation movements of the sixteenth century. The origins and varieties of Protestantism; the intersection of religious ideas and politics in Germany, Switzerland, Britain, France, and the Netherlands; the “wars of religion” and the emergence of the European state system.
Attribute/Distribution: HU

HIST 158 Europe in the 17th and 18th Centuries 4 Credits
Transformation of European civilization from the 30 Years War to the outbreak of the French Revolution. Origins and development of the European state system; absolutism; commercial expansion and competition for empire; science; the Enlightenment and its impact on European culture and politics.
Attribute/Distribution: HU

HIST 159 Revolutionary Europe, 1789-1870 4 Credits
Revolutions and reactions; the rise and spread of liberalism, nationalism, and socialism.
Attribute/Distribution: HU

HIST 160 Europe in the Age of Total War, 1870-1945 4 Credits
Origins of two world wars; revolutionary governments in Germany, Italy, and Russia.
Attribute/Distribution: HU

HIST 161 (CLSS 161) Roman Law 4 Credits
Examination of Roman legal systems from the Twelve Tables to the Digest of Justinian. Emphasis on development of legal concepts and their historical context. Readings in primary sources; lectures; discussion.
Attribute/Distribution: SS

HIST 162 Contemporary Europe 4 Credits
Development of European States since 1945; European Community; Soviet influence and collapse.
Attribute/Distribution: HU

HIST 163 France since 1789 4 Credits
France's tumultuous transformation from an absolutist monarchy to a modern democratic republic. Explores major cultural, social and economic changes, with particular attention given to industrialization and urbanization, gender and class, church and state relations, the French Left and France's unique contribution to modern philosophy, art and culture.
Attribute/Distribution: SS

HIST 170 (ASIA 170) The Last Samurai 4 Credits
Examination of Japanese society, social changes, and their continuing impact upon Japanese culture and society.
Attribute/Distribution: SS

HIST 179 (AAS 179) Black Political Thought in America 4 Credits
Black leadership, organizations, and philosophy in America from Reconstruction to the Civil Rights Era; ideas and programs of Booker T. Washington, W.E.B. DuBois, Marcus Garvey, Malcolm X and Martin Luther King, Jr.
Attribute/Distribution: SS

HIST 180 (REL 180) Religion and the American Experience 4 Credits
The historical development of major religious groups in this country from colonial times to the present. Their place in social and political life, and the impact of the national experience upon them. Emphasis on religious freedom and pluralism, and the church-state relationship.
Attribute/Distribution: HU

HIST 183 (ART 183, GS 183) France from Medieval to Modern: Soc., Pol. & Art 3 Credits
France's artistic, cultural, social, artistic and political development from early kingship and dominance of the Church in the Middle Ages to the grandeur of Versailles in the Age of Absolutism; radical transformations of culture and society during the French Revolution and advent of the Modern Nation-State; to twentieth century developments including the two World Wars, imperialism and impact of post-war globalization. Offered in summer only through Lehigh Study Abroad Office as part of Lehigh in Paris program.
Attribute/Distribution: HU

HIST 185 (JST 185, REL 185) Modern Jewish History 1800-2000 4 Credits
This course examines the emergence of distinct forms of Jewish culture in the modern age that challenge or depart from traditional Jewish sources and authority. Included are an examination of Freud's psychology, Chagall's paintings and Woody Allen's films.
Attribute/Distribution: HU

HIST 201 Historical Perspectives 4 Credits
Methodologies and interpretations of Western historians from ancient times to the present.
Attribute/Distribution: HU

HIST 202 Historical Research 4 Credits
An introduction to historical interpretation, research design, and methodology. Students will research and write a paper on a historical topic using secondary and primary sources.
Attribute/Distribution: SS

HIST 213 (CLSS 213, REL 213) Ancient Roman Religion 4 Credits
Attribute/Distribution: SS
HIST 253 (ARCH 253, GS 253) Paris: Plan of Metropolis 3 Credits
The splendor of modern Paris is due in large part to bold, large scale modernization and changes in the city’s patterns during the 19th century. This course, which is part of the Lehigh in Paris summer program, will cover a century of change and focus on the major accomplishments of its visionary planners.
Attribute/Distribution: HU

HIST 300 Apprentice Teaching 3 Credits
Attribute/Distribution: ND

HIST 303 Topics in History 3-4 Credits
Intensive study in a particular area of history for advanced students.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU, SS

HIST 305 Public History 3-4 Credits
An examination of the public role of history in modern society, with focus on issues facing historians in museums, historical societies, archives, historic preservation, the federal government, and other organizations in the public sphere.
Attribute/Distribution: SS

HIST 306 Internship in Public History 2-4 Credits
Professionally supervised work in a museum, historical society, archive, or other historical agency. Written journal or report evaluating the experience is required. Permission of department chair required. May be repeated for a maximum of six credits. May not be counted toward the major requirement of 12 hours of courses numbered 303 or higher.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

HIST 308 Industrial America since 1945 3-4 Credits
Explores efforts to achieve both prosperity and security in the postwar era. Among the topics discussed: new technologies, consumer culture, disposable products, advertising, defense spending, technical assistance, and multinational corporations.
Attribute/Distribution: SS

HIST 311 (CLSS 311) Twins and Sins: The Rise of Rome 3,4 Credits
Rome from its origins to the mid-third century B.C. Emphasis on foundation legends, the power of the monarchy, and development of Roman political and religious institutions. Papers, quizzes, discussions.
Attribute/Distribution: SS

HIST 312 (CLSS 312) Decline and Fall of the Roman Empire 3-4 Credits
Political, social, and economic history of the Roman Empire, A.D. 117- A.D. 565. Romanization of the provinces, diffusion of Christianity, and special attention to transformation to medieval period. Includes readings in translation of primary sources.
Attribute/Distribution: SS

HIST 314 (CLSS 314) Age of Caesar and Christ 3,4 Credits
Roman history of the 1st century A.D. Political, cultural, and socioeconomic changes; special attention to the evolution of absolute power. Lectures, discussions, papers.
Attribute/Distribution: SS

HIST 315 (ES 315) American Environmental History 3-4 Credits
Relationship between Americans and their natural environment from the colonial period to the present: impact of European settlement, attitudes toward wilderness, role of technological development, rise of preservation and conservation movements, establishment of national parks, recent environmental protection legislation.
Attribute/Distribution: SS

HIST 319 Colonial America 3,4 Credits
Founding and growth of colonies in North America through 1763. Emphasis on motives for settlement, Native American-European relations, and the economic, social, and political development of the British West Indies, and mainland provinces.
Attribute/Distribution: SS

HIST 323 American Cultural History since 1900 3-4 Credits
Development of American popular culture and media: popular press, Hollywood, radio, television, sports, and advertising, and the meanings these institutions have created in 20th-century United States.
Attribute/Distribution: HU

HIST 325 (SOC 325, WGSS 325) History of Sexuality and the Family in the U.S. 3-4 Credits
Changing conceptions of sexuality and the role of women, men, and children in the family and society from the colonial to the post World War II era. Emphasis on the significance of socioeconomic class and cultural background. Topics include family structure, birth control, legal constraints, marriage, divorce, and prostitution.
Attribute/Distribution: SS

HIST 326 (SOC 326) Social Class in American History 3,4 Credits
Emphasis on the 19th and 20th century, focusing on: emergence of a white collar middle class; condition and treatment of the poor and growth of the welfare state; conditions of industrial workers, struggle to organize unions and their later decline; indicators of social status and exclusion among the rich; changing distribution of income and wealth over time and extent of social mobility.
Attribute/Distribution: SS

HIST 328 American Intellectual History since 1900 3,4 Credits
Social, literary, and political thought in the 20th century with emphasis on pragmatism and progressivism, maturation of American literary culture, ideas of American exceptionalism at midcentury, civil rights movement and feminism, neocentrism and recent trends.
Attribute/Distribution: HU

HIST 329 Global Africa: Aid, Volunteerism, NGO’s and International Studies 3,4 Credits
This course traces the origins of Aid to Africa, explores various volunteer activities, the role of NGOs, missionaries, philanthropist, medical practitioners, and global education in Africa. It explores the ways that cross-cultural interactions and exchanges between Africans and foreigners shaped African societies positively and negatively.
Attribute/Distribution: SS

HIST 330 (AAS 330) Africans and the Atlantic World 3-4 Credits
This course chronicles the history of Africans and the Atlantic world from the fifteenth century. It explores cross-cultural interactions and exchanges between Africans and Europeans and covers major themes including trade, religion, slavery, abolition, identity, colonialism, gender, the “Back-to-Africa” movements and impact of Africans on Atlantic world history.
Attribute/Distribution: HU

HIST 331 (AAS 331) United States and Africa 3,4 Credits
Reciprocal relationships between North America and the African continent from the slave trade in the 17th century to the 20th century-Afrocentric movement; impact of Americans on the shaping of modern Africa, Pan-African relations; influence of African Americans on US policies toward Africa.
Attribute/Distribution: SS

HIST 332 (AAS 332) Slavery and the American South 3-4 Credits
The emergence and demise of the “peculiar institution” of African American slavery in British North America and the Old South. African background; colonial beginnings; 19th century-slave community; the ruling race and proslavery ideology; the death of slavery and its aftermath; slavery and freedom in a comparative context.
Attribute/Distribution: SS

HIST 333 American City to 1900 3-4 Credits
Settlement and planning of colonial towns; role of towns in the revolutionary era; industrialization and relationship of economic and technological change to urbanization; establishment of urban institutions; Irish and German immigration; beginnings of suburbanization; downtowns and the creation of a civic culture. Required field trip.
Attribute/Distribution: SS

HIST 334 American City in the Twentieth Century 3,4 Credits
Immigration; Progressive “reforms,” urban planning and zoning; impact of automobile and suburbanization; Depression and New Deal; public housing and racial ghettoes; urban decline and “renewal.” Required field trip.
Attribute/Distribution: SS
HIST 336 Bethlehem and the Lehigh Valley 3-4 Credits
Local history focusing on Native American communities, Moravian settlement, natural resources, industrial firms, immigration and ethnic communities, organized labor, housing patterns and urban sprawl, high-tech industry, and tourism. Includes an analysis of techniques used in presenting these topics to the public.
Attribute/Distribution: SS

HIST 337 History and Community Memory 3,4 Credits
This public history course provides students with the opportunity to research the history of a community. The community focus of the course will change each year. We will explore what constitutes community, what historical memory means, and how history functions to build or divide a community. Students will use both documents and oral history methods, and practice will be a major component of this course.
Attribute/Distribution: SS

HIST 338 Techniques in Public History 2,4 Credits
Designed to introduce students to a variety of public history techniques. Instructor will focus on one of the following topics each term: archives, documentary film, exhibit design, historical editing, material culture, oral history.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

HIST 339 Managing Nonprofit Organizations 3-4 Credits
Addresses the effective management of nonprofit organizations, focusing on operations, administration, legal, marketing, finance and accounting issues in the nonprofit environment and emphasizing organizations such as museums and preservation organizations.
Attribute/Distribution: SS

HIST 340 (ASIA 340) Japanese Industrialization 3-4 Credits
Explores economic growth in the traditional economy, the rise of an entrepreneurial class, the importation of western technology, and the social, political and economic institutions which support industrial society since the early 19th century.
Attribute/Distribution: SS

HIST 348 (GS 348) The British Empire and the Modern World 3-4 Credits
Examines the empire and its central role in the process of globalization between the 16th and 20th centuries. Topics include exploration, state-building, war, multinational corporations, industry, international finance, missionaries, racism, and independence movements.

HIST 349 Revolutions in Modern European History 3,4 Credits
Explores the origins, meanings, and impact of European revolutions from a theoretical and comparative perspective. Focuses on the English (1642-1660), the French (1789-1799), and the Russian Revolution (1917-1929), and how they reflected and shaped new ideologies and policies related to human rights, economic development, popular sovereignty, nationalism, class and gender politics, and State and society relations.
Attribute/Distribution: SS

HIST 350 19th Century Paris and the Invention of Modernity 3,4 Credits
This course considers the dramatic destruction and rebuilding of the city of Paris in the decades after 1850 and how changes in the built environment shaped social relations, political authority and cultural expression. Topics include the politics of city planning and architectural design; the history of the engineering profession, technology and the building trades; reactions to crime, disease and prostitution in the modern city; the 1848 Revolution, Paris Commune and political theory; the origins of photography, Impressionist painting and cinema; and the creation of mass consumer society.
Attribute/Distribution: HU

HIST 351 "The Gangs of New York" 3,4 Credits
The course will use the Martin Scorsese film "The Gangs of New York" as a window to examine the social economic transformations of New York City in the middle of the nineteenth century. Emphasis will be on immigration, slum gangs and street violence, politics, the Draft Riot of 1863, and the Tweed Ring. A recurrent theme will be to compare the historical record with the film's depiction of those events. There will be a required evening showing of the film. Not available for pass/fail.
Attribute/Distribution: HU

HIST 352 History of Total War 3-4 Credits
This seminar examines the gradual rise of the idea of total war from the religious and civil wars of the 17th century, through the French Revolution, the Napoleonic War, the American Civil War, the two World Wars, the Cold War, and The War on Terror. We will examine the difference between war as political means and modern warfare as the very ends of politics, religion, and culture.
Attribute/Distribution: HU

HIST 354 History of Fascism 3-4 Credits
This course examines the historical and philosophical roots of European right-wing extremism, such as Italian and French Fascism, German Nazism, Austro-Hungarian Conservative Revolution, and other forms of radical nationalism.
Attribute/Distribution: HU

HIST 355 (GS 355) Destruction and Reconstruction of Europe, 1879-1950 3,4 Credits
An analysis of the decline and disintegration of European civilization through two world wars and Europe's reintegration in the era of the European Union. Emphasis on the development of the European state system, international conflict, and political thought.
Attribute/Distribution: SS

HIST 356 European Cultural History 3,4 Credits
Transformation of European culture from the 18th century to the present. The Enlightenment, cultural impact of the French and industrial revolutions, romanticism and ideologies of the 19th century, contemporary European thought.
Attribute/Distribution: HU

HIST 357 Early Modern Germany, 1500-1850 3-4 Credits
The emphasis will be on one or more of the following topics: the Reformation, the Thirty Years' War and its impact, absolutism, the rise of Prussia, the failure of German liberalism.
Attribute/Distribution: HU

HIST 358 Modern Germany, 1850 to Present 3,4 Credits
Focus on one or more of the following topics: nationalism and unification, the Second Empire, World War I, the Weimar republic, the Nazi movement, the Third Reich, and postwar Germany.
Attribute/Distribution: HU

HIST 360 American Legal History 3,4 Credits
The interrelationship between law and social development with emphasis on modern period. Founding of constitutional government and balance of power within the federal system, the problem of slavery, legal support and regulation of business, and the use of law in various reform and civil rights movements.
Attribute/Distribution: SS

HIST 367 Rise and Fall of the Old South 3,4 Credits
Explores the American South as a region from the era before European contact to the end of the Civil War. Emphasis will be placed on exploration and settlement, Native American-European relations, the pre-Revolutionary contest for empire, and the rise and development of the plantation complex and slavery.
Attribute/Distribution: SS

HIST 368 Seminar in Latin American History 3,4 Credits
Readings and individual investigation of selected topics.
Attribute/Distribution: SS

HIST 370 (ANTH 370) Historical Archeology 3-4 Credits
This course examines the unique nature of historical archaeology of postcontact America. Topics include reconstructing the past through the archaeological and historical record, exhibiting past culture, and capturing the real or imagined past. Course includes fieldwork and visits to famous archaeological sites.
Attribute/Distribution: SS

HIST 371 Independent Study 1-4 Credits
Directed readings in a topic or area of history not covered by current course offerings. For students of demonstrated ability and adequate preparation. Consent of department chair required.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND
HIST 372 Special Topics In History 1-3 Credits
Attribute/Distribution: ND

HIST 373 The French Revolution and Napoleon 3,4 Credits
Breakdown of Absolute Monarchy; rise of Enlightenment culture and decadence of the court; storming of the Bastille and creation of republican government; daily life and “Great Fear” in rural areas; invention of modern nationalism and Napoleonic military culture; role of women in political life; uses of mass propaganda, public festivals and transformation of the arts; political violence in the “Terror,” Napoleon’s imperial system and warfare with Europe; impact on revolutionary movements abroad and geopolitical realignment of the Atlantic World.
Attribute/Distribution: HU

HIST 389 Honors Project 1-6 Credits
Attribute/Distribution: ND

HIST 391 Honors Thesis in History 4 Credits
Opportunity for undergraduate majors in history to pursue an extended project for senior honors. By invitation and department permission only.
Attribute/Distribution: ND

HIST 392 Honors Thesis in History 2 Credits
Continuation of History 391 available under exceptional circumstances where additional credit for honors project is warranted. Department permission only.
Prerequisites: HIST 391

HIST 401 Historical Research 3 Credits
Techniques of research in history: training in the critical handling of documentary materials, in measuring the value of evidence, and in formal presentation of the results of research. Students will write an original research paper using primary materials. Required of all graduate students in history.

HIST 404 Readings in the History of the Atlantic World, 1500-1900 3 Credits
Core readings offering a comparative and integrative approach to studying the development of nations, economic systems and trade, colonization, and cultural encounters among the people of Europe, Africa, and the Americas.

HIST 405 Readings in the History of Industrial America 3 Credits
Core readings in the history of technology and the larger framework of intellectual, social, economic, and political history. Includes comparative studies in the history of industrializing Europe and Japan.

HIST 412 Readings in the American Revolutionary Era 3 Credits
Study in small groups under the guidance of a faculty member on the historiography of the era of the American Revolution.
Repeat Status: Course may be repeated.

HIST 421 Readings in Topics in the Atlantic World 3 Credits
Study in small groups under the guidance of a faculty member on a particular topic in the history of the Atlantic World.
Repeat Status: Course may be repeated.

HIST 426 Readings in Topics in American History 3 Credits
Study in small groups under the guidance of a faculty member on a particular topic in U.S. history across several centuries.
Repeat Status: Course may be repeated.

HIST 438 Techniques in Public History 2,3 Credits
Designed to introduce students to a variety of public history techniques. Instructor will focus on one of the following topics each term: archives, documentary film, exhibit design, historical editing, material culture, oral history.
Repeat Status: Course may be repeated.

HIST 440 Readings in Colonial American History 3 Credits
Study in small groups under the guidance of a faculty member of the literature of the 17th and 18th centuries.
Repeat Status: Course may be repeated.

HIST 441 Readings in Nineteenth Century American History 3 Credits
Study in small groups under the guidance of a faculty member of the literature of the 19th century.
Repeat Status: Course may be repeated.

HIST 442 Readings in Twentieth Century American History 3 Credits
Study in small groups under the guidance of a faculty member of the literature of the 20th century.
Repeat Status: Course may be repeated.

HIST 443 Readings in English History 3 Credits
Study in small groups, under the guidance of a faculty member, of the literature of a particular period, problem, or area of English history.
Repeat Status: Course may be repeated.

HIST 444 Readings in Latin American History 3 Credits
Study in small groups, under the guidance of a faculty member, of the literature of a particular period, problem, or area of Latin American history.
Repeat Status: Course may be repeated.

HIST 445 Readings in the History of Science 3 Credits
Study in small groups under the guidance of a faculty member on the history of science.
Repeat Status: Course may be repeated.

HIST 446 Readings in the History of Technology 3 Credits
Study in small groups under the guidance of a faculty member of the history of technology.
Repeat Status: Course may be repeated.

HIST 447 Readings in European History 3 Credits
Study in small groups, under the guidance of a faculty member, of the literature of a particular period, problem or aspect of European history.
Repeat Status: Course may be repeated.

HIST 448 (POLS 448) Land Use, Growth Management, and the Politics of Sprawl 3 Credits
Introduction to issues of Land Use Planning, Community, Growth Management, and Sprawl. Examination of history of urban development in America from earliest settlements to the auto suburbs; also such planning and development factors as comprehensive plans, zoning, and the influence of infrastructure on development. Concludes with an assessment of the revival of city centers, alternatives to sprawl, and comparisons to development patterns in other countries.

HIST 451 Readings in Topics in American History 3 Credits
Study in small groups under the guidance of a faculty member on a particular topic in U.S. history across several centuries. May be repeated for credit with permission of the instructor.
Repeat Status: Course may be repeated.

HIST 452 Research in American History 3 Credits
An intensive research seminar on a phase of American history.
Repeat Status: Course may be repeated.

HIST 453 Research in English History 3 Credits
An intensive research seminar on a phase of English history.
Repeat Status: Course may be repeated.

HIST 454 Research in Latin American History 3 Credits
An intensive research seminar on a phase of Latin American history.
Repeat Status: Course may be repeated.

HIST 455 Research in History of Science and Technology 3 Credits
An intensive research seminar on a phase or aspect of the history of science and technology.
Repeat Status: Course may be repeated.

HIST 457 Research in European History 3 Credits
An intensive research seminar on a phase of European history.
Repeat Status: Course may be repeated.

HIST 458 (WGSS 458) Readings in Gender History 3 Credits
Study in small groups under the guidance of a faculty member on the literature of an issue, period, country or culture within gender history.
Repeat Status: Course may be repeated.

HIST 471 Special Topics in History 1-3 Credits
Individual study under the direction of a faculty member of a topic in history.
Repeat Status: Course may be repeated.
IDEAS Seminar I
IDEAS Seminar II
IDEAS Seminar III
IDEAS Seminar IV
IDEAS Seminar V
IDEAS Seminar VI
IDEAS Seminar VII
IDEAS Seminar VIII
Calculus I
Calculus II
Calculus III
Linear Methods

IDEAS: Integrated Degree in Engineering, Arts and Sciences

Co-Directors: Bruce Thomas, Associate Professor, College of Arts and Sciences; William Best, Professor of Practice, P.C. Rossin College of Engineering and Applied Science

IDEAS is a four-year honors program resulting in an integrated Bachelor of Science (BS) Degree—jointly administered by the College of Arts and Sciences and the P.C. Rossin College of Engineering and Applied Science.

Interdisciplinary education in the arts and sciences and engineering is of significant value to students who will pursue a wide variety of careers. The complex challenges and problems confronting us in the 21st century dramatically underscore the importance of liberally educated and technologically sophisticated individuals whose habits of thought are thoroughly and comfortably interdisciplinary. Moreover, Lehigh is one of a small number of universities with the resources necessary to provide such an education. The students in this program will benefit from the integrated strategic leveraging of strengths across college boundaries.

This program cultivates a new breed of cross-disciplinary innovators. It provides an education that produces students well versed in dual focus areas, one in engineering and one in the arts, humanities, social sciences, mathematics or natural sciences. This educational environment also cultivates a multitude of thinking styles. It is renaissance thinking for the technological era.

Entry Requirements
1. Admitted students who have expressed an interest when applying will be considered for the IDEAS program. Only a limited number of students will be accepted. Students are invited to join this honors program by invitation.

2. To remain in the IDEAS program students must maintain a 3.25 GPA. At the end of the first year, a student with a GPA below 3.25 is given two semesters to achieve a GPA of 3.25; otherwise the student will be asked to transfer to a regular degree program.

3. Students may transfer into the IDEAS program at the end of their first semester or year if space becomes available. A formal application to the program must be filed and approval from the co-directors must be obtained.

4. Students who are interested in the IDEAS program should indicate that interest when applying.

The IDEAS program is designed so that students who transfer out of the program at the completion of the first year will still be able to complete an arts and sciences or engineering degree in four years. The four-year IDEAS program does not lead to an ABET accreted engineering degree. It is possible for students to complete a BS degree in IDEAS and an ABET accredited BS engineering degree (dual degrees) in one or two additional semesters.

PROGRAM COMPONENTS

The IDEAS degree requires a minimum of 136 credits in the program components shown below:

IDEAS core
IDEA 011 IDEAS Seminar I 2
IDEA 012 IDEAS Seminar II 2
IDEA 111 IDEAS Seminar III 2
IDEA 112 IDEAS Seminar IV 2
IDEA 150 IDEAS Seminar V 1
IDEA 151 IDEAS Seminar VI 1
IDEA 250 IDEAS Seminar VII 1
IDEA 251 IDEAS Seminar VIII 1

Math/Science core
MATH 021 Calculus I 4
MATH 022 Calculus II 4
MATH 023 Calculus III 4
MATH 205 Linear Methods 3
Curriculum Details

IDEAS: Integrated Degree in Engineering, Arts and Sciences

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IDEAS: Integrated Degree in Engineering, Arts and Sciences

2. Primary faculty advisors from appropriate disciplines provide quality
curriculum advising in each of the student's chosen concentrations.

3. Students who wish to earn an accredited engineering degree in one
additional year should inform their advisors.

4. Arts and Sciences Majors: A&S majors are divided into two different
categories:
   a. Interdisciplinary Theme: an approved interdisciplinary theme
      (e.g., STS) in arts and sciences that can be coordinated with an
      engineering concentration.
   b. Liberal Arts Discipline: a defined liberal arts discipline, e.g.,
      English. Students will follow the curriculum defined by the chosen
      concentration.
      A minimum of 36 credits is required in the liberal arts
centration. If students choose a concentration that requires
fewer than 36 credits, in addition to those taken as part of the
math/science core, the additional credits must be selected in the
CAS.
      Students may select mathematics or science as the liberal
arts discipline. However, the humanities and social science
distribution requirement (8 credits of humanities and 8 credits of
social science) must be satisfied using the 16 credit elective core
which is also be accepted for distribution in the RCEAS.

5. Interdisciplinary Theme: an approved interdisciplinary theme
(e.g., STS) in arts and sciences that can be coordinated with an
engineering concentration.

6. Liberal Arts Discipline: a defined liberal arts discipline, e.g.,
English. Students will follow the curriculum defined by the chosen
concentration.
   a. A minimum of 36 credits is required in the liberal arts
centration. If students choose a concentration that requires
fewer than 36 credits, in addition to those taken as part of the
math/science core, the additional credits must be selected in the
CAS.
   b. Students may select mathematics or science as the liberal
arts discipline. However, the humanities and social science
distribution requirement (8 credits of humanities and 8 credits of
social science) must be satisfied using the 16 credit elective core
which is also be accepted for distribution in the RCEAS.

7. Combining the Engineering and Liberal Arts Concentrations: You
may combine your particular interests in engineering and in arts and
sciences and customize your academic experience at Lehigh in one
of the following ways:
   a. by combining an Engineering Discipline with an Arts and
      Sciences Discipline (e.g., Electrical Engineering and International
      Relations)
   b. by combining an Engineering Discipline with an Arts and
      Sciences Theme (e.g., Chemical Engineering and STS)
   c. by combining an Engineering Theme with an Arts and Sciences
      Discipline (e.g., Product Liability and Chemistry)
   d. or custom design your own combination between Engineering
      and Arts and Sciences with your advisors

Academic Advising

1. The program is jointly administered by co-directors from the
College of Arts and Sciences and the P.C. Rossin College of
Engineering and Applied Science. They, after the first year, become
the secondary academic advisors for all IDEAS students.

2. Primary faculty advisors from appropriate disciplines provide quality
curriculum advising in each of the student’s chosen concentrations.
Careful advising is required because of the greater flexibility of
IDEAS.

3. Students who wish to earn an accredited engineering degree in one
additional year should inform their advisors.

For general information visit the IDEAS web site at: www.lehigh.edu/
IDEAS

Courses
IDEA 011 IDEAS Seminar I 2 Credits
The first year IDEAS core courses will emphasize intensive faculty
mentoring within a small seminar environment where students develop,
write, and present their individual interest areas and select their
concentrations.

CHM 030 Introduction to Chemical Principles 4
PHY 011 Introductory Physics I 5
& PHY 012 and Introductory Physics Laboratory I
Select three of the following: 12
BIOS 041 & BIOS 042 Biology Core I: Cellular and Molecular
and Biology Core I: Cellular and Molecular Lab
CHM 110 & CHM 111 Organic Chemistry I
and Organic Chemistry Laboratory I 4
EES gateway courses
PHY 021 & PHY 022 Introductory Physics II
and Introductory Physics Laboratory II
MATH 231 Probability and Statistics

Engineering concentration 3
Specified by the college 36

Arts & Science concentration 4
Specified by the college 36

A&S distribution requirements 5
As defined by the college 16

Total Credits 140

1. The writing intensive IDEAS core courses consist of a first year course in
which students develop their interests, two stepping-stone courses in the
middle years where their interests are integrated with others and a senior
thesis course in the fourth year.

2. The math/science core consists of 24 credits of required courses (see table
above) plus 12 elective credits drawn from: BIOS 041, BIOS 042; CHM 110,
CHM 111; EES gateway courses; PHY 021, PHY 022; MATH 231. All
students in the IDEAS program will automatically fulfill the CAS math and
natural science distribution requirements.

3. The engineering concentration consists of a selection of engineering courses
drawn either from one of the traditional engineering disciplines or from an
approved interdisciplinary engineering program. Some engineering programs
are designed to coordinate with specific arts and sciences themes.

4. The arts and sciences concentration is either a curriculum specific one or an
interdisciplinary one such as Science, Technology and Society (STS).

5. The elective block may be used for a minor, another program, or to fulfill CAS
distribution requirements.

Additional details on the main curricular components of the program
include:

1. IDEAS Core Courses: One each semester.
   a. These courses replace ENGR 005, ENGL 001 & ENGL 002, the
      CAS college seminar, and the CAS junior year writing intensive
      requirement. All IDEAS core courses are writing intensive.
   b. IDEA 011 and IDEA 012: the first year IDEA core courses will
      emphasize intensive faculty mentoring within a small seminar
      environment where students develop, write, and present their
      individual interest areas and select their concentrations.
   c. IDEA 111 and IDEA 112: a continuation of IDEA 011 & IDEA 112
      where interest areas are integrated into themes as individual
      concentrations are pursued.
   d. IDEA 150 and IDEA 151: the junior year courses have students
      working on team-based projects and preparing for the senior
      year thesis work.
   e. IDEA 250 and IDEA 251: the senior year honors thesis courses.

2. Math/Science Core: All students are required to fulfill the 36
credit math/science requirement, regardless of their choice of
concentrations.

3. Engineering Majors: Engineering majors are divided into two
different categories:
   a. Interdisciplinary Theme: an approved interdisciplinary theme
      in engineering that can be coordinated with a liberal arts
      concentration.
   b. Engineering Discipline: a defined engineering discipline, e.g.,
      mechanical engineering. Students will follow a concentration in
      the curriculum defined by the chosen area.
IDEA 012 IDEAS Seminar II 2 Credits
The first year IDEAS core courses will emphasize intensive faculty mentoring within a small seminar environment where students develop, write, and present their individual interest areas and select their concentrations.

IDEA 111 IDEAS Seminar III 2 Credits
A continuation of IDEAS 01 & IDEA 012 where interest areas are integrated into themes as individual concentrations are pursued.

IDEA 112 IDEAS Seminar IV 2 Credits
A continuation of IDEAS 011 & IDEA 012 where interest areas are integrated into themes as individual concentrations are pursued.

IDEA 150 IDEAS Seminar V 1 Credit
The junior year courses have students working on team-based projects and preparing for the senior year thesis work.

IDEA 151 IDEAS Seminar VI 1 Credit
The junior year courses have students working on team-based projects and preparing for the senior year thesis work.

IDEA 250 IDEAS Seminar VII 1 Credit
The senior year honors thesis courses.

IDEA 251 IDEAS Seminar VIII 1 Credit
The senior year honors thesis courses.

IDEA 300 Apprentice Teaching 1-4 Credits
Repeat Status: Course may be repeated.

Industrial and Systems Engineering

Mission Statement
To pursue excellence and national prominence in the areas of manufacturing, operations research, information technology and related fields of industrial and systems engineering through innovative teaching, distinguished research and scholarship, and active professional leadership. Building on its unique strength and national reputation in undergraduate education and industrial research, the department strives for leadership in educational innovation, multidisciplinary research, and industrial partnership. Our ultimate mission is to produce leaders who have learned to think critically and analytically, have the skills and techniques to comprehend and create new knowledge, and are willing to serve and inspire others.

Physical Facilities
The industrial and systems engineering department is located in the Harold S. Mohler Laboratory at 200 West Packer Avenue at the northwest corner of the Lehigh University Asa Packer campus. The Mohler Lab building contains the classrooms, laboratories, and faculty offices of the department. Labs in the Mohler Laboratory building include:

Computational Optimization Research @ Lehigh (COR@L) Lab. The COR@L lab consists of high performance computer workstations, each equipped with state-of-the-art commercial and noncommercial software for large-scale numerical optimization. COR@L is used for both research and instruction.

Enterprise Systems Center Laboratories. The ESC Laboratories contain a variety of computer systems and software in support of agility in Computer Integrated Manufacturing (CIM) and in engineering logistics and distribution problem solving, including: Computer Aided Design (CAD) and Engineering (CAE), discrete event simulation, linear and nonlinear optimization, Finite Element Analysis (FEA), facilities design, process design, process control, and analytics software, such as the SAS software suite.

Manufacturing Technology Laboratory (MTL). The MTL contains equipment for instruction and research in manufacturing processes, numerical control (NC), NC part programming, material handling and storage, industrial control systems, and metrology.

Automation and Robotics Laboratory. This lab is located in the MTL, it contains a variety of industrial robots and other automated systems to provide students with hands-on experience in the planning and use of this kind of equipment.

Work Systems Laboratory. This classroom/laboratory affords the opportunity for undergraduate students to analyze and plan human work activities for individual workstations and worker team situations. A full scale manual assembly line is available for study.

ISE Computer Laboratories. Considerable use is made of university computer facilities in ISE coursework. ISE/computing center PC laboratories containing 38 and 16 PCs, respectively, are located in the Mohler Laboratory building.

Professors. Keith M Gardiner, PhD (Manchester College); Theodore K. Ralphp, PhD (Cornell University); Katya Scheinberg, PhD (Columbia University); Aleksandr Stoyan, PhD (USSR Academy of Science); Robert H. Storer, PhD (Georgia Institute of Technology); Tamas Terlaky, PhD (Eotvos Lorand University); Emory W. Zimmers, Jr., PhD (Lehigh University)

Associate Professors. Frank E. Curtis, PhD (Northwestern University); Eugene Perevalov, PhD (University Texas, Austin); Louis J. Pilebani, Jr., PhD (Lehigh University); Lawrence V Snyder, PhD (Northwestern University); Gregory L. Tonkay, PhD (The Pennsylvania State University); George R. Wilson, PhD (The Pennsylvania State University)

Assistant Professors. Boris Defourny, PhD (Universite de Liege); Martin Takac, PhD (University of Edinburgh); Luis Zuluaga, PhD (Carnegie Mellon University)

Professors Of Practice. Ana Iulia Alexandrescu, MS (Lehigh University); Pasqualle (Pat) J. Costa, BS (The Pennsylvania State University); Derya Pamukcu, PhD (Louisiana State University); Janos D Pinter, PhD (Lomonosov Moscow State University)

Emeriti. John W. Adams, PhD (University of North Carolina); Mikell P. Groover, PhD (Lehigh University); John C Wigginton, PhD (Carnegie Mellon University); Szu-Yung D. Wu, PhD (The Pennsylvania State University)

B.S. in Industrial & Systems Engineering
Industrial & Systems Engineering (ISE) is concerned with the analysis, design, and implementation of integrated systems of people, materials, information, and equipment to accomplish useful work.

Career Opportunities
ISE graduates are sought by nearly all industrial corporations as well as government agencies and other service institutions. Major employers of our graduates include management consulting firms, manufacturing companies, banks, hospitals, railroads, the postal service, and transportation/logistics services. A typical career path of an industrial and systems engineer is to start in an entry level engineering position or as a technical analyst and to progress through various management positions in the firm or institution. Significant numbers of industrial and systems engineers ultimately become chief executive officers, chief operating officers, and chief technology officers in their respective organizations.

Production Systems Career Opportunities
The discipline of industrial & systems engineering is applicable in nearly all industries, whether the industry involves manufacturing of a product or delivery of a service. Job functions performed by ISEs include: systems analysis, cost estimation, capital equipment selection, engineering economy, facilities planning, production planning and scheduling, inventory control, quality control, project management, operations management, engineering management, as well as methods analysis and work measurement. Manufacturing systems engineering (MSE) is a specialty field associated with industrial and systems engineering that emphasizes functions and technologies such as process planning, plant layout design, manufacturing resource planning, production management, production line design, automation, robotics, flexible manufacturing systems, and computer integrated manufacturing.

Information Systems Career Opportunities
The Industrial & Systems Engineering program can also produce graduates who understand the complex facets of modern information systems, and the integration of these systems in industrial, service and financial organizations. The ISE student has an opportunity to focus on three important areas that are key to a successful information systems-oriented career. (1) Information Economics, (2) Quantitative Systems Analysis, and (3) Information Technology. These areas
Program Educational Objectives
The set of key, over-arching objectives of the Industrial and Systems Engineering program are to prepare our students, within the first several years of the beginning of their careers, to
1. meet the expectations of employers of industrial and systems engineers,
2. pursue advanced study, if desired,
3. be active leaders in their profession and/or community.
Specifically, these general objectives can be met by graduates that
1. recognize and analyze problems, design innovative solutions, and lead their implementation,
2. excel as industrial and systems engineering professionals who are able to operate effectively in a global, culturally diverse society,
3. communicate effectively using written, oral, and electronic media,
4. pursue life-long learning and professional growth as ethical and responsible members of society,
5. form, lead, and participate on multi-disciplinary teams that solve problems in engineering and business.
In each course in the Industrial & Systems Engineering program, a subset of the student outcomes, listed below, are pursued to prepare students to achieve the Industrial and Systems Engineering program’s stated objectives. This list of student outcomes articulated by the Engineering Accreditation Commission of ABET, http://www.abet.org, have been adopted by the program and are as follows:
a) An ability to apply knowledge of mathematics, science, and engineering
b) An ability to design and conduct experiments, as well as to analyze and interpret data
c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d) An ability to function on multidisciplinary teams
e) An ability to identify, formulate, and solve engineering problems
f) An understanding of professional and ethical responsibility
g) An ability to communicate effectively, both orally and in writing
h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i) A recognition of the need for, and an ability to engage in life-long learning
j) A knowledge of contemporary issues
k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

ISE Major Requirements
The ISE degree requires a minimum of 130 credit hours.
See freshman year requirements on the First Year Courses for Engineering Degrees under the heading of the P.C. Rossin College of Engineering and Applied Science (p. 61) An HSS course is assumed to be taken in the freshman year in the following semester course plans.

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ISE Technical Electives include all ISE 300-level courses (except ISE 305, which is required), ISE 254, ISE 275, the CSE 2XX (except CSE 241 and CSE 252) and 3XX courses, the BIS 3XX courses, MATH 230, and MATH 251. In addition, ISE 215 can be used as a technical elective. ISE 172 is selected as a core course. Conversely, if ISE 215 and ISE 216 are selected as core courses, ISE 172 can be used as a technical elective. ISE 256 can be used as a technical elective. Of the 4 ISE technical electives that must be taken, at least 2 must be ISE courses.

Engineering Elective Course Candidates: Courses of 3 or more credits with course prefixes of BIOE, CHE, CEE, CSE, ECE, MAT, ME, or MECH for which the prerequisites are met. The courses with these prefixes that are excluded from consideration are listed on the following ISE Dept. web page: https://ise.lehigh.edu/content/courses. The list of excluded courses for an individual ISE major is governed by the catalog in force when admitted to Lehigh. A provisional course offered with one of these prefixes requires departmental approval. Any course meeting these stipulations is denoted “Engineering Elective Requirement” in the ISE program description.

Special Opportunities for ISE students

The following special opportunities are available to majors in industrial and systems engineering:

Nontechnical Minor. Students may choose to pursue a nontechnical minor in an area of the humanities, social sciences, business, or entrepreneurship. Students in the business minor can satisfy the ACCT 108 requirement by completing BUS 127.

Technical Minor. Technical minors such as engineering leadership, materials science, environmental engineering, and computer science are available through departments in the P. C. Rossin College of Engineering and Applied Science. Consult the specific department for more details.

Graduate Courses. Seniors in industrial and systems engineering can petition to take up to two graduate ISE courses (400-level) to satisfy two of their four 300-level elective ISE course requirements. The petitioning senior must have a good scholastic record (generally above a 3.0 GPA).

Senior Thesis Option. Students interested in continuing on to graduate school or performing research are encouraged to take the senior thesis option. In this option a student takes ISE 255 as a free elective to develop the thesis proposal. ISE 255 serves as a prerequisite to ISE 256 in which the thesis is written. ISE 256 may be used as an ISE technical elective.

Technical Minor in Engineering Leadership

The minor in engineering leadership provides students with the background and practice to become more effective leaders. The minor consists of 5 courses that explore different aspects of leadership. Additional details can be found on the Engineering Leadership Minor website (http://lehigh.edu/~inleader/).

Technical Minor in Manufacturing Systems Engineering

The minor in manufacturing systems engineering provides a concentration of courses in the manufacturing and production areas. This minor is not available to students majoring in industrial and systems engineering. It requires 16 credits.

Graduate Programs

Several programs leading to master's and doctoral degrees are offered by the Department of Industrial and Systems Engineering. Each program has core requirements. Core requirements can be satisfied by previous coursework. In addition, ISE 215 can be used as a technical elective. All core course prerequisites must also be satisfied. Prerequisites may be satisfied by (1) previous course work, (2) completing the prerequisite course without graduate credit, or (3) passing the final examination of the prerequisite course with a grade of B or better.

A Ph.D. student is required to complete core requirements with grades of B or better before being formally admitted to Ph.D. candidacy.

Further information about graduate programs is contained in an ISE graduate brochure available from the department. In addition, documents are available from the department that describe the requirements of each graduate program, both at the ISE departmental office and on its web page.

Certificate in Quality Engineering

The quality engineering certificate program provides students with the background necessary to analyze, propose and implement changes to improve the quality of products or the efficiency of service systems. The certificate requires four courses from a specified list of courses. Details can be found on the ISE Department website and in the ISE office.

M.S. in Industrial and Systems Engineering

The minimum program for the master of science degree in Industrial and Systems Engineering consists of 24 credit hours of approved coursework and completion of a satisfactory thesis. Courses in other departments for which the student has the prerequisites may be integrated into this program. Subject to advisor approval, up to nine credit hours of 300 and 400-level courses from other departments may be included in the Industrial and Systems Engineering masters program. The other department courses usually include other engineering disciplines, mathematics, computer science, and business and economics.

M.Eng. in Industrial and Systems Engineering

This program of study is for those students whose interests are toward engineering design rather than research. The program provides opportunity to gain greater breadth of field through 30 credit hours of coursework (which can include a 3-credit-hour project).

M.S. in Management Science and Engineering

See separate catalog listing under Management Science and Engineering (p. 302).

M.Eng. in Management Science and Engineering

See separate catalog listing under Management Science and Engineering (p. 302).

M.S. in Manufacturing Systems Engineering

This is an interdisciplinary graduate program leading to the master of science degree in manufacturing systems engineering. See separate catalog listing under Manufacturing Systems Engineering (p. 302).

M.Eng. in Healthcare Systems Engineering

This concentrated degree program is designed to prepare graduate students for engineering and management careers in firms engaged in delivering healthcare and health related products and services. See separate catalog listing under Healthcare Systems Engineering (p. 253).

M.S. in Analytical Finance

The Masters in Analytical Finance program combines key concepts in financial theory, mathematical finance and engineering decision making to produce professionals instrumental in creating innovative solutions to real financial issues. See separate catalog listing under Interdisciplinary Graduate Study and Research (p. 71).

Ph.D. in Industrial and Systems Engineering

The graduate program leading to the doctor of philosophy (Ph.D.) degree is organized to meet the individual goals and interests of graduate students whose professional plans include teaching, consulting, or research in an educational, governmental, or industrial environment. Each doctoral candidate is required to demonstrate: (1) a high level of proficiency in one or more fields of industrial and systems engineering, and (2) a capacity for independent research through the preparation of a dissertation related to his/her field of specialization. This is to be facilitated as follows. During the first year of study, all Ph.D. students must complete the following core courses (or a substitute approved by the Ph.D. program coordinator): ISE 401, ISE 402, ISE 406, ISE 420, ISE 417, and ISE 418. During the second year all Ph.D. students must pass ISE 407. At the end of the first year, each student must declare one of the following three methodological fields of study:

- Optimization, or
- Applied Probability and Statistics
- Applied Operations Research

In addition to the core courses, two courses in each of the three fields of study are required. Following the first year, an initial review, consisting of faculty evaluation, classroom performance, and a qualifier exam, must be passed. A review by the student’s dissertation committee must be
passed in each subsequent year, along with the required dissertation proposal and general exam.

Courses

ISE 100 Industrial Employment 0 Credits
Usually following the junior year, students in the industrial engineering curriculum are required to do a minimum of eight weeks of practical work, preferably in the field they plan to follow after graduation. A report is required. Must have sophomore standing.

ISE 111 Engineering Probability 3 Credits
Prerequisites: MATH 022 or MATH 096 or MATH 032 or MATH 052

ISE 112 Computer Graphics 1 Credit
Introduction to interactive graphics and construction of multiview representations in two and three dimensional space. Applications in industrial engineering. Must have sophomore standing in industrial engineering.
Prerequisites: ENGR 001

ISE 121 Applied Engineering Statistics 3 Credits
The application of statistical techniques to solve industrial problems. Regression and correlation, analysis of variance, quality control, and reliability.
Prerequisites: ISE 111 or MATH 231 or IE 111

ISE 131 Work Systems and Operations Management 3 Credits
Workmachine systems, work flow, assembly lines, logistics and service operations, and project management. Operations analysis, methods engineering, work measurement, lean production, and six sigma. Workplace ergonomics, plant layout design, and work management.
Prerequisites: ISE 111 or MATH 231 or IE 111
Can be taken Concurrently: ISE 111, MATH 231, IE 111

ISE 132 Work Systems Laboratory 1 Credit
Laboratory exercises, case studies, and projects in operations analysis, methods engineering, work measurement, and plant layout design.
Prerequisites: ISE 131 or IE 131
Can be taken Concurrently: ISE 131, IE 131

ISE 168 (EMC 168) Production Analysis 3 Credits
A course for students not majoring in industrial engineering. Engineering economy: application of quantitative methods to facilities analysis and planning, operations planning and control, work measurement, and scheduling.
Prerequisites: MATH 021 or MATH 031 or MATH 051 or MATH 075 or MATH 076

ISE 172 Algorithms in Systems Engineering 4 Credits
Use of computers to solve problems arising in systems engineering. Design and implementation of algorithms for systems modeling, systems design, systems analysis, and systems optimization. Computer systems, basic data structures, the design and implementation of efficient algorithms, and an application of algorithms to the design and optimization of complex systems such as those arising in transportation, telecommunications, and manufacturing. Weekly laboratory with exercises and projects.
Prerequisites: CSE 017 or CSE 018

ISE 215 Fundamentals of Modern Manufacturing 3 Credits
Manufacturing processes and systems. Metal machining and forming, polymer shape processes, powder metallurgy, assembly and electronics manufacturing. Introduction to automation, numerical control, and industrial robots.
Prerequisites: MAT 033

ISE 216 Manufacturing Laboratory 1 Credit
Laboratory exercises and experiments in manufacturing processes and systems.
Prerequisites: ISE 215 or IE 215
Can be taken Concurrently: ISE 215, IE 215

ISE 224 Information Systems Analysis and Design 3 Credits
An introduction to the technological as well as methodological aspects of computer information systems. Content of the course stresses basic knowledge in database systems. Database design and evaluation, query languages and software implementation. Students that take CSE 241 cannot receive credit for this course.

ISE 226 Engineering Economy and Decision Analysis 3 Credits
Economic analysis of engineering projects; interest rate factors, methods of evaluation, depreciation, replacement, breakeven analysis, aftertax analysis. Decision-making under certainty and risk.
Prerequisites: ISE 111 or MATH 231 or IE 111
Can be taken Concurrently: ISE 111, MATH 231, IE 111

ISE 230 Introduction to Stochastic Models in Operations Research 3 Credits
Formulating, analyzing, and solving mathematical models of real-world problems in systems exhibiting stochastic (random) behavior. Discrete and continuous Markov chains, queuing theory, inventory control, Markov decision process. Applications typically include traffic flow, call centers, communication networks, service systems, and supply chains.
Prerequisites: ISE 111 or IE 111 or MATH 231

ISE 240 Introduction to Deterministic Optimization Models in Operations Research 3 Credits
Formulating, analyzing, and solving mathematical models of real-world problems in systems design and operations. A focus on deterministic optimization models having parameters that are known and fixed. Algorithmic approaches for linear, integer, and nonlinear problems. Solving optimization problems utilizing specialized software.
Prerequisites: MATH 205

ISE 251 Production and Inventory Control 3 Credits
Techniques used in the planning and control of production and inventory systems. Forecasting, inventory models, operations planning, and scheduling.
Prerequisites: (ISE 121 or IE 121) and ((ISE 220 or IE 220), ) or ((ISE 230 or IE 230) and (ISE 240 or IE 240), )

ISE 254 Senior Project 3 Credits
The use of industrial and systems engineering techniques to solve a major problem in either a manufacturing or service environment. Problems are sufficiently broad to require the design of a system. Human factors are considered in system design. Laboratory.

ISE 255 Senior Thesis I 3 Credits
In-depth study of a research topic in industrial and systems engineering supervised by an Industrial and Systems Engineering department faculty member. Requires completion of a formal research proposal and a public presentation of the proposal at the end of the semester.

ISE 256 Senior Thesis II 3 Credits
Continued in-depth study of a research topic in industrial and systems engineering supervised by an Industrial and Systems Engineering department faculty member. Requires a formal thesis and public presentation of the results.
Prerequisites: ISE 255

ISE 275 Fundamentals of Web Applications 3 Credits
Introduction to web technologies required to support the development of client side and server side components of Internet based applications. Students will be exposed to the problems of design, implementation, and management by way of assigned readings, class discussion, and project implementation. Term project.
Prerequisites: ISE 224 or IE 224 or CSE 241
Can be taken Concurrently: ISE 224, IE 224, CSE 241

ISE 281 Leadership Project 1-3 Credits
Application of leadership principles through team projects with industry. Written report required.
Repeat Status: Course may be repeated.
Prerequisites: ISE 382 or IE 382
Prerequisites: ISE 121 or IE 121

ISE 316 Optimization Models and Applications 3 Credits
Modeling and analysis of operations research problems using techniques from mathematical programming. Linear programming, integer programming, multicriteria optimization, stochastic programming, and nonlinear programming using an algebraic modeling language.
Prerequisites: ISE 220 or IE 220 or ISE 240 or IE 240 or ISE 221 or IE 221 or ISE 222 or IE 222

ISE 319 Facilities Planning and Material Handling 3 Credits
Facilities planning including plant layout design and facility location. Material handling analysis including transport systems, storage systems, and automatic identification and data capture.
Prerequisites: ISE 131 or IE 131

ISE 320 3 Credits
Models and algorithms for reducing costs and improving customer service in service industries such as transportation, health care, retail, hospitality, education, and emergency services. Topics include facility location, resource allocation, inventory management, workforce planning, queuing analysis, call center management, and vehicle routing, with an emphasis on their applications in service industries. This course is an undergraduate version of ISE 420. Credit will not be given for both ISE 320 and ISE 420.
Prerequisites: ISE 230 and ISE 240
Can be taken Concurrently: ISE 230

ISE 321 Independent Study in Industrial & Systems Engineering 1-3 Credits
Experimental projects in selected fields of industrial engineering, approved by the instructor. A written report is required. Department permission required. 
Repeat Status: Course may be repeated.

ISE 324 Industrial Automation and Robotics 3 Credits
Introduction to robotics technology and applications. Robot anatomy, controls, sensors, programming, work cell design, part handling, welding, and assembly. Laboratory exercises. Must have senior standing.
Prerequisites: (MECH 003 or MECH 195 and MATH 205)

ISE 328 Engineering Statistics 3 Credits
Random variables, probability functions, expected values, statistical inference, hypothesis testing, regression and correlation, analysis of variance, introduction to design of experiments, and fundamentals of quality control. This course cannot be taken by IE undergraduates.
Prerequisites: MATH 023 or MATH 096

ISE 332 Product Quality 3 Credits
Introduction to engineering methods for monitoring, control, and improvement of quality. Statistical models of quality measurements, statistical process control, acceptance sampling, and quality management principles. Some laboratory exercises.
Prerequisites: ISE 121 or IE 121

ISE 334 Organizational Planning and Control 3 Credits
Design of organization and procedures for managing functions of industrial engineering. Analysis and design of resources planning and control, including introduction of change in manmachine systems; manpower management and wage administration. Must have junior standing.

ISE 339 Stochastic Models and Applications 3 Credits
Introduction to stochastic process modeling and analysis techniques and applications. Generalizations of the Poisson process; renewal theory and applications to inventory theory, queuing, and reliability; Brownian motion and stationary processes.
Prerequisites: ISE 220 or IE 220 or ISE 230 or IE 220

ISE 340 Production Engineering 3 Credits
Prerequisites: ISE 215 or IE 215

ISE 341 Data Communication Systems Analysis and Design 3 Credits
An introduction to the hardware as well as performance evaluation of data communication networks. Emphasis on data transmission, encoding, data link control, communication networking techniques, and queuing/simulation analysis of network performance.
Prerequisites: (ISE 230 or IE 230) and (ISE 240 or IE 240)
ISE 344 (MAT 344, ME 344) Metal Machining Analysis 3 Credits
Intensive study of metal cutting emphasizing forces, energy, temperature, tool materials, tool life, and surface integrity. Abrasive processes. Laboratory and project work.
Prerequisites: ISE 215 or IE 215 or ME 240 or MAT 206

ISE 345 Manufacturing Information Systems 3 Credits
A study of contemporary Information Technology solutions used to support the manufacturing function from product concept and design through production planning, manufacture, and delivery. Emphasis will be placed on information exchange protocol standards used to improve the overall integration of manufacturing systems.

ISE 347 Financial Optimization 3 Credits
Making optimal financial decisions under uncertainty. Financial topics include asset/liability management, option pricing and hedging, risk management and portfolio optimization. Optimization techniques covered include linear and nonlinear optimization, discrete optimization, dynamic programming and stochastic optimization. Emphasis on use of modeling languages and solvers in financial applications. Requires basic knowledge of linear optimization and probability. Credit will not be given for both IE 347 and IE 447.
Prerequisites: ISE 316 or IE 316

ISE 355 Optimization Algorithms and Software 3 Credits
Basic concepts of large families of optimization algorithms for both continuous and discrete optimization problems. Pros and cons of the various algorithms when applied to specific types of problems; information needed; whether local or global optimality can be expected. Participants practice with corresponding software tools to gain hands-on experience. Credit will not be given for both IE 355 and IE 455.
Prerequisites: ISE 220 or IE 220 or ISE 240 or IE 240

ISE 356 Introduction to Systems Engineering and Decision Analysis 3 Credits
Systems Engineering modeling techniques. Architectures for large scale systems design. Includes physical, functional, and operational architectures. Requirements engineering, interface and integration issues, graphical modeling techniques. Additional topics may include: decision analysis techniques for systems, uncertainty analysis, utility functions, multiattribute utility functions and analysis, indifference diagrams, risk preference, Analytical Hierarchy and Node Processes in decision making.
Prerequisites: (ISE 220 or IE 220) or ((ISE 230 or IE 230) and (ISE 240 or IE 240),)

ISE 357 Introduction to Industrial Engineering Mathematics 3 Credits
A review of linear algebra and an introduction to quantitative analysis, manipulation of matrices, core concepts associated with systems of linear equations and linear optimization, algebraic and geometric models. The credits for this course cannot be applied to any undergraduate degree offered by the Industrial & Systems Engineering Department. Consent of department required.

ISE 358 (ECO 358) Game Theory 3 Credits
A mathematical analysis of how people interact in strategic situations. Applications include strategic pricing, negotiations, voting, contracts and economic incentives, and environmental issues.
Prerequisites: (MATH 021 or MATH 031 or MATH 051 or MATH 076) and (ECO 105 or ECO 146 or ECO 146)
ISE 362 (MSE 362) Logistics and Supply Chain Management 3 Credits
Modeling and analysis of supply chain design, operations, and management. Analytical framework for logistics and supply chains, demand and supply planning, inventory control and warehouse management, transportation, logistics network design, supply chain coordination, and financial factors. Students complete case studies and a comprehensive final project.
Prerequisites: (ISE 220 or IE 220) and (ISE 251 or IE 251), or (ISE 230 or IE 230) and (ISE 240 or IE 240).

ISE 365 Applied Data Mining 3 Credits
Introduction to the data mining process including business problem understanding, data understanding and preparation, modeling and evaluation, and model deployment. Emphasis on hands-on data preparation and modeling using techniques from statistics, artificial intelligence, such as regression, decision trees, neural networks, and clustering. A number of application areas are explored. This course is an undergraduate version of IE 465. Credit will not be given for both IE 365 and IE 465.
Prerequisites: ISE 121 or IE 121 or ISE 328 or IE 328

ISE 367 Mining of Large Datasets 3 Credits
Explores how large datasets are extracted and analyzed. Discusses suitable algorithms for high dimensional data, graphs, and machine learning. Introduces the use of modern distributed programming models for large-scale data processing. An undergraduate version of ISE 467, with assignments better geared towards undergraduate students. Credit will not be given for both ISE 367 and ISE 467.
Prerequisites: ISE 111 or CSE 002

ISE 372 Systems Engineering Design 3 Credits
Analysis, design, and implementation of solutions to problems in manufacturing and service sectors using information technology. Emphasis on problem identification and the evaluation of proposed solutions and implementations. Term Project.
Prerequisites: (ISE 220 or IE 220) or ((ISE 230 or IE 230) and (ISE 240 or IE 240)), or (ISE 275 or IE 275)

ISE 382 Leadership Development 3 Credits
Exploration and critical analysis of theories, principles, and processes of effective leadership. Managing diverse teams, communication, and ethics associated with leadership. Application of knowledge to personal and professional life through projects and team assignments.

ISE 401 Convex Analysis 3 Credits
Theory and applications of convex analysis, particularly as it relates to convex optimization and duality theory. Content of the course emphasizes rigorous mathematical analysis as well as geometric and visually intuitive viewpoints of convex objects and optimization problems.

ISE 402 Applied Models in Operations Research 3 Credits
Applied models in operations research, including applications in supply chain, energy, health care, and other fields. Seminal models, theorems, algorithms, and experience in translating practical problems into mathematical ones.
Prerequisites: ISE 406 and ISE 429

ISE 404 Simulation 3 Credits
Applications of discrete and continuous simulation techniques in modeling industrial systems. Simulation using a high level simulation language. Design of simulation experiments. This course is a version of IE 305 for graduate students, with research projects and advanced assignments.
Prerequisites: ISE 121 or IE 121 or ISE 328 or IE 121

ISE 406 Special Topics in Industrial & Systems Engineering 3 Credits
An intensive study of some field of industrial & systems engineering.

ISE 407 Computational Methods in Optimization 3 Credits
Introduction to a wide range of topics related to computational methods encountered in the implementation of optimization algorithms. Lectures focus primarily on theoretical aspects of computation, but with the goal of understanding computation in practice. Assigned exercises focus on employing computational methods in real-world applications. Topical coverage will include data structures, design and analysis of algorithms (sequential and parallel), programming paradigms and languages, development tools and environments, numerical analysis, and matrix computations.

ISE 408 Management of Information Systems 3 Credits
Philosophies and methods for systematic planning, development, and implementation of management information systems. Concepts of information resource management, and strategic and longrange planning of information systems and services.

ISE 409 Time Series Analysis 3 Credits
Theory and applications of an approach to process modeling, analysis, prediction, and control based on an ordered sequence of observed data. Single or multiple time series are used to obtain scalar or vector difference/differential equations describing a variety of physical and economic systems.

ISE 410 Design of Experiments 3 Credits
Experimental procedures for sorting out important causal variables, finding optimum conditions, continuously improving processes, and trouble shooting. Applications to laboratory, pilot plant and factory. Must have some statistical background and experimentation in prospect.
Prerequisites: ISE 121 or IE 121 or ISE 328 or IE 328

ISE 411 Networks and Graphs 3 Credits
This course examines the theory and applications of networks and graphs. Content of the courses stresses on the modeling, analysis and computational issues of network and graph algorithms. Complexity theory, trees and arborescences, path algorithms, network flows, matching and assignment, primaldual algorithms, Eulerian and Hamiltonian walks and various applications of network models.
Prerequisites: ISE 406 or IE 406

ISE 412 Quantitative Models of Supply Chain Management 3 Credits
Analytical models for logistics and supply chain coordination. Modeling, analysis, and computational issues of production, transportation, and other planning and decision models. Logistics network configuration, risk pooling, stochastic decision-making, information propagation, supply chain contracting, and electronic commerce implication.
Prerequisites: (ISE 316 or IE 316) and (ISE 339 or IE 339)

ISE 413 Asset Valuation 3 Credits
Valuation of projects and companies by discounted cash flow models. Mechanics of present value calculations. Understanding financial statements. The determinants of equity risk, expected return, earnings, reinvestment needs and growth. Role of debt and taxation. Valuing start-up companies, distressed companies, cyclical companies, firms with exclusive rights.

ISE 414 Heuristic Methods in Combinatorial Optimization 3 Credits
Heuristic methods for solving combinatorial and discrete optimization problems such as routing, scheduling, partitioning and layout. Introduction to NPcompleteness theory, exact and inexact methods, performance analysis, fast and greedy heuristics, Lagrangean heuristics, and various search techniques including simulated annealing, genetic algorithms, Tabu search and iterative constructive heuristics.

ISE 416 Dynamic Programming 3 Credits
This course is concerned with the dynamic programming approach to sequential decision making under uncertainty, exact solution algorithms, and approximate methods adapted to large-scale problems. Value iteration, policy iteration and lambda-policy iteration are introduced and analyzed using fixed-point theory. The linear optimization approach to dynamic programming is introduced. Special policy structures are studied. Algorithms based on sampling and on the use of linear approximation architectures are covered.
Prerequisites: ISE 316 or IE 316
ISE 417 Nonlinear Optimization 3 Credits
Advanced topics in mathematical optimization with emphasis on modeling and analysis of nonlinear problems. Convex analysis, unconstrained and constrained optimization, duality theory, Lagrangian relaxation, and methods for solving nonlinear optimization problems, including descent methods, Newton methods, conjugate gradient methods, and penalty and barrier methods. Prerequisites: ISE 406 or IE 406

ISE 418 Discrete Optimization 3 Credits
Advanced topics in mathematical optimization with emphasis on modeling and analysis of optimization problems with integer variables. Polyhedral theory, theory of valid inequalities, duality and relaxation, computational complexity, and methods for solving discrete optimization problems, such as branch and bound.

ISE 419 Planning and Scheduling in Manufacturing and Services 3 Credits
Models for the planning and scheduling of systems that produce goods or services. Resource allocation techniques utilizing static and dynamic scheduling methods and algorithms. Application areas include manufacturing and assembly systems, transportation system timetabling, project management, supply chains, and workforce scheduling.

ISE 420 Service Systems Engineering 3 Credits
Models and algorithms for reducing costs and improving customer service in service industries such as transportation, health care, retail, hospitality, education, and emergency services. Topics include facility location, resource allocation, inventory management, workforce planning, queuing analysis, call center management, and vehicle routing, with an emphasis on their applications in service industries. This course is a graduate version of ISE 320 featuring some advanced assignments. Credit will not be given for both ISE 320 and ISE 420.

ISE 422 Measurement and Inspection Systems 3 Credits
Study of measurement instruments and sensors for manufactured products. Metrology standards, performance characteristics of measuring devices, calibration, error analysis, and gaging. Mechanical, optical, and other techniques. Online monitoring and control for product quality, and sensor integration and fusion.

ISE 424 Robotic Systems and Applications 3 Credits
Detailed analysis for robotic systems in manufacturing and service industries. Task planning and decomposition, motion trajectory analysis, conveyor tracking, error detection and recovery, end effector design, and systems integration.

ISE 425 Advanced Inventory Theory 3 Credits
Advanced analytical, algorithmic, and heuristic methods for optimizing and managing inventory systems. Economic order quantity model and extensions; power-of-two policies; base-stock and other policies for stochastic systems; the Clark-Scarf model; assembly and distribution systems; proofs of policy optimality.

ISE 426 Optimization Models and Applications 3 Credits
Modeling and analysis of operations research problems using techniques form mathematical programming. Linear programming, integer programming, multicriteria optimization, stochastic programming and nonlinear programming using an algebraic modeling language. This course is a version of IE 316 for graduate students, with research projects and advanced assignments. Closed to students who have taken IE 316. Prerequisites: ISE 240 or IE 240

ISE 429 Stochastic Models and Applications 3 Credits
Introduction to stochastic process modeling and analysis techniques and applications. Generalization of the Poisson process; renewal theory, queueing, and reliability; Brownian motion and stationary processes. This course is a version of IE 39 for graduate students, with research projects and advanced assignments. Closed to students who have taken IE 339. Prerequisites: ISE 220 or IE 220 or ISE 230 or IE 230

ISE 430 Management Science Project 3 Credits
Analysis of a management problem and design of its solution incorporating management science techniques. An individual written report is required. Recommended to be taken in the last semester of the program.

ISE 431 Operations Research Special Topics 3 Credits
Extensive study of selected topics in techniques and models of operations research.

ISE 432 Manufacturing Engineering Special Topics 3 Credits
Extensive study of selected topics in the research and development of manufacturing engineering techniques.

ISE 437 Advanced Database Analysis and Design 3 Credits
Intensive treatment of design and application of modern database technology, including information modeling and logical design of databases. Emphasis on applications to the manufacturing environment. Prerequisites: ISE 224 or IE 224

ISE 438 Advanced Data Communication Systems Analysis and Design 3 Credits

ISE 439 Queueing Systems 3 Credits
Queueing theory and analysis of manufacturing, distribution, telecommunications, and other systems subject to congestion. Design and analysis of queuing networks; approximation methods such as mean value analysis, uniformization, fluid and diffusion interpretations; numerical solution approaches.

ISE 441 Financial Engineering Projects 3 Credits
Analysis, design and implementation of solutions to problems in financial services using information technology, mathematical modeling, and other financial engineering techniques. Emphasis on realworld problem solving, problem definition, implementation and solution evaluation.

ISE 442 Manufacturing Management 3 Credits
Study of factors affecting the development of a manufacturing management philosophy; decision-making process in areas of organization, planning, and control of manufacturing. The principles and techniques of TQM, Deming and others; metrics, costs, benchmarking, quality circles, and continuous improvement. Influence of the social, technical, and economic environment upon manufacturing management decisions. Case studies.

ISE 443 (MSE 443) Automation and Production Systems 3 Credits
Principles and analysis of manual and automated production systems for discrete parts and products. Cellular manufacturing, flexible manufacturing systems, transfer lines, manual and automated assembly systems, and quality control systems. Prerequisites: ISE 215 or IE 215

ISE 444 Optimization Methods in Machine Learning 3 Credits
Machine learning models and advanced optimization tools that are used to apply these models in practice. Machine learning paradigm, machine learning models, convex optimization models, basic and advanced methods for modern convex optimization. Prerequisites: ISE 406 or IE 406

ISE 445 Assembly Processes and Systems 3 Credits

ISE 446 Discrete Event Dynamic Systems 3 Credits
Modeling of Discrete Event Dynamic systems (DEDS) particularly as applied to industrial systems. Modeling procedures with focus on Petri Nets. Hierarchical Petri Net modeling, performance analysis, behavioral and structural properties, and various synthesis and analytical techniques. Relationships to state space concepts, simulation, and finite state automata are introduced. Emphasis on use of such nets for the control of industrial systems. Consent of instructor required.
ISE 447 Financial Optimization 3 Credits
Making optimal financial decisions under uncertainty. Financial topics include asset/liability management, option pricing and hedging, risk management, and portfolio optimization. Optimization techniques covered include linear and nonlinear programming, integer programming, dynamic programming, and stochastic programming. Emphasis on use of modeling languages and solvers in financial applications. Requires basic knowledge of linear programming and probability. This course is a version of IE 347 for graduate students and requires advanced assignments. Credit will not be given for both IE 347 and IE 447.
Prerequisites: ISE 426 or IE 426 or ISE 316 or IE 316

ISE 448 Industrial Control Systems for Manufacturing 3 Credits
Techniques used to control manufacturing systems: numerical control, digital control, programmable logic controllers, and sensors.

ISE 449 Advanced Computer Aided Manufacturing 3 Credits
Numerical control in manufacturing; CAD/CAM systems; computer monitoring and control of manufacturing operations; adaptive control of manufacturing operations. Manufacturing resource planning, computer aided process planning, and shop floor control.

ISE 451 Intelligent Manufacturing Systems 1-3 Credits
Informational and control structures, architectures, and analysis techniques for autonomous and semiautonomous manufacturing systems. System architectures and techniques, knowledge based systems in production, and techniques based on fuzzy systems and neural networks. Applications in manufacturing systems control, process planning, and design and management problems in newly developing manufacturing and production systems. Consent of instructor required.

ISE 455 Optimization Algorithms and Software 3 Credits
Basic concepts of large families of optimization algorithms for both continuous and discrete optimization problems. Pros and cons of the various algorithms when applied to specific types of problems; information needed; whether local or global optimality can be expected. Participants practice with corresponding software tools to gain hands-on experience. This course is a version of IE 355 for graduate students and requires advanced assignments. Credit will not be given for both IE 355 and IE 455.
Prerequisites: ISE 220 or IE 220 or ISE 240 or IE 240

ISE 456 3 Credits
A Conic Optimization (CO) problem is an optimization problem where the objective and constraints are linear, and the decision variables are required to belong to a closed convex cone. CO has an elegant theory, and allows us to formulate a very rich class of optimization problems that require to belong to a closed convex cone. A number of application areas are explored. This course is a graduate version of IE 365 possessing some advanced assignments. Credit will not be given for both IE 365 and IE 465.
Prerequisites: ISE 121 or IE 121 or ISE 328 or IE 328

ISE 465 Applied Data Mining 3 Credits
Introduction to the data mining process including business problem understanding, data understanding and preparation, modeling and evaluation, and model deployment. Emphasis on hands-on data preparation and modeling using techniques from statistics, artificial intelligence, such as regression, decision trees, neural networks, and clustering. A number of application areas are explored. This course is a graduate version of IE 365 possessing some advanced assignments. Credit will not be given for both IE 365 and IE 465.

ISE 467 Mining of Large Datasets 3 Credits
Explores how large datasets are extracted and analyzed. Discusses suitable algorithms for high dimensional data, graphs, and machine learning. Introduces the use of modern distributed programming models for large-scale data processing. A graduate version of ISE 367 that will require graduate students to do more rigorous assignments. Credit will not be given for both ISE 367 and ISE 467. Students are expected to have basic knowledge of programming and probability.

ISE 470 Introduction to Healthcare Systems 3 Credits

ISE 471 Quality and Process Improvement in Healthcare 3 Credits
The dimensions of Healthcare quality and their definitions, quality metrics, accreditation and other benchmarking and evaluation methods. Change management, project planning and team management. Continuous improvement tools including “lean”, “six-sigma”, and “TQM”.

ISE 472 Financial Management in Healthcare 3 Credits
Engineering economics in Healthcare; value metrics (net present value, return on investment, etc.), cost-benefit analysis, capital projects and improvements. Accounting methods in Healthcare systems. Reimbursement methods, organizations, and alternatives. Financial strategy, planning, pricing and capital formation in “for”, and “not for” profit settings.

ISE 473 Information Technology in Healthcare 3 Credits
Introduction to information systems in Healthcare. Components of the system; electronic medical records, patient monitoring and data collection (clinical information systems), ancillaries (lab, pharmacy, radiology), imaging and digital technology, financial, inventory and management information systems. Enterprise systems in Healthcare, IT driven cost, efficiency and treatment quality metrics. Data warehousing, sharing, mining, protection and privacy issues.

ISE 474 Healthcare Systems Engineering Capstone Project 3 Credits
A three credit hour “capstone” project to be completed in collaboration with industry partners and under the supervision of faculty. Students will work in small groups on projects in the Healthcare industry. The Professor of Practice is the general advisor for the capstone project course.

ISE 475 Healthcare Systems Project 1-3 Credits
Intensive study of an area of healthcare systems engineering with emphasis upon design and application. Written report is required.

ISE 482 Leadership Development 3 Credits
Exploration and critical analysis of theories, principles, and processes of effective leadership. Managing diverse teams, communication, and ethics associated with leadership. Application of knowledge to personal and professional life through projects and team assignments. Credit will not be given to a student for both ISE 382 and ISE 482.

ISE 490 Thesis 1-6 Credits
ISE 499 Dissertation 1-15 Credits

Initial Teacher Preparation
Lehigh does not offer an undergraduate major in education. Instead, through the College of Education, we offer a 5-year program in which undergraduates are permitted to take selected courses while completing their undergraduate degrees in a content area. Following graduation, in
an additional year, these students complete the remaining coursework toward teacher certification and a master's degree.

Lehigh undergraduates who did not participate in our 5-year program, as well as students who have graduated from other institutions with at least a bachelor's degree, may also earn their teacher certification, either alone or as part of an appropriate master's degree.

Students seeking initial teacher certification may earn a Master of Education in Elementary Education with PreK-4 Teacher Certification or a Master of Education (or a Master of Arts) in Secondary Education with Teacher Certification. Students wishing to earn dual certification in both general education and special education may earn their master's degree and acquire such dual certification by completing additional courses in Special Education. If these students wish, they may also earn a second master's degree. Applicable Special Education master's degrees include the M.Ed. in Special Education at either the elementary level (PreK-8) or secondary level (7-12).

Courses toward initial teacher certification are taught by faculty from the Special Education program and the Teaching, Learning, and Technology program. Our preparation programs highlight research-based, inquiry-oriented, and technology-enabled strategies to reach all learners. We emphasize collaborative and equitable approaches to instruction and learning.

Lehigh's College of Education is accredited by the Pennsylvania Department of Education (PDE) to offer 11 teacher certifications:

- Elementary Education (PreK-4);
- Eight Secondary (7th-12th grade) certifications: Biology, Chemistry, Earth and Space Science, General Science, Physics, English, Mathematics, and Social Studies, and
- Two additional Special Education certifications: Elementary (PreK-8) and Secondary (7-12). Students may acquire special education dual certification either at the same time as they earn one of the general education certifications above or after they have earned that certification.

Pennsylvania has reciprocal agreements with 47 other states and the District of Columbia; individuals holding teacher certification in Pennsylvania may receive equivalent certification in one of those states. The College of Education also has relationships with international schools all over the world, enabling new teacher candidates to pursue teaching opportunities abroad.

For additional information about the program, please visit: http://coe.lehigh.edu/academics/disciplines/teachered

Professors. Linda M. Bambara, EdD (Vanderbilt University); Alec M. Bodzin, PhD (North Carolina State University); Ward M. Cates, EdD (Duke University); Lee Kern, PhD (University of South Florida); Gary M. Sasse, PhD (University of Kansas)

Associate Professors. Helen Lynn Columba-Piervallo, EdD (University of Louisville); Thomas Chalmers Hammond, PhD (University of Virginia); Brenna K. Wood, PhD (University of Arizona)

Assistant Professors. Minyi Shih Dennis, PhD (University Texas, Austin); Sara Kangas, PhD (Temple University); Laura Brook E. Sawyer, PhD (University of Virginia)

Professor Of Practice. Scott Roy Garrigan, EdD (Lehigh University)

Emeritus. Warren R. Heydenberk, PhD (University of Northern Colorado)

Lehigh undergraduates may enroll in either of the College of Education's 5-year teacher certification areas: Elementary Education (grade levels preK through 4) and Secondary Education (grade levels 7 through 12). A Minor in Education is offered through the College of Arts and Sciences.

For information on the 5-year programs, see below. For information on the Education Minor, see the College of Arts and Sciences 'Minor Programs in the College'.

5-YEAR MASTER OF EDUCATION IN ELEMENTARY EDUCATION AND PREK-4 TEACHER CERTIFICATION

The College of Education offers a five-year degree program that is designed to allow students to earn both a bachelor's degree and a master's degree in five years instead of the traditional six. The combined degree program leads to either a B.A. or B.S. degree in an academic discipline from the College of Arts and Sciences, the P.C. Rossin College of Engineering and Applied Sciences, or the College of Business and Economics, and an M.Ed. degree in Elementary Education. In addition, students also earn eligibility for an Instructional I teaching certificate from the Pennsylvania Department of Education (PDE) in grades PreK-4.

PROGRAM OF STUDY FOR PREK-4 CERTIFICATION:

B.A. or B.S. plus Master of Education (M.Ed.) in Elementary Education and PA Certification eligibility. This 42-credit (minimum) master's program prepares students for certification as PreK-4 teachers. Students complete coursework in three categories:

Core Course Work (21 credit hours)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPED 332</td>
<td>Education and Inclusion of Individuals with Special Needs in K-12</td>
</tr>
<tr>
<td>TLT 380</td>
<td>Child Development and Cognition</td>
</tr>
<tr>
<td>TLT 404</td>
<td>Diversity, Families, and School Collaborations in K-12</td>
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<td>TLT 405</td>
<td>Principles and Applications of K-12 Assessment</td>
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<td>TLT 407</td>
<td>Instructional Design for K-12</td>
</tr>
<tr>
<td>TLT 409</td>
<td>K-12 Classroom Environment and Management</td>
</tr>
<tr>
<td>TLT 411</td>
<td>Early Childhood Education</td>
</tr>
</tbody>
</table>

Development of Professional Skills (18 credit hours)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>TLT 412</td>
<td>Social Studies in PreK through 4th Grade</td>
</tr>
<tr>
<td>TLT 420</td>
<td>Reading and Literacy in PreK through 4th Grade</td>
</tr>
<tr>
<td>TLT 422</td>
<td>Language Arts in PreK through 4th Grade</td>
</tr>
<tr>
<td>TLT 426</td>
<td>Science in PreK through 4th Grade</td>
</tr>
<tr>
<td>TLT 428</td>
<td>Mathematics and Numeracy in PreK through 4th Grade</td>
</tr>
<tr>
<td>SPED 465</td>
<td>Advanced Inclusionary Practices in K-12</td>
</tr>
</tbody>
</table>

Extended Field Experience (3 credit hours)

<table>
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<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT 444</td>
<td>General Education Student Teaching and Seminar</td>
</tr>
</tbody>
</table>

In order to be eligible for PreK-4 certification, by the time a student finishes the program he or she must have demonstrated competence in the core content areas for that certification. At time of acceptance, each student will be informed of any additional content-area coursework he or she will be required to complete in order to demonstrate competence in the PreK-4 core content areas. The student is responsible for completing this coursework prior to applying for PreK-4 certification. The credits for this coursework are not included in the master's degree.

Distribution of coursework across undergraduate and graduate study:

Sophomore Year (3 credit hours)

Junior Year (3 credit hours)

Senior Year (12 credit hours)

College of Education - Summer (12 credits)

College of Education - Fall (9 credits)

College of Education - Spring (6 credits)

Students in the 5-year program will take 18 credits pre-bachelor's and an additional 27 credits post-bachelor's. However, the University requires that master's degrees carry at least 30 credits minimum. This means students in the 5-year program must have at least 3 credits “left over” from their bachelor’s program to move across to the College of Education to put toward their master's degree.
5-YEAR MASTER OF EDUCATION IN SECONDARY EDUCATION AND 7-12 TEACHER CERTIFICATION
The College of Education offers a five-year degree program that is designed to allow students to earn both a bachelor’s degree and a master’s degree in five years instead of the traditional six.

The combined degree program leads to (1) a B.A./B.S. degree in an academic discipline from the College of Arts and Sciences, the P.C. Rossin College of Engineering and Applied Sciences, or the College of Business and Economics, and (2) an M.Ed. degree in Secondary Education. In addition, students also earn eligibility for Instructional I teacher certification from the Pennsylvania Department of Education (PDE) in one of the 8 subject areas below:

- Biology 7-12
- Chemistry 7-12
- Earth and Space Science 7-12
- English 7-12
- General Science 7-12
- Mathematics 7-12
- Physics 7-12
- Social Studies 7-12

PROGRAM OF STUDY:
B.A. or B.S. plus Master of Education (M.Ed., 33 credits minimum) and Pennsylvania teacher certification eligibility. In addition to meeting the requirements for the bachelor’s degree, students must satisfy the Pennsylvania Department of Education guidelines for demonstrated content-area competence (see below).

Students complete coursework in three categories:

Core Coursework (15 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>SPED 332</td>
<td>Education and Inclusion of Individuals with Special Needs in K-12</td>
<td>3</td>
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<td>Diversity, Families, and School Collaborations in K-12</td>
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<td>Instructional Design for K-12 Classrooms</td>
<td>3</td>
</tr>
<tr>
<td>TLT 409</td>
<td>K-12 Classroom Environment and Management</td>
<td>3</td>
</tr>
</tbody>
</table>

Development of Professional Skills (12 credits)

Content-area teaching methods course with approval of adviser (one of the following):

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>TLT 431</td>
<td>Social Studies in Middle Level and High School Education</td>
<td>3</td>
</tr>
<tr>
<td>TLT 434</td>
<td>English in Middle Level and High School Education</td>
<td>3</td>
</tr>
<tr>
<td>TLT 436</td>
<td>Science in Middle Level and High School Education</td>
<td>3</td>
</tr>
<tr>
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Plus:

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<td>3</td>
</tr>
<tr>
<td>SPED 465</td>
<td>Advanced Inclusionary Practices in K-12</td>
<td>3</td>
</tr>
</tbody>
</table>

TLT XXX Elective with adviser approval | 3       |

Extended Field Experiences (6 credits)

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>TLT 440</td>
<td>Pre-professional Seminar</td>
<td>3</td>
</tr>
<tr>
<td>TLT 444</td>
<td>General Education Student Teaching and Seminar</td>
<td>1-6</td>
</tr>
</tbody>
</table>

In order to be eligible for secondary certification, by the time a student finishes the program he or she must have demonstrated competence in the subject matter area of that certification. Each student upon admission meets with the content-area specialist in the field in which that student seeks secondary certification. The content-area specialist, who is a faculty member in the College of Arts and Sciences, reviews the student’s transcripts and compares that student’s coursework with the content-area guide sheet approved by the Pennsylvania Department of Education (PDE). Following this audit, the content-area specialist will identify what additional coursework in the content-area is needed, if any. The student is responsible for completing this coursework prior to applying for secondary certification. The credits for this course work are not included in the M.Ed. degree.

Students in the secondary teacher-preparation program are expected to have completed almost all their content area coursework prior to going out to student teach. This is important because student teachers need to have mastery of their content in order to fulfill their responsibilities to their students and to derive maximum benefit from the student teaching experience.

Distribution of coursework across undergraduate and graduate study:

Sophomore Year (3 credit hours)

Junior Year (6 credit hours)

Senior Year (6 credit hours)

College of Education - Summer (6 credits)

College of Education - Fall (9 credits)

College of Education - Spring (3 credits)

Students in this program unable to accrue enough credits outside their undergraduate degree programs may need to take additional credits after beginning graduate study in order to reach the 33-credit minimum.

Students in this program who wish to obtain the Master of Arts (M.A.) degree rather than the M.Ed. degree may petition to change to that degree after admission to graduate study. The M.A. degree requires 42 credits instead of 33 credits and has specific content-area expertise requirements. See the M.A. degree description for its requirements.

Five-Year Bachelor’s Plus Master of Education in Elementary Education and PreK-4 Certification

The College of Education offers a five-year degree program that is designed to allow students to earn both a bachelor’s degree and a master’s degree in five years instead of the traditional six. The combined degree program leads to either a B.A. or B.S. degree in an academic discipline from the College of Arts and Sciences, the P.C. Rossin College of Engineering and Applied Sciences, or the College of Business and Economics, and an M.Ed. degree in Elementary Education. In addition, students also earn eligibility for an Instructional I teaching certificate from the Pennsylvania Department of Education (PDE) in grades PreK-4.

PROGRAM OF STUDY FOR PREK-4 CERTIFICATION:
B.A. or B.S. plus Master of Education (M.Ed.) in Elementary Education and PA Certification eligibility. This 42-credit (minimum) master’s program prepares students for certification as PreK-4 teachers. Students complete coursework in three categories:

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<td>Diversity, Families, and School Collaborations in K-12</td>
<td>3</td>
</tr>
<tr>
<td>TLT 405</td>
<td>Principles and Applications of K-12 Assessment</td>
<td>3</td>
</tr>
<tr>
<td>TLT 407</td>
<td>Instructional Design for K-12 Classrooms</td>
<td>3</td>
</tr>
<tr>
<td>TLT 409</td>
<td>K-12 Classroom Environment and Management</td>
<td>3</td>
</tr>
<tr>
<td>TLT 411</td>
<td>Early Childhood Education</td>
<td>3</td>
</tr>
</tbody>
</table>

Development of Professional Skills (18 credit hours)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT 412</td>
<td>Social Studies in PreK through 4th Grade</td>
<td>3</td>
</tr>
<tr>
<td>TLT 420</td>
<td>Reading and Literacy in PreK through 4th Grade</td>
<td>3</td>
</tr>
</tbody>
</table>
Students in the secondary teacher-preparation program are expected to have completed almost all their content area coursework prior to going out to student teach. This is important because student teachers need to have mastery of their content in order to fulfill their responsibilities to their students and to derive maximum benefit from the student teaching experience.

**Distribution of coursework across undergraduate and graduate study:**
- Sophomore Year (3 credit hours)
- Junior Year (6 credit hours)
- Senior Year (6 credit hours)
- Year (6 credits)

**Five-Year Bachelor's Plus Master of Education in Secondary Education and Teacher Certification**
The College of Education offers a five-year degree program that is designed to allow students to earn both a bachelor's degree and a master's degree in five years instead of the traditional six.

The combined degree program leads to (1) a B.A./B.S. degree in an academic discipline from the College of Arts and Sciences, the P.C. Rossin College of Engineering and Applied Sciences, or the College of Business and Economics, and (2) an M.Ed. degree in Secondary Education. In addition, students also earn eligibility for Instructional I teacher certification from the Pennsylvania Department of Education (PDE) in one of the 8 subject areas below:
- Biology 7-12
- Chemistry 7-12
- Earth and Space Science 7-12
- English 7-12
- General Science 7-12
- Mathematics 7-12
- Physics 7-12
- Social Studies 7-12

**PROGRAM OF STUDY:**
B.A. or B.S. plus Master of Education (M.Ed., 33 credits minimum) and Pennsylvania teacher certification eligibility. In addition to meeting the requirements for the bachelor's degree, students must satisfy the Pennsylvania Department of Education guidelines for demonstrated content-area competence (see below).

Students complete coursework in three categories:

**Core Coursework (15 credits):**
- SPED 332 Education and Inclusion of Individuals with Special Needs in K-12 3
- TLT 404 Diversity, Families, and School Collaborations in K-12 3

**Extended Field Experience (3 credit hours)**
In order to be eligible for PreK-4 certification, by the time a student finishes the program he or she must have demonstrated competence in the core content areas for that certification. At time of acceptance, each student will be informed of any additional content-area coursework he or she will be required to complete in order to demonstrate competence in the PreK-4 core content areas. The student is responsible for completing this coursework prior to applying for PreK-4 certification. The credits for this coursework are not included in the master’s degree.

Distribution of coursework across undergraduate and graduate study:
- Sophomore Year (3 credit hours)
- Junior Year (3 credit hours)
- Senior Year (12 credit hours)

**College of Education - Summer (12 credits)**
- College of Education - Fall (9 credits)
- College of Education - Spring (6 credits)

Students in the 5-year program will take 18 credits pre-bachelor's and an additional 27 credits post-bachelor's. However, the University requires that master's degrees carry at least 30 credits minimum. This means students in the 5-year program must have at least 3 credits “left over” from their bachelor’s program to move across to the College of Education to put toward their master’s degree.

**Five-Year Bachelor's Plus Master of Education in Secondary Education and Teacher Certification**
The College of Education offers a five-year degree program that is designed to allow students to earn both a bachelor's degree and a master's degree in five years instead of the traditional six.

The combined degree program leads to (1) a B.A./B.S. degree in an academic discipline from the College of Arts and Sciences, the P.C. Rossin College of Engineering and Applied Sciences, or the College of Business and Economics, and (2) an M.Ed. degree in Secondary Education. In addition, students also earn eligibility for Instructional I teacher certification from the Pennsylvania Department of Education (PDE) in one of the 8 subject areas below:
- Biology 7-12
- Chemistry 7-12
- Earth and Space Science 7-12
- English 7-12
- General Science 7-12
- Mathematics 7-12
- Physics 7-12
- Social Studies 7-12

**PROGRAM OF STUDY:**
B.A. or B.S. plus Master of Education (M.Ed., 33 credits minimum) and Pennsylvania teacher certification eligibility. In addition to meeting the requirements for the bachelor's degree, students must satisfy the Pennsylvania Department of Education guidelines for demonstrated content-area competence (see below).

Students complete coursework in three categories:

**Core Coursework (15 credits):**
- SPED 332 Education and Inclusion of Individuals with Special Needs in K-12 3
- TLT 404 Diversity, Families, and School Collaborations in K-12 3

**Extended Field Experience (3 credit hours)**
In order to be eligible for PreK-4 certification, by the time a student finishes the program he or she must have demonstrated competence in the core content areas for that certification. At time of acceptance, each student will be informed of any additional content-area coursework he or she will be required to complete in order to demonstrate competence in the PreK-4 core content areas. The student is responsible for completing this coursework prior to applying for PreK-4 certification. The credits for this coursework are not included in the master’s degree.

Distribution of coursework across undergraduate and graduate study:
- Sophomore Year (3 credit hours)
- Junior Year (3 credit hours)
- Senior Year (12 credit hours)

**College of Education - Summer (12 credits)**
- College of Education - Fall (9 credits)
- College of Education - Spring (6 credits)

Students in the 5-year program will take 18 credits pre-bachelor’s and an additional 27 credits post-bachelor’s. However, the University requires that master's degrees carry at least 30 credits minimum. This means students in the 5-year program must have at least 3 credits “left over” from their bachelor’s program to move across to the College of Education to put toward their master’s degree.

**Extended Field Experience (3 credit hours)**
In order to be eligible for PreK-4 certification, by the time a student finishes the program he or she must have demonstrated competence in the core content areas for that certification. At time of acceptance, each student will be informed of any additional content-area coursework he or she will be required to complete in order to demonstrate competence in the PreK-4 core content areas. The student is responsible for completing this coursework prior to applying for PreK-4 certification. The credits for this coursework are not included in the master’s degree.

**Five-Year Bachelor's Plus Master of Education in Secondary Education and Teacher Certification**
The College of Education offers a five-year degree program that is designed to allow students to earn both a bachelor's degree and a master's degree in five years instead of the traditional six.

The combined degree program leads to (1) a B.A./B.S. degree in an academic discipline from the College of Arts and Sciences, the P.C. Rossin College of Engineering and Applied Sciences, or the College of Business and Economics, and (2) an M.Ed. degree in Secondary Education. In addition, students also earn eligibility for Instructional I teacher certification from the Pennsylvania Department of Education (PDE) in one of the 8 subject areas below:
- Biology 7-12
- Chemistry 7-12
- Earth and Space Science 7-12
- English 7-12
- General Science 7-12
- Mathematics 7-12
- Physics 7-12
- Social Studies 7-12

**PROGRAM OF STUDY:**
B.A. or B.S. plus Master of Education (M.Ed., 33 credits minimum) and Pennsylvania teacher certification eligibility. In addition to meeting the requirements for the bachelor's degree, students must satisfy the Pennsylvania Department of Education guidelines for demonstrated content-area competence (see below).

Students complete coursework in three categories:

**Core Coursework (15 credits):**
- SPED 332 Education and Inclusion of Individuals with Special Needs in K-12 3
- TLT 404 Diversity, Families, and School Collaborations in K-12 3

**Extended Field Experience (3 credit hours)**
In order to be eligible for PreK-4 certification, by the time a student finishes the program he or she must have demonstrated competence in the core content areas for that certification. At time of acceptance, each student will be informed of any additional content-area coursework he or she will be required to complete in order to demonstrate competence in the PreK-4 core content areas. The student is responsible for completing this coursework prior to applying for PreK-4 certification. The credits for this coursework are not included in the master’s degree.

Distribution of coursework across undergraduate and graduate study:
- Sophomore Year (3 credit hours)
- Junior Year (3 credit hours)
- Senior Year (12 credit hours)

**College of Education - Summer (12 credits)**
- College of Education - Fall (9 credits)
- College of Education - Spring (6 credits)

Students in the 5-year program will take 18 credits pre-bachelor’s and an additional 27 credits post-bachelor’s. However, the University requires that master's degrees carry at least 30 credits minimum. This means students in the 5-year program must have at least 3 credits “left over” from their bachelor’s program to move across to the College of Education to put toward their master’s degree.

**Five-Year Bachelor's Plus Master of Education in Secondary Education and Teacher Certification**
The College of Education offers a five-year degree program that is designed to allow students to earn both a bachelor's degree and a master's degree in five years instead of the traditional six.

The combined degree program leads to (1) a B.A./B.S. degree in an academic discipline from the College of Arts and Sciences, the P.C. Rossin College of Engineering and Applied Sciences, or the College of Business and Economics, and (2) an M.Ed. degree in Secondary Education. In addition, students also earn eligibility for Instructional I teacher certification from the Pennsylvania Department of Education (PDE) in one of the 8 subject areas below:
- Biology 7-12
- Chemistry 7-12
- Earth and Space Science 7-12
- English 7-12
- General Science 7-12
- Mathematics 7-12
- Physics 7-12
- Social Studies 7-12

**PROGRAM OF STUDY:**
B.A. or B.S. plus Master of Education (M.Ed., 33 credits minimum) and Pennsylvania teacher certification eligibility. In addition to meeting the requirements for the bachelor's degree, students must satisfy the Pennsylvania Department of Education guidelines for demonstrated content-area competence (see below).

Students complete coursework in three categories:
in one of 8 subject areas below and leads to eligibility for a master’s degree in secondary education:

- Biology 7-12
- Chemistry 7-12
- Earth and Space Science 7-12
- English 7-12
- General Science 7-12
- Mathematics 7-12
- Physics 7-12
- Social Studies 7-12

Students complete coursework in four categories:

**Core Coursework (15 credit hours)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPED 332</td>
<td>Education and Inclusion of Individuals with Special Needs in K-12</td>
<td>3</td>
</tr>
<tr>
<td>TLT 404</td>
<td>Diversity, Families, and School Collaborations in K-12</td>
<td>3</td>
</tr>
<tr>
<td>TLT 405</td>
<td>Principles and Applications of K-12 Assessment</td>
<td>3</td>
</tr>
<tr>
<td>TLT 407</td>
<td>Instructional Design for K-12 Classrooms</td>
<td>3</td>
</tr>
<tr>
<td>TLT 409</td>
<td>K-12 Classroom Environment and Management</td>
<td>3</td>
</tr>
</tbody>
</table>

**Development of Professional Skills (12 credit hours)**

Content-area teaching methods course with approval of your adviser (one of the following):

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT 431</td>
<td>Social Studies in Middle Level and High School Education</td>
<td>3</td>
</tr>
<tr>
<td>TLT 434</td>
<td>English in Middle Level and High School Education</td>
<td>3</td>
</tr>
<tr>
<td>TLT 436</td>
<td>Science in Middle Level and High School Education</td>
<td>3</td>
</tr>
<tr>
<td>TLT 438</td>
<td>Mathematics in Middle Level and High School Education</td>
<td>3</td>
</tr>
</tbody>
</table>

Plus:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT 432</td>
<td>Reading and Critical Thinking in Middle Level and High School Education</td>
<td>3</td>
</tr>
<tr>
<td>SPED 465</td>
<td>Advanced Inclusionary Practices in K-12</td>
<td>3</td>
</tr>
</tbody>
</table>

TLT XXX: Elective with advisor approval. [These credits may be used for content-area course.]

**Extended Field Experiences (6 credit hours)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT 440</td>
<td>Pre-professional Seminar</td>
<td>3</td>
</tr>
<tr>
<td>TLT 444</td>
<td>General Education Student Teaching and Seminar</td>
<td>1-6</td>
</tr>
</tbody>
</table>

**Content Area Knowledge (12 credit hours)**

Twelve credits are required for the M.A. degree and these courses must be taken from Lehigh departments outside the College of Education at the 200 level and above.

In order to be eligible for secondary certification, by the time a student finishes the program, he or she must have demonstrated competence in the subject matter area of that certification. Each student upon admission meets with the content-area specialist in the field in which that student seeks secondary certification. The content-area specialist, who is a faculty member in the College of Arts and Sciences, reviews the student’s transcripts and compares that student’s coursework with the content-area guide sheet approved by the Pennsylvania Department of Education (PDE). Following this audit, the content-area specialist will identify what additional coursework in the content-area is needed, if any. The student is responsible for completing this coursework prior to applying for secondary certification. For the MA degree, at least 12 credits of content area courses must be taken at Lehigh at the 200 level or higher.

Students in the secondary teacher-preparation program are expected to have completed almost all their content area coursework prior to going out to student teach. This is important because student teachers need to have mastery of their content in order to fulfill their responsibilities to their students and to derive maximum benefit from the student teaching experience.

**Master of Education in Elementary Education and PreK-4 Teacher Certification**

This 42-credit (minimum) program prepares students for Pennsylvania Level I certification as PreK-4 teachers and leads to the awarding of a master’s degree in Elementary Education. Students complete coursework in three categories:

**Core Course Work (21 credit hours)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPED 332</td>
<td>Education and Inclusion of Individuals with Special Needs in K-12</td>
<td>3</td>
</tr>
<tr>
<td>TLT 380</td>
<td>Child Development and Cognition</td>
<td>3</td>
</tr>
<tr>
<td>TLT 404</td>
<td>Diversity, Families, and School Collaborations in K-12</td>
<td>3</td>
</tr>
<tr>
<td>TLT 405</td>
<td>Principles and Applications of K-12 Assessment</td>
<td>3</td>
</tr>
<tr>
<td>TLT 407</td>
<td>Instructional Design for K-12 Classrooms</td>
<td>3</td>
</tr>
<tr>
<td>TLT 409</td>
<td>K-12 Classroom Environment and Management</td>
<td>3</td>
</tr>
<tr>
<td>TLT 411</td>
<td>Early Childhood Education</td>
<td>3</td>
</tr>
</tbody>
</table>

**Development of Professional Skills (18 credit hours)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT 412</td>
<td>Social Studies in PreK through 4th Grade</td>
<td>3</td>
</tr>
<tr>
<td>TLT 420</td>
<td>Reading and Literacy in PreK through 4th Grade</td>
<td>3</td>
</tr>
<tr>
<td>TLT 422</td>
<td>Language Arts in PreK through 4th Grade</td>
<td>3</td>
</tr>
<tr>
<td>TLT 426</td>
<td>Science in PreK through 4th Grade</td>
<td>3</td>
</tr>
<tr>
<td>TLT 428</td>
<td>Mathematics and Numeracy in PreK through 4th Grade</td>
<td>3</td>
</tr>
<tr>
<td>SPED 465</td>
<td>Advanced Inclusionary Practices in K-12</td>
<td>3</td>
</tr>
</tbody>
</table>

**Extended Field Experience (3 credit hours)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT 444</td>
<td>General Education Student Teaching and Seminar</td>
<td>1-6</td>
</tr>
</tbody>
</table>

Thirty (30) credits minimum is required for the master’s degree. In order to be eligible for PreK-4 certification, the time a student finishes the program, he or she must have demonstrated competence in the core content areas for that certification (English, mathematics, science, social studies). At time of acceptance, each student will be informed of any additional content-area coursework he or she will be required to complete in order to demonstrate competence in the PreK-4 core content areas (language arts, mathematics, science and social studies). The student is responsible for completing this coursework prior to applying for PreK-4 certification. The credits for this coursework are not included in the master’s degree.

**Master of Education in Secondary Education and Teacher Certification**

This 33 credit (minimum) program of study prepares students for Pennsylvania Level I certification as secondary content-area teachers in one of the subject areas (below) and leads to eligibility for a master’s degree in secondary education:

- Biology 7-12
- Chemistry 7-12
- Earth and Space Science 7-12
- English 7-12
- General Science 7-12
- Mathematics 7-12
- Physics 7-12
- Social Studies 7-12

Students complete coursework in three categories:

**Core Coursework (15 credit hours)**
**Course Work in the Area of Specialization (6 credits)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPED 411</td>
<td>Early Childhood Education</td>
<td>3</td>
</tr>
<tr>
<td>SPED 419</td>
<td>Academic Interventions: PreK-8</td>
<td>3</td>
</tr>
</tbody>
</table>

**Education Electives (6 credits with approval of the adviser)**

**Intensive Teaching Experience (2 credits)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPED 420</td>
<td>Field Experience: Special Education Certification</td>
<td>1-3</td>
</tr>
</tbody>
</table>

**Master of Education in Special Education and Special Education PreK-8 Dual Certification**

This 30 credit (minimum) master’s program is designed for students seeking Pennsylvania certification as Special Education PreK-8 teachers (with dual certification eligibility).

**Students complete the following coursework:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPED 332</td>
<td>Education and Inclusion of Individuals with Special Needs in K-12</td>
<td>3</td>
</tr>
<tr>
<td>SPED 404</td>
<td>Diversity, Families, and School Collaborations in K-12</td>
<td>3</td>
</tr>
<tr>
<td>SPED 405</td>
<td>Principles and Applications of K-12 Assessment</td>
<td>3</td>
</tr>
<tr>
<td>SPED 409</td>
<td>K-12 Classroom Environment and Management</td>
<td>3</td>
</tr>
<tr>
<td>TLT 432</td>
<td>Reading and Critical Thinking in Middle Level and High School Education</td>
<td>3</td>
</tr>
<tr>
<td>SPED 465</td>
<td>Advanced Inclusionary Practices in K-12</td>
<td>3</td>
</tr>
<tr>
<td>TLT XXX</td>
<td>Elective with adviser approval</td>
<td>3</td>
</tr>
</tbody>
</table>

**Extended Field Experiences (6 credit hours)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT 440</td>
<td>Pre-professional Seminar</td>
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</tr>
<tr>
<td>TLT 444</td>
<td>General Education Student Teaching and Seminar</td>
<td>1-6</td>
</tr>
</tbody>
</table>

**In order to be eligible for secondary certification, by the time a student finishes the program he or she must have demonstrated competence in the subject matter of the certification. Each student upon admission meets with the content-area specialist in the field in which that student seeks secondary certification. The content-area specialist, who is a faculty member in the College of Arts and Sciences, reviews the student’s transcripts and compares that student’s coursework with the content-area guide sheet approved by the Pennsylvania Department of Education (PDE). Following this audit, the content-area specialist will identify what additional coursework in the content-area is needed, if any. The student is responsible for completing this coursework prior to applying for secondary certification. The credits for this course work are not included in the M.Ed. degree.**

Students in the secondary teacher-preparation program are expected to have completed almost all their content area coursework prior to going out to student teach. This is important because student teachers need to have mastery of their content in order to fulfill their responsibilities to their students and to derive maximum benefit from the student teaching experience.

**Master of Education in Special Education and Special Education PreK-8 Additional Certification**

This 32-credit (minimum) master’s program is designed for graduate students seeking Pennsylvania additional certification as Special Education PreK-8 teachers.

Students take coursework in four categories:

**Core Course Work (18 credits)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPED 404</td>
<td>Diversity, Families, and School Collaborations in K-12</td>
<td>3</td>
</tr>
<tr>
<td>SPED 418</td>
<td>Alternative Curricular Approaches</td>
<td>3</td>
</tr>
<tr>
<td>SPED 429</td>
<td>Professional Seminar</td>
<td>3</td>
</tr>
<tr>
<td>SPED 432</td>
<td>Positive Behavior Support</td>
<td>3</td>
</tr>
<tr>
<td>SPED 452</td>
<td>Assessment in Special Education</td>
<td>3</td>
</tr>
<tr>
<td>SPED 465</td>
<td>Advanced Inclusionary Practices in K-12</td>
<td>3</td>
</tr>
</tbody>
</table>

**Course Work in the Area of Specialization (6 credits)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPED 411</td>
<td>Early Childhood Education</td>
<td>3</td>
</tr>
<tr>
<td>SPED 419</td>
<td>Academic Interventions: PreK-8</td>
<td>3</td>
</tr>
</tbody>
</table>

**Education Electives (6 credits with approval of the adviser)**

**Intensive Teaching Experience (2 credits)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPED 420</td>
<td>Field Experience: Special Education Certification</td>
<td>1-3</td>
</tr>
</tbody>
</table>
Master of Education in Special Education and Special Education 7-12

Dual Certification

This 30 credit (minimum) master’s program is designed for graduate students seeking Pennsylvania certification as Special Education 7-12 teachers (with dual certification eligibility).

Students complete the following coursework:

**SPED 332**  Education and Inclusion of Individuals with Special Needs in K-12 3 Credits

**SPED 404**  Diversity, Families, and School Collaborations in K-12 3 Credits

**SPED 405**  Principles and Applications of K-12 Assessment 3 Credits

**SPED 409**  K-12 Classroom Environment and Management 3 Credits

**SPED 418**  Alternative Curricular Approaches 3 Credits

**SPED 421**  Academic Interventions: Secondary Level 3 Credits

**SPED 423**  Transition to Post-school Life 3 Credits

**SPED 432**  Positive Behavior Support 3 Credits

**SPED 452**  Assessment in Special Education 3 Credits

**SPED 465**  Advanced Inclusionary Practices in K-12 3 Credits

NOTE: Students seeking dual certification in general education 7-12 (initial certification) and Special Education 7-12 (additional certification) must complete 5 courses (15 credits) that are not listed above [including SPED 442, General Education and Special Education Student Teaching and Seminar]. These courses/credits are required to be eligible for dual certification but are not part of the master’s program in Special Education.

Special Education Courses

**SPED 300**  Special Topics in Special Education 1-3 Credits

Current issues in the education of individuals with special needs. Titles vary.

**Repeat Status:** Course may be repeated.

**SPED 332**  Education and Inclusion of Individuals with Special Needs in K-12 3 Credits

Overview of social, developmental, legal, and educational issues and practices related to the special education of individuals with disabilities. Covers social, environmental, and physiological etiology; development; identification; learning characteristics; and needs of individuals identified for special education. Emphasizes meeting diverse needs of students in general education classrooms through evidence-based practices and adaptations matched to learner needs. Addresses legal rights of students and their families, as well as legal responsibilities of teachers as required by IDEA and other related special legislation.

**SPED 338**  Emotional and Behavioral Disorders of Children 3 Credits

Definition, classification, etiology, treatment, and historical perspective of children and adolescent disorders.

**SPED 402**  Applied Behavior Analysis 3 Credits

Theory and application of behavior modification methods in classroom and clinical settings. Topics include behavior analysis, outcome research, task utilization, and single case research.

**SPED 404**  Diversity, Families, and School Collaborations in K-12 3 Credits

Cultural and linguistic diversity as critical variables in educational equity for all learners, including ELL. Explores home-school partnerships, family and professional collaboration, and teacher self-awareness. Implementing culturally sensitive and responsive classroom practices as well as forming collaborative relationships with families that respect diversity of family contexts. Collaborative, multidisciplinary teaming to support, optimize, and advocate for student’s educational needs and connect to community services and resources available to individuals and families. Addresses family mental health issues and wraparound services.

**SPED 405**  Principles and Applications of K-12 Assessment 3 Credits

Assessment applied to learning in classroom learning environments, including universal screening and progress monitoring. Discusses assessment approaches, ways to implement assessment, and use of assessment tools to monitor all students, including ELL and students with disabilities. Use of data-management and grading systems. Addresses diagnostic assessments for student placement and analysis of assessment data to tailor instruction to diverse student needs. Emphasis on research-based practices of assessment to inform instructional decision-making consistent with the RtI framework.

**SPED 409**  K-12 Classroom Environment and Management 3 Credits

Designing inclusive classroom environments that maximize learning. Emphasis on fostering a community of learners using connections among classroom arrangement, classroom management, and cognitive development to create positive learning outcomes for all students, including ELL learners and students with disabilities. Addresses the tiered model of prevention and positive behavior support, including the role of functional assessment and individual positive behavior support plans in classroom management. Highlights the ways a positive climate for learning involves establishing and maintaining partnerships with families.

**SPED 411**  Early Childhood Education 3 Credits

Introduction to development of early childhood education in the U.S. Emphasizes evidence-based methods and materials to assist young children in the learning process, including arrangement of indoor/ outdoor space, developmentally appropriate practices, and the design of instruction to foster young children’s emotional, social, language, cognitive, physical, and creative development. Includes embedded instruction and adaptations for students with identified disabilities, children at risk for developing disabilities, and children with culturally and linguistically diverse backgrounds, and family collaboration within the instructional planning process.

**SPED 418**  Alternative Curricular Approaches 3 Credits

Curricular and instructional methods for students with pervasive support needs (e.g., intellectual disabilities, autism) who follow an alternative or modified curriculum. Methods for developing an individualized curriculum, embedding instruction and accessing the general education curriculum, systematic instruction, and instruction for full participation in school, home, and community settings are covered. Strategies for facilitating emergent social and communication skills, teaching augmentative and alternative communication, and use of assistive technologies to enhance self-directed learning are included.

**SPED 419**  Academic Interventions: PreK-6 3 Credits

Methods course designed to address the needs of students with disabilities to increase knowledge of instruction of comprehensive pre-literacy and literacy skills and their components. Additionally, pre-reading, reading, language arts, mathematics, and content area reading literacy skills in primary and elementary settings will be addressed. Emphasis on instructional planning, differentiated instructional strategies, appropriate assessments modifications, and adaptations needed for use with individuals with disabilities through a conceptual foundation in the components of reading and the integration of research validated interventions.

**SPED 420**  Field Experience: Special Education Certification 1-3 Credits

Intensive practice in the application of principles of teaching in a supervised experience in the schools for students who already hold another content area certification (e.g., elementary, middle school, secondary). Consent of the program.
SPED 442 Academic Interventions: Secondary Level 3 Credits
Methods course designed to increase knowledge of core components of reading in secondary settings, language arts, mathematics, and content area literacy skills for students with disabilities and those who are culturally and/or linguistically diverse. Emphasis on instructional planning, differentiated instructional strategies, appropriate assessments, modifications, and adaptations needed for use with individuals with disabilities through a conceptual foundation in the components of reading and the integration of research validated interventions.

SPED 423 Transition to Post-school Life 3 Credits
Best instructional practices for preparing students for post-school adult life: employment, post-secondary education, and community participation in inclusive settings. Topics include transition planning, personcentered and work-based assessments, family and interagency collaboration, innovative post-school and inschool transition services, and self-determination. Evidence-based practices to promote positive student outcomes are emphasized.

SPED 429 Professional Seminar 3 Credits
Master’s seminar on current issues in the area of special education and research design. Must have 18 graduate credits in special education.

SPED 430 Advanced Seminar in Special Education 3 Credits
Advanced issues relating to the field of special education. Titles will vary. Repeat Status: Course may be repeated.

SPED 432 Positive Behavior Support 3 Credits
Design of comprehensive, multi-component behavior support plans for individuals with a variety of disabilities who engage in problem behavior. Topics include functional assessment, antecedent and setting event interventions, replacement behaviors, consequence and crisis procedures, lifestyle interventions, and teaming strategies. Assessment focuses on the link between curriculum, academic performance, and behavior problems. Promotes consideration of diverse populations for understanding behavioral differences. Describes strategies for ongoing monitoring and maintenance of behavior reductions.

SPED 434 Applied Research Practicum 1-3 Credits
Designing and conducting research projects in applied settings.

SPED 440 Early Academic Intervention 3 Credits
Explores the potential effectiveness of interventions to prevent academic failure of children at risk for learning difficulties. Emphasis on research-based interventions in the areas of beginning reading, language and vocabulary, writing and spelling, awareness of print and exposure to print, and mathematics (number sense).

SPED 442 (TLT 442) General Education and Special Education Student Teaching and Seminar 1-6 Credits
Intensive practice in the application of principles of teaching for both general and special education settings in a supervised internship in the schools (for dual certification). Regular meetings among student teachers for critical analysis and discussion of classroom instructional practices, as illustrated by the student teachers’ experiences in the schools. Practical mentoring on professionalism, applying differentiated instructional models in real-world setting, and aligning instruction with standards. Consent of program director required.

SPED 448 Practicum/Seminar in Positive Behavior Specialist 1-3 Credits
Introductory supervised field work with emphasis on conducting functional assessments, designing positive behavior support plans, and teaming with families and professionals. Requires one-hour weekly meetings with faculty and other practicum students. This course is restricted to students enrolled in the Positive Behavior Specialist program.

SPED 450 Practicum/Seminar in Positive Behavior Specialist 2-3 Credits
Advanced field work with emphasis on resolving difficult case problems in positive behavior support. Requires one-hour weekly meetings with faculty and other practicum students. This course is restricted to students enrolled in the Positive Behavior Specialist program.

SPED 452 Assessment in Special Education 3 Credits
Identification, administration and interpretation of a variety of assessments used for planning and to determine special education eligibility and to assess social, emotional, behavioral, and academic functioning. Discusses strengths and limitations of various models and assessment, both formal and informal, instruments used to evaluate the need for special education. Describes strategies to enhance the relationship between assessment and service delivery. Addresses assessment practices to identity curricular needs consistent with the RtI framework.

SPED 465 Advanced Inclusionary Practices in K-12 3 Credits
Advanced techniques grounded in current research-based methods and best practice for educating and assessing students with disabilities, students from diverse backgrounds, and English language learners using a standards-aligned system. Accommodations, modifications, planning for physical and instructional inclusion through embedded strategic instruction, adaptations, and curriculum overlapping. Addresses decision hierarchies for level of instructional adaptation and social inclusion methods through social facilitation techniques. Explores critical factors in developing, implementing, and modifying curriculum using evidence-based practices. Explores collaborative co-planning and co-teaching models. Prerequisites: SPED 332

SPED 482 Practicum in University Teaching: Special Education 1-4 Credits
Monitored and guided co-teaching focused on the design, organization, pedagogy and assessment of university courses in Special Education. Students in this course will work with a faculty member to apply best practices in university teaching with feedback while co-teaching students in a course in the College of Education. Students taking the course must meet the college standards for participation and be approved by the program director and department chair. May be repeated for credit. Repeat Status: Course may be repeated.

SPED 490 Doctoral Seminar in Special Education 3 Credits
Advanced knowledge of issues and research in the education of individuals with special needs. Topics will vary. Must be admitted for doctoral studies. Repeat Status: Course may be repeated.

SPED 499 Dissertation 1-15 Credits
Repeat Status: Course may be repeated.

Teaching Learning Technology Courses

TLT 367 (ES 367) Environmental Education 3 Credits
Introductory environmental education course designed to prepare students to implement environmental education opportunities in formal and non-formal education settings. Topics include history and philosophy of environmental education, environmental laws and regulations, GIS, environmental issues and decision making, curriculum integration and environmental education teaching methodologies. This is a Web enhanced containing both online and fieldwork components.

TLT 368 (ES 368) Teaching and Learning with Geospatial Tools 3 Credits
Exploration of geospatial tools, including but not limited to global positioning systems (GPS), geographic information systems (GIS), and related visualization tools (e.g. Google Earth). Application of these tools and techniques to instructional settings, including appropriate pedagogy and assessment.

TLT 380 Child Development and Cognition 3 Credits
Introduction to physical, motor, perceptual, cognitive, language, emotional, social, and gender development of young children and adolescents. Developmental history, theories, and research, as well as the effect of culture, family, peers, media, and schooling on the individual and groups. Students investigate typical and atypical development and explore the implications of individual differences for teaching and learning, with an emphasis on evidence-based instructional practices designed to optimize the growth and development of all learners. Explores mental health issues and at-risk students.
TLT 391 Workshops 1-3 Credits
Cooperative study of current educational problems. Provides elementary, secondary, and special education teachers an opportunity to work at their own teaching levels and in their own fields. Limited to six credits during a summer session but the student may register for more than one workshop provided there is no duplication in subject matter. Repeat Status: Course may be repeated.

TLT 394 Special Topics in Education: 1-3 Credits
Examination of a topic of research or professional interest in education. Subtitle will vary. May be repeated for credit as subtitle varies. Repeat Status: Course may be repeated.

TLT 401 Overview of Teaching and Learning 3 Credits
Foundations and key concepts in learning and instructional theory. Cognition and brain-based research with a focus on innovations in teaching and learning.

TLT 402 Critical Reading and Writing 3 Credits
Using literature to build persuasive written arguments. Searching and identifying promising sources, distilling research findings, synthesizing literature to support an argument, and organizing written materials to enhance persuasiveness. Suited to those writing qualifying projects, dissertation proposals, dissertations, funding proposals, conference proposals, and journal articles.

TLT 403 Instructional Design 3 Credits
Social, cognitive, and environmental factors in designing for teaching and learning. Systems theory applied to learning settings. Special emphasis on motivational theories and technological affordances. Prerequisites: TLT 401 Can be taken Concurrently: TLT 401

TLT 404 (SPED 404) Diversity, Families, and School Collaborations in K-12 3 Credits
Cultural and linguistic diversity as critical variables in educational equity for all learners, including ELL. Explores home-school partnerships, family and professional collaboration, and teacher self-awareness. Implementing culturally sensitive and responsive classroom practices as well as forming collaborative relationships with families that respect diversity of family contexts. Collaborative, multidisciplinary teaming to support, optimize, and advocate for student's educational needs and connect to community services and resources available to individuals and families. Addresses family mental health issues and wraparound services.

TLT 405 (SPED 405) Principles and Applications of K-12 Assessment 3 Credits
Assessment applied to learning in classroom learning environments, including universal screening and progress monitoring. Discusses assessment approaches, ways to implement assessment, and use of assessment tools to monitor all students, including ELL and students with disabilities. Use of data-management and grading systems. Addresses diagnostic assessments for student placement and analysis of assessment data to tailor instruction to diverse student needs. Emphasis on research-based practices of assessment to inform instructional decision-making consistent with the RtI framework.

TLT 407 Instructional Design for K-12 Classrooms 3 Credits
Introduces the systematic design of instruction following the Response to Instruction and Intervention (RtII) and Universal Design for Learning models. Explores theories of learning and instructional applications as a part of technology-based and standards-aligned classroom education grounded in the use of a quality, research-based core curriculum and effective instructional practices to meet the needs of all learners. Addresses appropriate use of instructional technologies for universal learning. Students will plan, design, and develop student-centered, standards-aligned, technology-supported instruction and appropriate learner assessments.

TLT 409 (SPED 409) K-12 Classroom Environment and Management 3 Credits
Designing inclusive classroom environments that maximize learning. Emphasis on fostering a community of learners using connections among classroom arrangement, classroom management, and cognitive development to create positive learning outcomes for all students, including ELL learners and students with disabilities. Addresses the tiered model of prevention and positive behavior support, including the role of functional assessment and individual positive behavior support plans in classroom management. Highlights the ways a positive climate for learning involves establishing and maintaining partnerships with families.

TLT 410 The Writing Process 3 Credits
Developmental characteristics of children’s writing and relationships among writing, spelling and reading. Predictors of writing achievement, teaching strategies and activities, and evaluation schemes will be emphasized, K-12.

TLT 411 (SPED 411) Early Childhood Education 3 Credits
Introduction to development of early childhood education in the U.S. Emphasizes evidence-based methods and materials to assist young children in the learning process, including arrangement of indoor/outdoor space, developmentally appropriate practices, and the design of instruction to foster young children’s emotional, social, language, cognitive, physical, and creative development. Includes embedded instruction and adaptations for students with identified disabilities, children at risk for developing disabilities, and children with culturally and linguistically diverse backgrounds, and family collaboration within the instructional planning process.

TLT 412 Social Studies in PreK through 4th Grade 3 Credits
Overview of Pennsylvania’s PreK-4 Standards for social studies, including: Pennsylvania history, United States history, economics, civics and government, citizenship, political science/government, and geography. Development, implementation and evidence-based assessment of PreK-grade 4 social studies curricula. Effective teaching techniques such as lesson planning, inclusive practices, integrating instructional technologies into instruction, reflecting on teaching, and the latest research-based teaching and assessment methods. Emphasis on alignment of instruction with standards.

TLT 420 Reading and Literacy in PreK through 4th Grade 3 Credits
Methods of teaching reading and literacy in PreK-4, including critical components of early literacy. Selection of appropriate materials, instructional strategies, techniques, and formative and summative assessments. Best practices in reading instruction in a standards-aligned curriculum, explicit strategies for teaching vocabulary and comprehension, and using evidence-based practices to teach reading to learners at all levels of proficiency. Helping learners make the transition from learning to read to reading to learn. Working with families and non-school support services to enhance reading development.

TLT 421 Language Arts in PreK through 4th Grade 3 Credits
Principles of language learning and the development of communication skills from preK-4. Implications of developmental differences and experiences in non-school settings on student readiness and skills. Helping parents support their children’s language skills development. Methods of teaching listening, speaking, and writing, including spelling, punctuation, grammar, and handwriting. Selection of appropriate standards-aligned materials, textbooks, assessments, and evidence-based approaches to teach the language arts to learners from a variety of backgrounds and across a range of abilities.

TLT 422 Language Arts in PreK through 4th Grade 3 Credits
Role of literature in the instructional program of the elementary schools. Use of trade books for individualized instruction in reading, language arts, mathematics, science, and social studies.
TLT 426 Science in PreK through 4th Grade 3 Credits
Overview of inquiry-based activities and investigations to promote science learning in pre-K-grade 4 classrooms. Emphasis on Pennsylvania’s PreK-4 Standards for Science and Technology and Environment and Ecology standards and aligning instruction with standards. Activities include planning effective lessons, trying out new methods of teaching, inclusionary methods, reflective practice, and integrating instructional technologies into science learning. Evidence-based assessment types are highlighted within instructional contexts.

TLT 428 Mathematics and Numeracy in PreK through 4th Grade 3 Credits
Trends, theories, activities, and manipulative materials for teaching early numeracy and elementary mathematics. Pre-school development and in-school skills and concepts, including sets, systems of numeration, experience with numbers, number operations and concepts, numerals, measurement, early algebra, and elements of geometry. Implications of developmental differences and early non-school experiences on learner readiness and skills. Helping parents support their children’s mathematics conceptual development. Research-based practices and inclusionary approaches to teach mathematics to learners from a variety of backgrounds and across ability levels.

TLT 431 Social Studies in Middle Level and High School Education 3 Credits
Middle and high school curriculum, content, teaching strategies, and instructional materials for the social studies. Emphasis on organizing content, using appropriate methods, testing and evaluation, and appropriate integration of technology. Overview of Pennsylvania’s 4-8 and 8-12 standards for social studies and related standards from the National Council for the Social Studies and other national organizations. Explores relevant research, courses of study, textbooks, and teacher-made materials. Addresses inclusive evidence-based and standards-aligned instructional approaches and techniques, including co-teaching.

TLT 432 Reading and Critical Thinking in Middle Level and High School Education 3 Credits
Development of reading in the secondary content areas (English/language arts, mathematics, science, social studies). Highlights effective teaching strategies in critical areas, such as higher order reading and study skills. Addresses analysis of evidence based methods and current research for improving the reading development and analytical skills of all students.

TLT 434 English in Middle Level and High School Education 3 Credits
Curricula, philosophy, methods, strategies, and materials for the teaching of middle and high school English. Literature, genres, and the nature of text and text differences. Critical analysis and drawing inferences from narrative text and poetry. Techniques for teaching and enhancing writing in various styles. Applications of technology and assessment principles. Addresses inclusive evidence-based and standards-aligned instructional approaches and techniques, including co-teaching.

TLT 436 Science in Middle Level and High School Education 3 Credits
Overview of inquiry-based activities and investigations to promote science learning in secondary science classrooms. Emphasis on aligning instruction with Pennsylvania’s Standards for Science and Technology and Environment and Ecology standards. Activities include planning effective lessons, trying out new methods of teaching, inclusionary methods, reflective practice, and integrating instructional technologies into science learning. Evidence-based assessment types highlighted within instructional contexts.

TLT 438 Mathematics in Middle Level and High School Education 3 Credits
Standards-based and technology-intensive curricula, instructional activities, and manipulative aids for mathematics in middle level and high schools. This course models and explores an investigative and hands-on approach to secondary mathematics instruction. Particular attention given to learning theories, curriculum issues, and recommended practices for improving the reading development and analytical skills of students. Consent of program director required.

TLT 440 Pre-professional Seminar 3 Credits
Study, directed observation of, and initial practice in the various phases of teaching in secondary schools. Guided opportunities to try out strategies to facilitate the inclusion of special education students, differentiated instructional practices, and standards-aligned and evidence-based instructional approaches in actual school settings. Consent of program director required.

TLT 442 (SPED 442) General Education and Special Education Student Teaching and Seminar 1-6 Credits
Intensive practice in the application of principles of teaching for both general and special education settings in a supervised internship in the schools (for dual certification). Regular meetings among student teachers for critical analysis and discussion of classroom instructional practices, as illustrated by the student teachers’ experiences in the schools. Practical mentoring on professionalism, applying differentiated instructional models in real-world setting, and aligning instruction with standards. Consent of program director required.

TLT 444 General Education Student Teaching and Seminar 1-6 Credits
Intensive practice in the application of principles of teaching for general education settings in a supervised internship in the schools. Regular meetings among student teachers for critical analysis and discussion of classroom instructional practices, as illustrated by the student teachers’ experiences in the schools. Practical mentoring on professionalism, applying differentiated instructional models in real-world setting, and aligning instruction with standards. Consent of program director required.

TLT 454 Applied Instructional and Interface Design Principles 3 Credits
Exploration and application of design models for learning. Special emphasis on the application of perception theory, communication theory, and learning theory to the design of media for teaching and learning. Prerequisites: TLT 403

TLT 456 Instructional Design and Development Studio 3 Credits
Studio-based, authentic and collaborative design experiences led by a faculty mentor. Students work in teams to complete substantial multimedia design and development projects. Prerequisites: TLT 454 and TLT 460

TLT 458 Introduction to Multimedia Programming and Resource Development for Learning 3 Credits
Introduction to programming and resource development tools used in the creation of interactive multimedia teaching and learning materials.

TLT 460 Advanced Multimedia Programming and Resource Development for Learning 3 Credits
Advanced exploration of programming and resource development tools used in the creation of interactive teaching and learning materials. Prerequisites: TLT 458

TLT 462 Special Topics in Development of Instructional Resources and Technologies for Learning 1-3 Credits
We know the use of technology in education will continue to increase. This course extrapolates current research to envision the innovations we can expect in a planning horizon of 2 to 5 years. We will study schools and systems that use emerging technologies today that could be widely adopted tomorrow. The course focuses equally on technology and pedagogy. Repeat Status: Course may be repeated.
Integrated Business and Engineering Honors Program

Admission to the Integrated Business and Engineering Honors Program is highly selective, with annual admission limited to approximately 50 students. The University’s Office of Admissions (610-758-3100) can explain the procedure for applying to the program. It is possible that a small number of exceptional students may be admitted to the program following the completion of their freshman year. Admission at this point would be highly competitive and based upon freshman year GPA, faculty recommendations, and space availability.

The co-directors of the IBE Honors Program are Stephen G. Buell, Professor of Finance (steve@lehigh.edu) and Robert H. Storer, Professor of Industrial and Manufacturing Systems Engineering (rhs2@lehigh.edu). For additional information, visit the IBE web site at www.lehigh.edu/ibe.

Courses

IBE 010 Integrated Business and Engineering Seminar 1 Credit
Introduction to the various business and engineering professions through a series of presentations and demonstrations. Emphasis is on the diversity of business and engineering career opportunities and the associated curricular choices. Students also create their web page with four-year curriculum plan and an updated resume, learn Cad-Cam and presentation software, and explore career opportunities. Open only to first-year students in the Integrated Business and Engineering Honors Program.

IBE 050 Integrated Business and Engineering Workshop 3 Credits
The course introduces students to the interaction and interdependence of business planning and engineering design in the context of entrepreneurial new product development. Students develop skills in communication, teamwork and critical thinking while working in such areas as competitive strategy, financial modeling, marketing mix, prototyping, product testing, and the development of technical specifications. Open only to students in the Integrated Business & Engineering Honors Program.

IBE 150 Integrated Business and Engineering Sophomore Laboratory 1 Credit
A series of cases that integrate elements of business and engineering. Example topics include, but are not limited to, introduction to cost benefit analysis, introduction to modeling and optimization, team dynamics, and international negotiation and joint ventures. Oral presentations and written reports. Open only to students in the Integrated Business and Engineering Honors Program.

IBE 171 Integrated Business and Engineering Independent Study 1 Credit
Students address a technical issue in a business context from an entrepreneurial focus. Students pursue their own business start-up idea, either a product or a service, and develop a business plan that includes prototypes and testing (engineering) as well as a marketing plan and a base case financial model (business). The goal of the course is for students to enter a business plan or entrepreneurial competition in a local, regional or national level. Open only to students in the Integrated Business and Engineering Honors Program.

Prerequisites: IBE 050

IBE 250 Integrated Business and Engineering Junior Laboratory 1 Credit
A semester-long simulation game in which interdisciplinary teams of IBE students compete against each other. Topics include market analysis, working capital management, capital budgeting, raising long-term capital, plant location, and inventory control. Oral presentations and written reports. Open only to students in the Integrated Business and Engineering Honors Program.
IBE 271 Independent Study 1 Credit
IBE 380 Integrated Business and Engineering Capstone Project I 3 Credits
IBE students work in cross-disciplinary teams of 5 to 6 business and engineering majors with a faculty mentor on the marketing, financial and economic planning, and technical and economic feasibility of actual new product concepts initiated by the course’s corporate sponsors. These sponsors are incubator start-up firms to ensure that the projects have both business and engineering elements. Written reports and oral presentations to sponsors and invited venture capitalists are required. Open only to students in the Integrated Business and Engineering Honors Program.

IBE 385 Integrated Business and Engineering Capstone Project II 3 Credits
IBE students continue to work with the detailed design including the fabrication and testing of working prototypes of their new products designed in IBE Capstone Project I course. In addition to the technical design of the products, detailed financial and marketing plans are required. Written reports and oral presentations to sponsors and invited venture capitalists are required. Open only to students in the Integrated Business and Engineering Honors Program.

Integrated Real Estate at Lehigh Program
Integrated Real Estate At Lehigh (ire@l) is a three or four year course of study designed to complement a wide range of majors, from art and architecture to civil engineering to environmental science to finance to marketing to economics. The mission of the ire@l program is to prepare the future generation of real estate leaders. Students completing the ire@l program will earn a minor in real estate.

The director of the Goodman Center for Real Estate Studies and the ire@l program is Associate Professor Stephen Thode (inrealgc@lehigh.edu) and the center phone number is 610-758-4786.

IRE@L MINOR

Required Courses
- IPRE 001 Introductory Seminar in Real Estate 3
- IPRE 002 Field Laboratory 2
- IPRE 301 Case Studies in Real Estate Value Creation 3
- IPRE 302 IPRE Internship 1
- IPRE 347 Practicum in Real Estate I 2
- IPRE 348 Practicum in Real Estate II 2

Recommended Courses
- IPRE 101 Real Estate Practicum Clerkship I 1
- IPRE 102 Real Estate Practicum Clerkship II 1

Total Credits 13

Courses
IPRE 001 Introductory Seminar in Real Estate 3 Credits
Required of all entering ire@l students, this seminar explores a variety of issues related to real estate, entrepreneurship and leadership. Topics include: the relationship of real estate to finance, architecture, environmental issues, government, engineering, urban planning and economic development; the role of the entrepreneur in real estate and real estate development; ethical considerations in real estate; and, models of leadership. The seminar will consist of lectures and presentations by a variety of Lehigh faculty, entrepreneurs, and real estate professionals. Must have freshman OR sophomore standing. Consent of instructor required.

IPRE 002 Field Laboratory 2 Credits
An introduction to the real estate development process. Using an actual, planned commercial real estate development, the class will engage in an extensive inquiry into the breadth and depth of the real estate development process. Topics include: the sequence of events in the development process; parallel and sequential activities; impediments to highest and best use; strategies for overcoming impediments; managing relationships with various constituents; sources of capital; and, market analysis. Each class member will submit a final report detailing his or her findings with respect to these topics. Consent of instructor required.

Prerequisites: IPRE 001

IPRE 101 Real Estate Practicum Clerkship I 1 Credit
Just as medical school and law school students serve clerkships as a key part of their academic preparation, ire@l students may serve clerkships in the Real Estate Practicum. Clerkship students will rotate among all of the groups engaged in the Real Estate Practicum - accompanying Practicum groups on site visits, observing those groups’ interactions with various faculty and real estate professionals, and assisting those groups in the completion of numerous tasks. During the fall semester, the focus of these rotations be on the physical characteristics of the Practicum properties including design considerations, structural integrity, floor plans, building systems and tenant improvements. Students will also develop an understanding of the property’s location, and how that location affects the use(s) of the property. Finally, students will gauge the area in which the property is located. Concurrent with these rotations, these students will reference their Field Laboratory property that is in an earlier stage of development, drawing a contrast between a completed property and a property under development. Consent of instructor required.

Prerequisites: (IPRE 001 and IPRE 002)

IPRE 102 Real Estate Practicum Clerkship II 1 Credit
A continuation of the fall semester, the spring semester rotations focus on the real estate markets in which the Practicum properties are located, and on the financial analysis (valuation) of the Practicum properties. Clerkship students will reference their Field Laboratory property to contrast the difference between the demonstrated value created (in a completed property) and the value that is expected to be created (in a property under development).

Prerequisites: (IPRE 001 or IPRE 002)

IPRE 300 Apprentice Teaching 1-4 Credits
Repeat Status: Course may be repeated.

IPRE 301 Case Studies in Real Estate Value Creation 3 Credits
An investigation into ways in which the entrepreneur is able to create value through the development or redevelopment of real estate. Issues: establishing a real property’s highest and best use; the entrepreneurial thought process; zoning, planning and land use regulations and their effects on real estate development; real and potential environmental impacts and their effects on real estate development; the role of government in stimulating (or destimulating) real estate development; overcoming barriers to real estate development; negotiation techniques; and, application of alternative strategies in the development process. The course is taught using the case method with the majority of the cases from previous Real Estate Practica. The course is a combination of lectures, presentations by entrepreneurs, and site visits to (re)developed properties as well as properties in the planning phase. Consent of instructor required.

IPRE 302 IPRE Internship 0-1 Credits
Open to students in the Integrated Real Estate At Lehigh (ire@l) Program. The student will be evaluated on a directed writing assignment of no fewer than 9 pages and on a detailed evaluation provided by his or her work supervisor. A minimum of 150 hours of work must be completed in the internship, and verified by work supervisor. It should be noted that the work experience itself is not the basis for academic credit. Course registration and related arrangements must be made in advance of the work experience. This course cannot be used to satisfy any major requirements. Consent of program director required. In extraordinary circumstances and with the consent of the program director this requirement can be altered according to the director’s stipulations.

Prerequisites: (IPRE 001 and IPRE 002)
IPRE 347 Practicum in Real Estate I 2 Credits
Organized into teams, with each team assigned a different subject commercial real property, the class engages in the study of the physical and locational characteristics of commercial real estate as they relate to value including: property history; architecture; physical attributes that add to or detract from value; tenant mix; the immediate neighborhood environment; and, the specific market in which the real property competes for tenants. Each team meets with the property owner and conducts a thorough review of the property’s development process including, where applicable, previous attempts to develop the property, prior uses for the property, and significant phase points in the development process (for example, “deal killing” impediments that were overcome). Each team submits a written report of their findings and produces a 10-minute video documentary on their subject property. Permission of the instructor required.

IPRE 348 Practicum in Real Estate II 2 Credits
A continuation of the study of the creation of value in commercial real estate begun in the Practicum in Real Estate I. Each student team continues with the subject commercial real property assigned to them in Practicum I. The class engages in the study of the market and financial characteristics of commercial real estate as they relate to value through: a financial analysis of the market in which their property is located to include market rents, market vacancy rates and market absorption rates; and, financial analysis of the subject property to include both historical results, and pro forma estimates of revenues, expenses, cash flow and residual value. Each team also studies the financial characteristics of comparable properties. The grand finale of the Real Estate Practicum (and the IPRE curriculum) is the Collins Family Scholarship Competition. Held at the conclusion of the spring semester, this competition is the public vehicle for the Practicum teams to present the results of their property studies. Consent of instructor required.

Prerequisites: IPRE 347

International Relations

Today’s world is more interconnected than ever before: what happens “here” affects what happens “there” and vice versa. The economic fortunes of countries, firms, and individuals have become so sensitive to trade, monetary, and investment decisions made elsewhere that economic policy that is purely national has become all but impossible. Nuclear weapons, which can kill thousands in minutes, do not respect international boundaries; neither do the consequences of ethnic and communal conflicts. Non-state actors, from terrorists to human rights activists, also act across boundaries. The Internet has made it easier than ever to form networks and political movements that span borders. Climate everywhere is affected by environmental decisions anywhere.

In the 21st century, no state – not even the United States, though it has become the first sole superpower in the history of the modern international system – and no citizen can make important choices in a sound manner without understanding how their decisions are shaped by what happens outside the boundaries of their homeland; moreover, their decisions often affect people who live far beyond those borders.

International Relations (IR) is the study of world politics in all of its aspects: International security covers issues related to war and peace, among and within societies. International political economy focuses on the political dimensions of trade, investment, development, and poverty. International law, organizations, and ethics and norms involve the study of how legal principles and agreements and moral values contribute to the creation of order, create the basis for stable expectations, and regulate transactions among states and other participants in world affairs. IR theory exposes students to the major explanatory frameworks that have been developed for the study of international relations.

IR investigates the gamut of economic, technological, social, and cultural and military forces that create the increasing interdependence that we call “globalization.” IR examines the ways in which globalization and other factors have sometimes contributed to creation of order but also often to breakdown of order, violence among and within states, and to assertions of particularity, whether based on ethnicity, nationalism, or on differences in culture, or wealth. Much of IR is devoted to explaining the behavior of states, but IR also encompasses many entities besides sovereign states. These include international organizations (such as the United Nations and its affiliate organizations); nongovernmental organizations; and intergovernmental organizations, such as the World Trade Organization, the European Union, the African Union, or Mercosur, the Latin American trading bloc.

Lehigh University has one of the few Departments of International Relations in the United States. At Lehigh world politics is not simply a division of political science. The IR Department is therefore able to offer a concentrated and multifaceted program, and one that is truly interdisciplinary. Some IR faculty study world politics as scholars of particular geographic regions, others as theorists seeking to explain the major processes of world politics regardless of where and when they occur; for instance, the causes and consequences of different forms of warfare; the rise and decline of empires; the challenges posed by environmental degradation; and the forces that create both wealth and poverty. What we share is the dedication to teaching and scholarship and the commitment to encouraging our students to engage new ideas and to subject familiar ones to thorough scrutiny.

Judging by the number of students who choose IR as their major, it is one of the most popular disciplines at Lehigh. Moreover, as befits a field that cuts across so many disciplines, we draw students who also pursue coursework, minors, or “double majors” in fields ranging from Religion Studies, Modern Languages and Literatures, Economics, and History to Computer Science, Biology, Engineering, and Environmental Policy.

THE CURRICULUM

Students considering course work in international relations are strongly encouraged to visit the International Relations web site (http://cas.lehigh.edu/ir). Prospective International Relations majors should enroll in IR 010 and ECO 001 as early as possible. We recommend that IR majors fulfill the mathematics portion of their college distribution requirement with MATH 012 (Basic Statistics), although this course is not required for the major.

DEPARTMENTAL HONORS

To graduate with Departmental honors, a major in international relations must:

1. successfully complete a two semester honors thesis (IR 388) in the senior year;
2. attain a GPA of at least 3.5 in the courses constituting the IR major program at the time of graduation. See department website for additional information.

BEYOND THE IR CURRICULUM

In close cooperation with the international education office, the department assists students interested in study abroad programs. In addition, Lehigh has an array of summer programs, which involve course work and/or internships in such countries as China, the Czech Republic, and the United Kingdom.

Every semester students with expertise on various aspects of world affairs visit Lehigh. Featured speakers have included Dr. Madeline Albright, former U.S. Ambassador to the United Nations; Dr. Shashi Tharoor, former U.N. Under-Secretary-General for Communications and Public Information; Dr. Ernesto Zedillo, former President of Mexico and Director of the Yale Center for the Study of Globalization; and General Anthony Zinni, 40 year Marine Corps veteran and U.S. peace envoy to the Middle East.

The student-run World Affairs Club sponsors a number of activities each year, including student-faculty socials, guest speakers, and related programs. It organizes the Model United Nations program to which Lehigh sends a delegation each year. From time to time, delegations are also sent to other student conferences, including at West Point and the U.S. Naval Academy.

The department has an active program in conjunction with Career Services to help place students in internships. We strongly encourage students to obtain an internship. Most of these internships are likely to be in New York or Washington, D.C.

UPON GRADUATING

While a degree in international relations does not lead to a specific career in the way that, for example, accounting or engineering does, a major in international relations, by emphasizing clarity in speech and writing, analytical skills, and a detailed knowledge of world politics prepares students for careers in international business, government, journalism, law, nongovernmental organizations, and teaching and
research. Recent IR graduates currently work in all of these fields. Some have gone directly into careers upon graduating; others have enrolled in graduate school prior to employment.

Professors. Henri J. Barkey, PhD (University of Pennsylvania); Norrin M. Ripsman, PhD (University of Pennsylvania)

Associate Professors. Dinissa Duwanova, PhD (Ohio University); Yinan He, PhD (Massachusetts Institute of Technology); Chaim D. Kaufmann, PhD (Columbia University); Kevin Narizny, PhD (Princeton University)

Assistant Professor. Arman Grigoryan, PhD (Columbia University)

Emeriti. Rajan M. Menon, PhD (University of Illinois Urbana); Bruce E. Moon, PhD (Ohio State University); Oles M. Smolansky, PhD (Columbia University); Raymond F. Wylie, PhD (University of London)

MAJOR IN INTERNATIONAL RELATIONS

The major consists of eleven courses for a total of 40 credits, plus one collateral course. This is the minimum requirement, however, and we strongly urge students to enrich their educations by going further. The courses required are:

Collateral requirements
ECO 001 Principles of Economics 4

Introductory courses
IR 010 Introduction to World Politics 4

Core courses
Select four courses, one from each of the following functional groups: 16

- International Relations Theory and Methods
  - IR 100 Methods and Research Design
  - IR 105 Theories of International Relations
  - IR 106 Foreign Policy

- International Political Economy
  - IR 220 Globalization and World Politics
  - IR 225 International Political Economy

- International Security Studies
  - IR 234 Great Power Politics
  - IR 235 International Security
  - IR 236 Causes of War

- International Governance
  - IR 242 International Law
  - IR 245 International Organization

Advanced courses
Select any two IR courses numbered 300-387 (except IR 307) or IR 393 8

Electives
Select any IR courses other than IR 019, IR 090, IR 388 or IR 391 (normally three 4-credit courses). 12

Total Credits 40

1 Core or advanced courses beyond the minimum requirements may be counted as electives. Certain courses offered by other departments may also qualify. See the Department of International Relations for a complete list.

MINOR IN INTERNATIONAL RELATIONS

The minor consists of 16 credits:

- IR 010 Introduction to World Politics 4

Select one advanced IR elective numbered 300-387 (except IR 307) or IR 393 4

Select free IR electives other than IR 019, IR 090 or IR 391 (normally two 4-credit courses). 8

Total Credits 16

JOINT INTERNATIONAL RELATIONS AND ECONOMICS MAJOR

Please click here: Joint IR/Eco Major (p. 289)

JOINT INTERNATIONAL RELATIONS AND MODERN LANGUAGES AND LITERATURES MAJOR

Please click here: Joint IR/MLL Major (p. 290)
IR 052 Ukraine at the Crossroads: Regime Change and International Politics 4 Credits
This course investigates Ukraine’s Orange Revolution, Euromaidan protests, Russia’s annexation of Crimea, and the armed conflict in Eastern Ukraine. It will analyze domestic and international causes and consequences of these events through the lenses of news reports, social media, and scholarly publications. The course will introduce students to some basic concepts in the study of domestic and international conflict and facilitate a better understanding of current international events.
Attribute/Distribution: SS

IR 056 European International Relations 4 Credits
Examines the evolution of the modern states system in Europe. Conceptual, theoretical and historical topics include the transition from feudalism to the Westphalian system, nationalism, imperialism, the causes of war and attempted peace settlements, the Cold War, the European Union, and the impact of the collapse of the USSR on the political and strategic structure of Europe.
Attribute/Distribution: SS

IR 057 Political Economy of Post-Communist Transitions and European Integration 4 Credits
Central and Eastern Europe, which was once ruled by communist regimes supported by the Soviet Union, underwent radical political and economic transformations in the 1990s. For the first time after decades of communism, East European countries held competitive elections, introduced market principles in their economies, and joined European institutions. This course focuses on the analysis of post-communist economic transitions and the region’s economic integration with the European Union.
Attribute/Distribution: SS

IR 061 (ASIA 061) East Asian International Relations 4 Credits
Introduction to East Asian international relations, with emphasis on post-1945 period: historical background of Asian international system; Cold War conflicts; China’s rise and regional responses; Japan’s changing international role; the two Koreas; ASEAN and Asian regionalism; U.S. and Russian policies; current and future issues.
Attribute/Distribution: SS

IR 062 (ASIA 062) US-China Relations 4 Credits
Introduction and analysis of the historical context and key aspects of contemporary US-China relations: Korean War, Vietnam War, and US containment; rapprochement and diplomatic normalization; Taiwan controversy; post-Tiananmen twists and turns; economic interdependence and frictions; security relations; human rights and environmental issues.
Attribute/Distribution: SS

IR 063 (ASIA 063) U.S.-China Relations 4 Credits
Introduction and analysis of the historical context and key aspects of contemporary US-China relations: Cold War US containment, rapprochement and diplomatic normalization; American arms sale and the Taiwan controversy; conflict and cooperation in the Korean Peninsula; economic interdependence and frictions; human rights and security relations; Asian regional disputes. Students may not receive credit for both IR/ASIA 063 and IR/ASIA 163.
Attribute/Distribution: SS

IR 074 American Foreign Policy 4 Credits
Addresses major themes and trends in U.S. foreign policy, including its historical evolution. Assesses the interests and values that underlie the goals of policy and the beliefs that shape decisions on how to achieve those goals. Also examines issues such as the constitutional division of authority, bureaucratic politics and processes, civil-military relations, and public opinion.
Attribute/Distribution: SS

IR 082 Middle East in World Affairs Since 1945 4 Credits
Rise of Turkish, Iranian, and Arab nationalism; creation of Israel; decline of British and French power; growth of U.S. and Soviet influence; Middle East as the world’s major oil producer.
Attribute/Distribution: SS

IR 086 (JST 086) The Israeli-Palestinian Conflict 4 Credits
Attribute/Distribution: SS

IR 100 Methods and Research Design 4 Credits
The course has two principal aims - to introduce students to the logic of social scientific research and to equip them with the basic tools of research design. To that end the course 1) examines controversies surrounding the scientific method; 2) analyzes the logics of experimental, statistical, and case-study methods; 3) explores the most common methodological errors in social scientific research; and 4) gives students a hands-on experience in designing a study.
Prerequisites: IR 010
Attribute/Distribution: SS

IR 105 Theories of International Relations 4 Credits
The role of theory in historical explanation, prediction, and policy. Issues of theory design and testing. Important theoretical approaches to international relations, including Realism; the Democratic Peace; the domestic politics of foreign policy; history and mythmaking; psychological explanations.
Prerequisites: IR 010
Attribute/Distribution: SS

IR 106 Foreign Policy 4 Credits
Investigation of foreign policy processes and repeating patterns in the United States and other countries. Roles of political systems and cultures, permanent institutions and bureaucratic politics, and elite and mass psychology.
Prerequisites: IR 010
Attribute/Distribution: SS

IR 108 Game Theory and International Politics 4 Credits
The course is designed as a rigorous treatment of the concept of strategic interaction. The focus is on topics like collective action, bargaining under incomplete information, problems of moral hazard and adverse selection, and evolutionary models of interaction. The empirical examples will mostly be drawn from international politics, but anyone curious about the general claim that good outcomes do not necessarily follow from good intentions should find this course interesting.
Attribute/Distribution: MA, SS

IR 119 Issues in International Relations 1-4 Credits
Readings on selected themes in world politics, with theme to change each semester. Offered on an occasional basis only.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS

IR 127 Research in International Relations 4 Credits
Research skills in international relations. The role of theory, models and evidence in the explanation of international phenomena. Literature review; problem formulation; theory construction; research design, methods and measures; collection, analysis and interpretation of data; principles of hypothesis testing. Professional writing, either through individual research projects under faculty supervision or an apprenticeship in ongoing faculty research projects. Consent of instructor required.
Prerequisites: IR 010
Attribute/Distribution: SS
IR 132 Nationalism and Ethnic Conflict 4 Credits
The ideal of nationalism exerts a powerful pull on almost all people everywhere. This course investigates the sources, spread, and possible future decline of nationalism and national identity, the manipulation of nationalist feelings for political purposes, and the sources of national and ethnic conflict. We will also consider proposals for managing ethnic conflicts and their records of success (or failure). We will study recent and current cases, such as the Israeli-Palestinian conflict, ethnic relations in Iraq and Afghanistan, the Balkans, or others as current events demand. Prospects for the futures of nationalism, ethnic conflict, and ethnic conflict management. Simulations of decision-making of groups involved in ethnic conflicts.
Attribute/Distribution: SS

IR 140 The United Nations 4 Credits
Provides overview of key issues and debates in the United Nations and helps students understand the formal and informal operations of this global organization. We will explore two major questions. First, what are the major obstacles to effective international cooperation in the United Nations? Second, what does globalization mean for UN efforts to promote democracy, development, and human rights? Includes a trip to UN Headquarters in NY and an in-class UN simulation exercise.
Prerequisites: IR 010
Attribute/Distribution: SS

IR 163 (ASIA 163) U.S.-China Relations 4 Credits
Introduction and analysis of the historical context and key aspects of contemporary US-China relations: Cold War US containment, rapprochement and diplomatic normalization, American arms sale and the Taiwan controversy; conflict and cooperation in the Korean Peninsula; economic interdependence and frictions; human rights and security relations; Asian regional disputes. This is an advanced course on US-China relations. Students may not receive credit for both IR/ASIA 063 and IR/ASIA 163.
Prerequisites: IR 010 or IR 061
Attribute/Distribution: SS

IR 164 (ASIA 164) Japan in a Changing World 4 Credits
This course explores Japanese foreign policy through its historical and international context; domestic determinants; foreign and security policymaking process; policy to major regional players; foreign economic policy; current grand strategic debates.
Prerequisites: IR 010 or IR 061
Attribute/Distribution: SS

IR 169 The Politics of Eurasia 4 Credits
The course is an exploration of the most important issues and debates about the politics of the post-Soviet space. They include the collapse of communism, the collapse of the USSR, the problems of economic and political transition, the conflicts of the post-Soviet space, the problem of selective integration of post-Communist states into the Western integration, and many others.
Attribute/Distribution: SS

IR 177 International Relations of Latin America 4 Credits
Survey of major international and domestic crises facing Central and South America. Examines factors affecting Latin American system of states such as international debt, involvement of foreign powers, and social and political instabilities.
Attribute/Distribution: SS

IR 220 Globalization and World Politics 4 Credits
An exploration of the economic, political, cultural, and military manifestations of globalization and the effects on the internal order of states and the relations among them.
Prerequisites: IR 010 and ECO 001
Attribute/Distribution: SS

IR 222 Political Economy of North-South Relations 4 Credits
Political economy of relations between developed and less developed countries. Issues arising from trade, investment, and foreign aid. Consequences of North-South transactions. Controversies over system structure and reform proposals for international institutions (e.g. World Bank, IMF, WTO).
Prerequisites: IR 125 or POLS 125
Attribute/Distribution: SS

IR 225 (POLS 225) International Political Economy 4 Credits
Principles governing the interaction between the economic and political components of international phenomena. Political aspects of trade, investment, and global economic order. Political underpinnings of international economic relations. Domestic and international political consequences of economic policy and international economic relations.
Prerequisites: IR 010 and ECO 001
Attribute/Distribution: SS

IR 226 Political Economy of Corruption II 4 Credits
This course examines causes and consequences of various forms of corruption from the political-economic perspective; helps students better understand various sources, types, patterns, and consequences of corruption; considers corruption that exists in both the public and private sectors; evaluates how corruption affects economic growth and resource allocation; and assesses global and national strategies to reduce corruption. Students may not receive credit for both IR 026 and IR 226.
Prerequisites: ECO 001
Attribute/Distribution: SS

IR 234 Great Power Politics 4 Credits
Overview of the dynamics of strategic interaction between great powers, including the causes of conflict, origins of alliances, logic of coercion, sources of order, and definition of national interests. Focus on the interwar period (multi-polarity), the Cold War (bio-polarity), and the post-Cold War period (uni-polarity).
Prerequisites: IR 010
Attribute/Distribution: SS

IR 235 International Security 4 Credits
Explanations of international wars, civil wars, genocides, and terrorism. Arms races, escalation, and conflict resolution. The nuclear revolution and ballistic missile defense. Tools of national grand strategy, including alliances, deterrence, coercion, and institutions and norms. Current issues and near future prospects. Case studies.
Prerequisites: IR 010
Attribute/Distribution: SS

IR 236 Causes of War 4 Credits
Systematic examination of major schools of thoughts on the origins and prevention of war, including system-level theories of war and peace, domestic and societal sources of conflict, military policy, and ideational and psychological causes of war. Application and testing of theories to classic cases of war and conflict in history and the contemporary world.
Prerequisites: IR 010
Attribute/Distribution: SS

IR 242 International Law 4 Credits
This course deals with the nature and sources of international law and the major theoretical and historical developments that have created the legal system of states as it now stands. Topics include: armed conflict, international trade, human rights and international environmental law.
Prerequisites: IR 010
Attribute/Distribution: SS

IR 245 International Organization 4 Credits
Examines how cooperation is achieved and sustained in world politics. Under what circumstances does cooperation take place? What role do formal international organizations play? What is the relative importance of power, ideas, and economic interests? Pursues questions theoretically and in practical terms across topical issues (e.g., humanitarian intervention, environmental protection).
Prerequisites: IR 010
Attribute/Distribution: SS
IR 257 Political Economy of Post-Communist Transitions and European Integration 4 Credits
Central and Eastern Europe, which was once ruled by communist regimes supported by the Soviet Union, underwent radical political and economic transformations in the 1990s. For the first time after decades of communism, East European countries held competitive elections, introduced market principles in their economies, and joined European institutions. This course focuses on the analysis of post-communist economic transitions and the region’s economic integration with the European Union.
Prerequisites: ECO 001
Attribute/Distribution: SS

IR 307 (ENTP 307, SDEV 307) International Social Entrepreneurship Practicum 4 Credits
International social entrepreneurship aims to change the world through innovation in solving social problems. Focus on the nexus between social entrepreneurship and development practice, especially in relation to NGOs. Emphasis on acquiring tools and conceptual frameworks to launch new social ventures through real hands-on international fieldwork and team-oriented learning by doing. Exposure to best practices of how to affect meaningful social change in poor countries, to generate and evaluate innovative ideas to develop them into concrete on-the-ground startups.
Attribute/Distribution: SS

IR 321 Economic Relations of Advanced Industrial Societies 4 Credits
Foreign economic policies of advanced industrial nations. Bilateral and multilateral economic relations; international economic regimes and institutions; interdependence and Cooperation; managing conflict. Consent of department required.
Prerequisites: (IR 125)
Attribute/Distribution: SS

IR 322 Poverty and Development 4 Credits
Patterns and causes of poverty in poor countries. Diagnosis of development problems and evaluation of development planning. Explanations for choices of development policy, especially issues of trade, foreign aid, and foreign direct investment. Written and oral presentation of individual country research. Consent of department required.
Prerequisites: IR 010
Attribute/Distribution: SS

IR 323 Political Economy of Industrialization and Development 4 Credits
Political foundation and consequences of economic development and growth. Global inequality in the rates and levels of economic development. Analysis of the differences between the development strategies adopted in different parts of the world. Explanations for patterns of success and failure. Origins of underdevelopment; the politics of failed development strategies; the challenge of the increasingly competitive world economy and relations with the U.S. and other developed nations. Consent of department required.
Prerequisites: IR 125 and IR 010
Attribute/Distribution: SS

IR 330 Mass Murder 4 Credits
Is mass murder modern or ancient? Is such violence committed by states or societies? Why do some conflicts degenerate to mass murder and some do not? Are democracies immune to committing this kind of violence? These are just some of the questions that inform the critical examination of the literature on mass murder, which is the principal aim of this course. The prominent cases of mass murder in the 20th century form its main empirical content. Consent of department required.
Prerequisites: IR 010
Attribute/Distribution: SS

IR 333 (ES 333) International Environmental Law & Policy 4 Credits
This course examines the basic international legal setting for the protection and management of the global environment. It examines how international law concerning nature is made and applied, the role of international environmental regimes or institutions, enforcement strategies, and compliance mechanisms. Emphasis will be placed on a review of various regulatory regimes for the protection of the global commons, including the history and legal sources of the Global Climate Change Convention.
Attribute/Distribution: SS

IR 334 Prospects for Peace in the 21st Century 4 Credits
Will the 21st century be more or less peaceful than the “terrible 20th”? This course examines: globalization as a force both for and against peace, the proliferation of weapons of mass destruction, terrorism, nationalism and communal conflict, humanitarian intervention and peacekeeping, climate change and other issues affecting prospects for peace in the near future. We will also consider the special situation of American as the world’s sole superpower, choices in U.S. policy between unilateral and multilateral approaches to preserving global and regional peace, and decision-making processes of the U.S. and other important actors. Consent of department required.
Prerequisites: IR 010
Attribute/Distribution: SS

IR 335 Intervention 4 Credits
Strong states frequently intervene in the affairs of weaker societies. Since 1945, the most frequent intervener has been the United States. International norms cut both ways—sovereignty opposes intervention while an emerging “responsibility to protect” sometimes favors it. This course explores why and by what means states and international organizations intervene and what factors influence the success of interventions. We focus mainly on two types – counterinsurgency and humanitarian intervention – that have been and are likely to remain the most common. Consent of department required.
Prerequisites: IR 010
Attribute/Distribution: SS

IR 337 Conflict and Cooperation 4 Credits
The course is designed as an advanced undergraduate seminar to students, who are interested in getting deeper familiarity with the rational choice literature on conflict and cooperation. Its primary focus is on socially suboptimal outcomes in situations that can be modeled as a prisoners’ dilemma, collective action problems, bargaining failures due to incomplete information and commitment problems, etc. The applied material deals with issues like crisis bargaining, alliance politics, revolutions, interventions, trade, democratic transitions, etc. Consent of department required.
Attribute/Distribution: SS

IR 342 (ES 342) 4 Credits
Beginning in the 13th Century, this course traces the various philosophical, historical, and policy design arguments that have been used to explain, justify, and influence the evolution of the rule of law between states (ius gentium).
Attribute/Distribution: SS

IR 343 (ES 343) Comparative Environmental Law & Policy 4 Credits
This course studies the different ways in which domestic legal systems handle the regulation of humanity’s relationship to the natural world. The first part of the course concentrates on comparative law that examines the evolution of distinct types of legal systems from their origins in the ancient world. The second part of the course specifically and comparatively examines environmental law as it has developed in Canada, China, the European Union and the United States. Ranges of alternatives for environmental law and policy as practiced in various parts of the world will be explored.
Attribute/Distribution: SS
IR 344 International Politics of Oil 4 Credits
Historical influence of oil in international politics and the role it plays today. Focus on differing views of producers, such as Middle Eastern and Latin American states, and consuming nations, largely the economically developed Western states. Consent of department required.
Prerequisites: IR 010 or ECO 001
Attribute/Distribution: SS

IR 345 Democratization 4 Credits
Interdisciplinary analysis of international and transnational influences on regime transitions. Addresses the role of war, trade, colonial legacies, waves of democratization, socializations, demonstration effects, and international law; the policies of the United States, EU, OAS, UN, World Bank, and NGOs; and the efficacy of different instruments of democracy promotion. Consent of department required.
Prerequisites: IR 010
Attribute/Distribution: SS

IR 346 Contemporary Ethical Dilemmas in World Politics 4 Credits
This course is designed to explore, challenge, and re-conceptualize the boundaries of moral community and ethical responsibility through such current dilemmas in world politics as famine, terrorism, torture, genocide, weapons of mass destruction, organized crime and more. Consent of department required.
Prerequisites: IR 010
Attribute/Distribution: SS

IR 347 Non-State Actors in a Globalized World 4 Credits
Role of non-state political groups (e.g., international advocacy organizations, multinational corporations, news media, terrorists, etc.) in world affairs. Thematic focus on globalization, the relationship between non-state and state actors, and the implications of non-state actors for the future of world order. Themes explored through past and current events (e.g., the WTO demonstrations, 9/11, the CNN effect, AIDS, anti-sweatshop campaigns.) Consent of department required.
Prerequisites: IR 010
Attribute/Distribution: SS

IR 364 (ASIA 364) Chinese Foreign Policy 4 Credits
Research-oriented seminar focusing on the sources of Chinese foreign policy preferences and goals, foreign policy decision-making processes; international implications of the rise of China, and the pressing regional and global issues that China is facing now and in the future. Consent of department required.
Prerequisites: IR 010 or IR 061 or IR 062 or ASIA 061 or ASIA 062 or IR 063 or ASIA 063 or IR 161 or ASIA 161 or IR 163 or ASIA 163
Attribute/Distribution: SS

IR 367 International Relations of Russia and other Post-Soviet States 4 Credits
Analysis of foreign relations of Russia and the other fourteen states that emerged after the collapse of the USSR. Consent of department required.
Prerequisites: (IR 010 or IR 169)
Attribute/Distribution: SS

IR 388 Honors Thesis in International Relations 4 Credits
International relations majors with senior standing may undertake an intensive, two-semester project under the direct guidance of a faculty member in the student's special area of interest. Students who successfully complete the thesis and whose GPA in the major at the time of graduation is 3.5 or higher receive Departmental Honors. Department permission required. See the Department or IR website http://cas.lehigh.edu/ir for additional information.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS

IR 389 (MLL 389) IR/MLL Capstone Project 4 Credits
A research project on international politics that will include original research in at least one foreign language under the joint supervision of an adviser in IR and one in the relevant language in MLL. Consent of department required.
Attribute/Distribution: SS

IR 390 Readings in International Relations 1-4 Credits
Directed course of readings intended for students with special competence or interest in fields of international relations not fully covered by regular course offerings. Department permission required.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS

IR 391 Internship in International Relations 1-4 Credits
Internship in public or private agency. Departmental permission required.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS

IR 392 Independent Study 1-4 Credits
This course enables students to work with faculty on individual projects and material not covered by the current course offerings. Department permission required.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS

IR 393 Seminar in International Relations 3,4 Credits
Advanced seminar, comparable to other 300-level seminars, that focuses on discussion and research on specialized subjects in international relations. Variable subject matter. Junior standing and department permission required.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS

IR 394 Special Topics in International Relations 1-4 Credits
Intensive, research oriented study for students with a special competence or interest in fields of international relations not fully covered by regular course offerings. Department permission required.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS

IR 493 IR Graduate Seminar 3 Credits
Graduate level research seminar.
Repeat Status: Course may be repeated.

Jewish Studies

Program Director: Hartley Lachter, Ph.D. (https://religion.cas2.lehigh.edu/content/hartley-lachter) New York University (https://religion.cas2.lehigh.edu/content/hartley-lachter) (https://religion.cas2.lehigh.edu/content/hartley-lachter)

Email: lachter@lehigh.edu # Phone: 610-758-2130
Website: http://cjs.cas2.lehigh.edu/

Supported by the Office of Interdisciplinary Programs, 610-758-3996; incasip@lehigh.edu
Williams Hall, 31 Williams Drive

Core Faculty
Jodi Eichler-Levine, Ph.D. (Department of Religion Studies); Hartley Lachter, Ph.D. (Department of Religion Studies); Nitzan Lebovic, Ph.D. (Department of History); Roslyn Weiss, Ph.D. (Department of Philosophy); Ben Wright, Ph.D. (Department of Religion Studies)

The Jewish studies minor, coordinated by the Philip and Muriel Berman Center for Jewish Studies, provides students with the opportunity to explore the history, literature, religion, and social institutions of the Jewish people from its inception to the present. The diverse selection of courses highlights the interaction of Judaism with other cultures and societies in Europe, the Middle East, and the United States. Students will discover that courses in Jewish studies enhance their understanding of individual and group identity and the dynamics of religious-cultural pluralism. The program is designed to appeal to students with varied interests in any field of concentration. The flexible requirements of the minor in Jewish Studies make it an ideal compliment to any major or minor in Arts and Sciences, Business and Economics, Engineering, or Education. Students should coordinate their minor program in Jewish studies with the director.

The Berman Center for Jewish Studies supplements formal course offerings through an extensive program of lectures, colloquia, films, field trips, and other cultural events. The Center also provides funding
to students to help them pursue study abroad experiences or other enhancements to their academic work in the field of Jewish Studies. Students pursuing a minor in Jewish studies must fulfill 16 credit hours.

Four (4) courses from the approved course list or in consultation with the program director.¹

Total Credits 16

¹ A maximum of eight credit hours of Hebrew may be counted

**Courses**

**JST 073 (REL 073) The Jewish Tradition 4 Credits**

Judaism is both a textual tradition and a lived religion. Students read the Jewish scriptures in context, exploring the complex relationships and interactions between the textual and the lived. This course is designed to provide a broad overview of Jewish traditions and beliefs, with a focus on how these traditions have been interpreted and practiced throughout history. It covers the history of Judaism, from its origins to the present day, and examines key themes and concepts in Jewish thought and practice. The course also explores the ways in which Jewish traditions have evolved and transformed over time, and how they continue to shape the lives of Jews today. Students will have the opportunity to engage with primary texts and sources, as well as with secondary literature and scholarly commentary. The course is taught in English, and students will be expected to participate actively in class discussions and to produce written work that demonstrates a deep understanding of the material covered. Attribute/Distribution: SS

**JST 066 (IR 086) The Israeli-Palestinian Conflict 4 Credits**


**JST 102 (AAS 102, ENGL 102, REL 102) Promised Lands: Jewish and African American Children’s Literature 4 Credits**

In the Hebrew Bible, Psalm 137 asks, "How can we sing the Lord’s song in a strange land?" For Jews, blacks, and black Jews, this was and is a poignant question. This course examines how these two rich, often overlapping and interacting groups tell their stories in literature for children and young adults, with a particular focus on the mediation of traumatic pasts. What does it mean to imagine promised lands beyond such pasts—and can they be reached? Attribute/Distribution: HU

**JST 112 (REL 112) The Beginnings of Judaism and Jewish Origins: Jewish Diversity in the Greco-Roman World 4 Credits**

The religious expression of the Hebrews, Israelites, and Jews as found in the Jewish Scriptures (TANAK/Christian Old Testament). Near Eastern context of Hebrew religion, the Patriarchs, the Exodus, the monarchy, prophecy, Exile and Return. Emphasis on historical, literary, critical problems, and newer socio-historical methods. Attribute/Distribution: HU


The religious expression of the Hebrews, Israelites, and Jews as found in the Jewish Scriptures (TANAK/Christian Old Testament). Near Eastern context of Hebrew religion, the Patriarchs, the Exodus, the monarchy, prophecy, Exile and Return. Emphasis on historical, literary, critical problems, and newer socio-historical methods. Attribute/Distribution: HU

**JST 121 (REL 121) Sources for the Life of Jesus: the Jewish and Christian Context 4 Credits**

Consideration of how major Jewish thinkers from the first to 21st centuries confronted questions at the intersection of religion and philosophy: the existence and nature of God, free will, evil, divine providence, miracles, creation, revelation, and religious obligation. Attribute/Distribution: HU
JST 138 (REL 138, WGSS 138) Sex, Gender, Jews 4 Credits
How do Jews of all genders tell their stories? What are the varied Jewish approaches to sexuality? How have feminist movements affected Jewish rituals? In this course, we will consider how religion, gender, sexuality, race, and class intersect in the lives of Jews, with a particular focus on North America. Topics and will include: Jewish women’s memoirs; the voices of LGBTQ Jews; recent innovations in Jewish ritual and leadership; Jewish masculinities; and the gendering of Jewish children’s literature, among others.
Attribute/Distribution: HU

JST 139 (ANTH 139, REL 139) Jewish Folklore 4 Credits
Examines the transformation of folk and popular Judaism from the Old World, through the period of immigration to America, to ethnic and later forms of American Jewish culture. Attention paid to concept of folklore revivals and their meanings. Four case studies: folk tales and storytelling, klezmer music, life-cycle rituals, and food.
Attribute/Distribution: SS

JST 152 (REL 152) American Judaism 4 Credits
Diverse cultural and social forms through which American Jews express their distinct identity. Is American Jewry an example of assimilation and decline or creative transformation? What, if anything, do American Jews share in common? Compatibility of Judaism with individualism, pluralism, and voluntarism. How have the Holocaust and the State of Israel shaped the self-understanding of American Jewry?
Attribute/Distribution: HU

JST 154 (HIST 154, REL 154) The Holocaust: History and Meaning 4 Credits
The Nazi Holocaust in its historical, political and religious setting. Emphasis upon the moral, cultural and theological issues raised by the Holocaust.
Attribute/Distribution: HU

JST 156 (REL 156) Judaism and Comic Books 4 Credits
Is The Thing Jewish? What does Superman have to do with the bible? Do Orthodox Jewish girls fight trolls? In this course, we will closely examine comic books and graphic novels in order to expand our understanding of what Jewishness might mean. With a POW! and a BAM!, we will consider many topics “from Krakow to Krypton,” including American Jewish history, how representations of Jews are gendered, and decline or creative transformation? What, if anything, do American Jews share in common? Compatibility of Judaism with individualism, pluralism, and voluntarism. How have the Holocaust and the State of Israel shaped the self-understanding of American Jewry?
Attribute/Distribution: HU

JST 174 (REL 174) Contemporary Theology 4 Credits
Major 20th century movements within Christian and Jewish theology understood as responses to the problems of modern times. May be repeated for credit as the subject matter varies.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

JST 180 Independent Study in Jewish Studies 1-4 Credits
Directed readings or research on a Jewish Studies related topic under the direction of a Jewish Studies faculty member. May be repeated for credit up to eight credits. Must have consent of the program director.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU, SS

JST 181 Special Topics in Jewish Studies 4 Credits
Study of a subject or issue in Jewish Studies not covered in other courses. May be repeated for credit as subtitle varies.
Repeat Status: Course may be repeated.

JST 185 (HIST 185, REL 185) Modern Jewish History 1800-2000 4 Credits
This course examines the emergence of distinct forms of Jewish culture in the modern age that challenge or depart from traditional Jewish sources and authority. Included are an examination of Freud’s psychology, Chagall’s paintings and Woody Allen’s films.
Attribute/Distribution: HU

JST 230 (REL 230) Kabbalah: Jewish Mystical Tradition 4 Credits
Explores the history of the quest to know God, through mystical experience or theosophical speculation, as found in Jewish tradition. Examines such issues as the tensions between institutional religion and personal religious experience, between views of God as immanent in the world or transcending it, and between imagery for God and religious experience of God.
Attribute/Distribution: HU

JST 231 (REL 231) Classic Jewish Texts 4 Credits
Many people know that the Hebrew Bible (“Old Testament”) is a foundational scripture for Judaism. Fewer are familiar with the post-biblical Jewish classics. Yet these works shaped the understanding of God, the identity of the Jewish people, and the vision of history and of the ethical life that inform Judaism today. As students read the Talmud, Midrash, and traditional prayer-book, they will become familiar with the wisdom of the rabbinic sages, and the central concepts of Judaism.
Attribute/Distribution: HU

Joint International Relations and Economics Major
This major combines international economics, which is the study of markets and economic policy, with international political economy, which studies international institutions and the interactions of states with those institutions and each other motivated by tradeoffs among economic goals and considerations of power, national security, and citizen welfare. Study of economic theory as well as institutional arrangements allows students to understand consequences for the world economy including political and distributional consequences.
Program Advisors: Professor Dinissa Duvanova, International Relations Department

Professor Frank R. Gunter, Economics Department

Professors.
Henri J. Barkey, PhD (University of Pennsylvania); Shin-Yi Chou, PhD (Duke University); James A. Dearden, PhD (The Pennsylvania State University); Mary E. Deily, PhD (Harvard University); Frank R. Gunter, PhD (Johns Hopkins University); Thomas J. Hyclak, PhD (University of Notre Dame); Judith A. McDonald, PhD (Princeton University); Vincent G. Munley, PhD (State University of NY, Binghamton University); Norrin M. Ripsman, PhD (University of Pennsylvania); Larry W. Taylor, PhD (University of North Carolina Chapel Hill); Robert J. Thornton, PhD (University of Illinois Upper Chicago); Todd A. Watkins, PhD (Harvard University)

Associate Professors.
Dinissa Duvanova, PhD (Ohio University); Yinan He, PhD (Massachusetts Institute of Technology); Chaim D. Kaufmann, PhD (Columbia University); Chad Meyerhoefer, PhD (Cornell University); Kevin Nariney, PhD (Princeton University); Oleksandr Nikolosko Rchesvsky, PhD (University of Houston University Park); Muzhe Yang, PhD (University of California Berkeley)

Assistant Professors.
Weijia Dai, PhD (University of Maryland); Arman Grigoryan, PhD (Columbia University); Ernest-Kong-Wah Lai, PhD (University of Pittsburgh); Alberto Lamadrid, PhD (Cornell University); Irina Panovska, PhD (Washington University); Seth Richards-Shubik, PhD (University of Pennsylvania)

Professor Of Practice. Marija Baltrusaitiene, MA (University of Iowa)
Emeriti.
J. Richard Aronson, PhD (Clark University); Nicholas W. Balabkins, PhD (Rutgers University); Jon T. Innes, PhD (University of Oregon); Arthur E. King, PhD (Ohio State University); John R. Mc Namara, PhD (Rensselaer Polytechnic Institute); Rajan M. Menon, PhD (University of Illinois Urbana); Bruce E. Moon, PhD (Ohio State University); Anthony Patrick O’Brien, PhD (University of California Berkeley); Warren A. Pillsbury, PhD (University of Virginia); Oleksandr Nikolsky, PhD (Columbia University); Raymond F. Wylie, PhD (University of London)

Collateral course in Mathematics:
Any one of the following courses:
MATH 021 Calculus I 4
MATH 031 Honors Calculus I 4
MATH 051 Survey of Calculus I 4
MATH 075 Calculus I, Part A 4
& MATH 076 Calculus I, Part B 4
The multidisciplinary Joint IR/MLL Major is offered jointly by the Department of International Relations (IR) and the Department of Modern Languages and Literatures (MLL). The program, which offers a Bachelor of Arts, incorporates courses from both IR and MLL, as well as electives from a broad cross-section of other departments, for a challenging program that requires overseas study, language facility, and undergraduate research.

The Joint IR/MLL Major recognizes that Lehigh graduates must be adequately prepared to play and active role in the world of the 21st century. For that, they will need an acute understanding of essential issues of global politics, broad linguistic and cultural skills, significant overseas experience, and both intellectual and cultural sophistication. The Joint IR/MLL Major meets those requirements with courses in economics, international relations, language, and culture. Extended study abroad and undergraduate research in more than one language are also required. The program will help students develop a deeper and richer understanding of cultural, linguistic, and political diversity around the world.

The program requires a total of 16 courses for 60-64 credits. At least one semester of study abroad in an approved Lehigh program is required, as is undergraduate research that uses sources in at least one language other than English. Each student will have two major advisors, one each from IR and MLL.

**Professors.** Henri J. Barkey, PhD (University of Pennsylvania); Marie-Helene Chabut, PhD (University of California San Diego); Constance A. Cook, PhD (University of California Berkeley); Kiri Lee, PhD (Harvard University); Mary A. Nicholas, PhD (University of Pennsylvania); Norrin M. Ripsman, PhD (University of Pennsylvania)

**Associate Professors.** Marie-Sophie Armstrong, PhD (University of Oregon); Matthew R. Bush, PhD (University of Colorado Boulder); Dinissa Duvanova, PhD (Ohio University); Yinan He, PhD (Massachusetts Institute of Technology); Chaim D. Kaufmann, PhD (Columbia University); Kevin Narizny, PhD (Princeton University); Antonio Prieto, PhD (Princeton University); Vera S. Stegmann, PhD (Indiana University)

**Assistant Professors.** Taieb Berrada, PhD (Northwestern University); Thomas Chen, PhD (University of California Los Angeles); Arman Grigoryan, PhD (Columbia University); Miguel Pillado, PhD (University of California Berkeley); Nobuko Yamasaki, PhD (University of Washington)

**Lecturers.** Jessica Racines Brandt, MA (Lehigh University); Eunice Cortez, PhD (Temple University)

**Professor Of Practice.** Limei Shan, MS (East China Normal University)

**Emeriti.** Linda S. Lefkowitz, PhD (Princeton University); Rajan M. Menon, PhD (University of Illinois Urbana); Bruce E. Moon, PhD (Ohio State University); David W. Pankenier, PhD (Stanford University); Oles M. Smolansky, PhD (Columbia University); Anje C. Van Der Naald, PhD (Delft University of Technology); Thomas Chen, PhD (University of California Berkeley); Kiri Lee, PhD (Harvard University); Matthew R. Bush, PhD (University of Colorado Boulder); Dinissa Duvanova, PhD (Ohio University); Yinan He, PhD (Massachusetts Institute of Technology); Chaim D. Kaufmann, PhD (Columbia University); Kevin Narizny, PhD (Princeton University); Antonio Prieto, PhD (Princeton University); Vera S. Stegmann, PhD (Indiana University)

**Collateral Requirement**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECO 001</td>
<td>Principles of Economics</td>
<td>4</td>
</tr>
</tbody>
</table>

**International Relations - five courses - 20 credits**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>IR 010</td>
<td>Introduction to World Politics</td>
<td>4</td>
</tr>
<tr>
<td>IR 100</td>
<td>Methods and Research Design</td>
<td>4</td>
</tr>
<tr>
<td>or IR 105</td>
<td>Theories of International Relations</td>
<td></td>
</tr>
<tr>
<td>or IR 106</td>
<td>Foreign Policy</td>
<td></td>
</tr>
<tr>
<td>IR 220</td>
<td>Globalization and World Politics</td>
<td>4</td>
</tr>
<tr>
<td>or IR 225</td>
<td>International Political Economy</td>
<td></td>
</tr>
<tr>
<td>or IR 234</td>
<td>Great Power Politics</td>
<td></td>
</tr>
<tr>
<td>or IR 235</td>
<td>International Security</td>
<td></td>
</tr>
<tr>
<td>or IR 236</td>
<td>Causes of War</td>
<td></td>
</tr>
<tr>
<td>or IR 242</td>
<td>International Law</td>
<td></td>
</tr>
<tr>
<td>or IR 245</td>
<td>International Organization</td>
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</tr>
</tbody>
</table>

Two IR advanced courses numbered 300-387 (except IR 307) or IR 393

**Capstone Project**
A background in journalism, with its emphasis on research and writing, also proves to be excellent preparation for many other fields and provides a fine basis for the study and practice of law, graduate study in a variety of disciplines, government service, teaching and business management.

Students in science and environmental writing can expect to pursue careers in science, health and environmental journalism in both the traditional and online media; public relations for scientific societies, environmental organizations, government agencies, universities or hospitals; technical writing for industry and government agencies, and other areas, such as management, administration and teaching. The program also prepares students for graduate study in science or environmental writing, journalism and other disciplines.

The interdisciplinary minor in mass communication will be useful to Arts & Sciences students interested in organizational and written communication, law, business, philosophy, government, teaching, telecommunication or other careers where understanding of communication is important.

Students are also eligible for scholarships and awards. Incoming high school seniors can apply for the Rodale Scholar award, which provides a scholarship along with opportunities at Rodale, Inc., the global publisher of magazines, books and multimedia. Lehigh Journalism students compete for an array of prestigious writing prizes that include the William Prizes in Journalism, the Kachel Awards in Writing, the Cagan Award for reporting, the Strassberg Award for research, and the Jesse Siegel Writing Award.

Professors. Sharon M. Friedman, MA (The Pennsylvania State University); John F. Lule, PhD (University Georgia Athens)

Associate Professor. Kathleen K. Olson, PhD (University of North Carolina)

Assistant Professors. Haiyan Jia, PhD (The Pennsylvania State University); Jayeon Lee, PhD (Ohio State University); Jeremy J. Littau, PhD (University of Missouri, Columbia)

Professors Of Practice. Imaani El-Burki, PhD (Drexel University); Matthew Veto, MA (University of Missouri, Columbia)

Emeriti. Carole M. Gorney, MS (Northwestern University); Walter W. Trimble, MA (Ohio State University)

REQUIRED MATH COURSE
Understanding statistical information has become extremely important in modern society. MATH 012, Basic Statistics, is required for students taking a journalism or science and environmental writing major. Students should take MATH 012 to fulfill the college’s distribution requirement. ECO 045, Statistical Methods, is an acceptable alternative. For science/science writing double majors, calculus will be considered as a substitute for statistics.

JOURNALISM MAJOR
Core Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOUR 001</td>
<td>Brown and White</td>
<td>1</td>
</tr>
<tr>
<td>JOUR 002</td>
<td>Brown and White</td>
<td>1</td>
</tr>
<tr>
<td>JOUR 003</td>
<td>Brown and White</td>
<td>1</td>
</tr>
<tr>
<td>JOUR 004</td>
<td>Brown and White</td>
<td>1</td>
</tr>
<tr>
<td>COMM 030</td>
<td>Media and Society</td>
<td>4</td>
</tr>
<tr>
<td>JOUR 021</td>
<td>Writing for the Media</td>
<td>4</td>
</tr>
<tr>
<td>JOUR 023</td>
<td>Editing</td>
<td>4</td>
</tr>
<tr>
<td>JOUR 024</td>
<td>Visual Communication</td>
<td>4</td>
</tr>
<tr>
<td>JOUR 122</td>
<td>Media Ethics and Law</td>
<td>4</td>
</tr>
</tbody>
</table>

Advanced Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOUR 275</td>
<td>Writing for Media II (Course fulfills university junior writing intensive requirement)</td>
</tr>
<tr>
<td>JOUR 361</td>
<td>Internship</td>
</tr>
</tbody>
</table>

Senior Seminar: Journalism or Communication course at 300 level

Required Elective
Select one additional 4-credit Journalism or Communication course.
Collateral Requirements
Students must also complete a second major, OR a minor outside of the Department of Journalism and Communication.

<table>
<thead>
<tr>
<th>Total Credits</th>
<th>55</th>
</tr>
</thead>
</table>

1. NOTE: Students must consult an adviser in choosing the elective course as not all courses with JOUR or COMM designations can be used.

**JOURNALISM/SCIENCE AND ENVIRONMENTAL WRITING MAJOR**

**Core Courses**
- JOUR 001 Brown and White 1
- JOUR 002 Brown and White 1
- or JOUR 231 Science Writing Practicum 1

Select one of the following:
- JOUR 123 Basic Science and Technical Writing 4
- JOUR 311 Science and Technical Writing 4
- JOUR 021 Writing for the Media 4
- JOUR 023 Editing 4
- JOUR 024 Visual Communication 4
- JOUR 230 Multimedia Storytelling 4
- JOUR 275 Writing for Media II (Choose between Jour 230 or Jour 275) 4

**Advanced Courses**
- JOUR/STS 124 Politics of Science 4
- JOUR 125 Environment, the Public and the Mass Media 4
- JOUR/STS/HMS 323 Health and Environmental Controversies 4
- JOUR 361 Internship 4

**Required Electives**
Select one additional 4-credit Journalism or Communication course. 4

<table>
<thead>
<tr>
<th>Total Credits</th>
<th>42</th>
</tr>
</thead>
</table>

1. NOTE: Students must consult an adviser in choosing the elective course as not all courses with JOUR or COMM designations can be used.

Collateral Requirements
Students must also complete 15-16 credits in science for the journalism/ science and environmental writing major.

**Required science courses**
A minimum of 15-16 credits in the physical, biological, environmental or social sciences or engineering is required. These hours can be concentrated in any one area or distributed among all five areas, although an area concentration is recommended. Dual majors in journalism/science and environmental writing and a science are encouraged. Science courses should be chosen in consultation with the major adviser.

**Science and environmental writing field research program**
Available to science, environmental and technical writing students at the junior or senior level, this program provides practical experience in scientific research and science writing for students who work on and write about research projects directed by university scientists and engineers. Another segment of the program allows students to attend major scientific meetings as fully accredited science reporters. Students observe professional science writers in action and write their own stories about the scientific sessions and press conferences held at the meetings.

**SCIENCE AND ENVIRONMENTAL WRITING MINOR**

<table>
<thead>
<tr>
<th>JOUR 001 Brown and White 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>or JOUR 231 Science Writing Practicum 4</td>
</tr>
<tr>
<td>JOUR 021 Writing for the Media 4</td>
</tr>
<tr>
<td>or JOUR 123 Basic Science and Technical Writing 4</td>
</tr>
<tr>
<td>JOUR 124 Politics of Science 4</td>
</tr>
<tr>
<td>JOUR 125 Environment, the Public and the Mass Media 4</td>
</tr>
</tbody>
</table>

**Total Credits**

<table>
<thead>
<tr>
<th>JOUR 323 Health and Environmental Controversies 4</th>
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</thead>
</table>

**MASS COMMUNICATION MINOR**

**Purpose**
The Mass Communication Minor focuses on how information is disseminated and the effect on the shaping of societies. As traditional forms of mass communication change and new forms arise, it is more important than ever to understand the interplay of the media and society. In this minor, students will learn to evaluate and interpret media messages so that they can understand and participate in this increasingly complicated world. They can also choose to combine theory with practice in research, interviewing, writing, visual communication and editing to enhance their skills in those areas. Because the minor draws on the same courses, it is not open to majors in Journalism or Journalism/Science and Environmental Writing.

**Requirements**
Four 3- or 4-credit COMM or JOUR classes, with one at or above the 200 level. NOTE: Students must consult an adviser in choosing the elective courses as not all courses with JOUR or COMM designations can be used.

**Total 15-16 credits**

**PREREQUISITES FOR JOURNALISM COURSES**
Some courses thus require prerequisites before students can register for the class. Check the course schedule each semester.

**MEDIA INTERNSHIPS**
All majors in journalism and journalism/science and environmental writing take professional internships during their senior year or the preceding summer. The internships provide real-world experience with newspapers, magazines, cable, television or radio stations, web sites or in public relations settings. Science writing minors may take an internship instead of working on The Brown and White.

**Communication Courses**

<table>
<thead>
<tr>
<th>COMM 030 Media and Society 4 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMM 040 (ENTP 040) Entrepreneurial Communication for Creative Industries 3 Credits</td>
</tr>
<tr>
<td>This introduction to the roles of mass media in U.S. and global society explores a media-saturated society. Students learn how mass media operate in relationship to society, controversies surrounding their activities, social consequences of media behavior, and theories for examining mass media. Upperclassmen allowed only by instructor’s permission.</td>
</tr>
<tr>
<td>Attribute/Distribution: SS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMM 130 Public Speaking 4 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMM 135 (JOUR 135, SOC 135) Human Communication 4 Credits</td>
</tr>
<tr>
<td>Processes and functions of human communication in relationships and groups.</td>
</tr>
<tr>
<td>Attribute/Distribution: SS</td>
</tr>
</tbody>
</table>
COMM 143 Persuasion and Influence 4 Credits
The social, symbolic, and rhetorical means of persuasion and how this persuasive influence is expressed in politics, advertising, and the mass media. Students will gain experience in evaluating and creating persuasive communication messages and campaigns.
Attribute/Distribution: SS

COMM 160 Public Speaking (for IBE Students) 4 Credits
Applying the principles of public speaking to making informative and persuasive presentations effectively. Emphasis on speech composition and effective oral communication skills. This class is limited to students in the Integrated Business and Engineering Honors Program.
Attribute/Distribution: HU

COMM 220 Public Relations 4 Credits
Study of public relations principles and writing. Ethical, legal and public opinion environments for public relations; development of communication strategies for various audiences, including the mass media. Preparing publicity; planning and conducting news conferences; writing speeches, brochures, newsletters and reports.
Prerequisites: (JOUR 013 or JOUR 023) and (JOUR 014 or JOUR 024)
Attribute/Distribution: ND

COMM 248 (GS 248) Global Communication 4 Credits
This class uses historical and cultural perspectives to study how globalization shapes and is shaped by communication and media structures and processes, with emphasis on journalism, the media industries and popular culture. Topics include: global media industries and media flow, entertainment, media hybridity, development communication and alternative media.
Attribute/Distribution: SS

COMM 276 (AAS 276) Media and Race 4 Credits
Examines the representation of various races and ethnicities in news media as well as the impact of such portrayals upon public opinion, public policy and interpersonal life. Considers the role of print, broadcast focuses on making connections between information and entertainment media that perpetuate stereotypes and dominant understandings of various groups.
Attribute/Distribution: SS

COMM 277 (AAS 277) Race Representations & News Media 4 Credits
This course examines the representation of racial and ethnic minorities in American media and media outlets globally. It begins with a comparative analysis of majority/minority representations. It further analyzes the impact of such portrayals upon public opinion, public policy, and interpersonal life within the U.S. and abroad. Class discussions and assignments will address the role of print, broadcast and online media in shaping the contemporary dominant understandings of various racial groups in a globalized world and social constructions of reality.
Attribute/Distribution: SS

COMM 300 Apprentice Teaching 1-4 Credits

COMM 325 Special Topics In Communication 1-4 Credits
Attribute/Distribution: SS

COMM 327 Mass Communication and Society 4 Credits
A review of theories and research on the relationship of mass communication to social processes. Intensive analysis of selected media products (e.g., TV news, dramas, and sitcoms; films; print; music videos, etc.).
Prerequisites: SOC 001 or ANTH 001
Attribute/Distribution: SS

COMM 331 Business and Professional Speaking 4 Credits
The principals of oral communication as applied to business and professional situations. Professional presentations, small group interaction and interpersonal communication in the business setting.
Attribute/Distribution: ND

COMM 376 (AAS 376, WGSS 376) New Media, Race and Gender 4 Credits
This class explores the relationship among race, gender and new media. It examines depictions of racial minorities and women online; how users access and use new media across race and gender (including a look at the digital divide); and differences in use of social media websites across race and gender. The goal is for students to understand how existing racial and gender categorizations are/are not transmitted to the online community and do/do not become extensions of present social hierarchy.
Attribute/Distribution: SS

Journalism Courses

JOUR 001 Brown and White 1 Credit
This course is a student's first semester on the staff of the semiweekly undergraduate newspaper. Students register for this course, attend a meeting on the first Wednesday of the semester, and are placed on the staff. Because this is an introductory training class, JOUR 001 is for students with freshman or sophomore standing; juniors only with consent of department chair.
Attribute/Distribution: ND

JOUR 002 Brown and White 1 Credit
Enrollment constitutes continued membership on the staff of the semiweekly undergraduate newspaper. These courses are taken consecutively after a student has completed JOUR 001. For a second semester on the newspaper, a student registers for JOUR 002. For a third semester, JOUR 003. For a fourth semester, JOUR 004. And so on.
Prerequisites: JOUR 001
Attribute/Distribution: ND

JOUR 003 Brown and White 1 Credit
Enrollment constitutes continued membership on the staff of the semiweekly undergraduate newspaper. These courses are taken consecutively after a student has completed JOUR 001. For a second semester on the newspaper, a student registers for JOUR 002. For a third semester, JOUR 003. For a fourth semester, JOUR 004. And so on.
Prerequisites: JOUR 002
Attribute/Distribution: ND

JOUR 004 Brown and White 1 Credit
Enrollment constitutes continued membership on the staff of the semiweekly undergraduate newspaper. These courses are taken consecutively after a student has completed JOUR 001. For a second semester on the newspaper, a student registers for JOUR 002. For a third semester, JOUR 003. For a fourth semester, JOUR 004. And so on.
Prerequisites: JOUR 003
Attribute/Distribution: ND

JOUR 005 Brown and White 1 Credit
Enrollment constitutes continued membership on the staff of the semiweekly undergraduate newspaper. These courses are taken consecutively after a student has completed JOUR 001. For a second semester on the newspaper, a student registers for JOUR 002. For a third semester, JOUR 003. For a fourth semester, JOUR 004. And so on.
Prerequisites: JOUR 004
Attribute/Distribution: ND

JOUR 006 Brown and White 1 Credit
Enrollment constitutes continued membership on the staff of the semiweekly undergraduate newspaper. These courses are taken consecutively after a student has completed JOUR 001. For a second semester on the newspaper, a student registers for JOUR 002. For a third semester, JOUR 003. For a fourth semester, JOUR 004. And so on.
Prerequisites: JOUR 005
Attribute/Distribution: ND
JOUR 007 Brown and White 1 Credit
Enrollment constitutes continued membership on the staff of the
semiweekly undergraduate newspaper. These courses are taken
consecutively after a student has completed JOUR 001. For a second
semester on the newspaper, a student registers for JOUR 002. For a
third semester, JOUR 003. For a fourth semester, JOUR 004. And so
on.
Prerequisites: JOUR 006
Attribute/Distribution: ND

JOUR 008 Brown and White 1 Credit
Enrollment constitutes continued membership on the staff of the
semiweekly undergraduate newspaper. These courses are taken
consecutively after a student has completed JOUR 001. For a second
semester on the newspaper, a student registers for JOUR 002. For a
third semester, JOUR 003. For a fourth semester, JOUR 004. And so
on.
Prerequisites: JOUR 007
Attribute/Distribution: ND

JOUR 009 Brown and White Photography 1 Credit
Enrollment constitutes membership on the photography staff of the
semiweekly undergraduate newspaper. Students should have basic
camera skills and knowledge of digital photography. Classes will
include review of these subjects and more advanced techniques in
digital darkroom techniques. Members of the class work on a series of
assignments for the newspaper. Students should have their own digital
SLR camera equipment and will be expected to provide examples of
their work for admission to the class.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

JOUR 010 Brown and White 1-2 Credits
Enrollment constitutes an editorial position on the staff of the semiweekly
undergraduate newspaper. Editors are chosen by the instructors and the
newspaper's editorial board. Consent of department required.
Repeat Status: Course may be repeated.
Prerequisites: JOUR 001
Attribute/Distribution: ND

JOUR 012 Brown and White Videography 1 Credit
Enrollment constitutes membership on the videography staff of the
student newspaper. Students should have basic cameraman skills and
knowledge of editing video. Members of the class use the newspaper's video
equipment and work on assignments for the newspaper's Web site. First-time students should provide examples of their work for
admission to the class. Does not count in department's majors or minors.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

JOUR 021 Writing for the Media 4 Credits
Practice gathering, writing, and editing news; definition and components of
news; structure and style; interviewing. Study and practice in use of
social media and blogs by journalists as a way to gather and publish
information. Requires freshman or sophomore standing.
Attribute/Distribution: ND

JOUR 023 Editing 4 Credits
Students will strengthen news judgment, critical thinking and writing
through careful editing of articles for accuracy, fairness and clarity,
including use of proper spelling, grammar, usage and style. Practice in
writing headlines for print and the Web, including search engine
optimization and multimedia presentation of content.
Prerequisites: JOUR 021 or JOUR 123
Attribute/Distribution: ND

JOUR 024 Visual Communication 4 Credits
Study of and practice in techniques of multimedia storytelling including
photography, data visualization, print layout, and video-shooting and
ingushing skills. This course combines principles of visual communication
with hands-on work to help improve your visual literacy and multimedia
skills and develop a professional digital portfolio. Prerequisite: Jour 21 or
Jour 123.
Prerequisites: JOUR 021 or JOUR 123
Attribute/Distribution: SS
JOUR 125 (ES 125) Environment, the Public and the Mass Media 4 Credits
Extensive exploration of local, national and international environmental problems and their social, political and economic impacts. Analysis of mass media coverage of complex environmental issues and the media’s effects on public opinion and government environmental policies. Examination of environmental journalism principles and practices in the United States and around the world. 
Attribute/Distribution: SS

JOUR 135 (COMM 135, SOC 135) Human Communication 4 Credits
Processes and functions of human communication in relationships and groups.
Attribute/Distribution: SS

JOUR 141 Photojournalism 4 Credits
Ethics and history of photojournalism; instruction and practice in basic camera techniques; scanning and digital manipulation of black and white and color photographs using Adobe PhotoShop; cropping and sizing photographs and production of layouts using Quark Express.
Attribute/Distribution: ND

JOUR 166 Beyond Google – Internet Research: Principles and Practice 4 Credits
Students often turn first to the Internet for research. Yet they often are unaware of the promise and pitfalls of Internet research. This course has three objectives: 1) Students will learn methods of identifying and locating resources on the Internet, including resources not reached by traditional search engines; 2) Students will be introduced to steps for the assessment and evaluation of information gathered from the Internet; 3) Students will explore issues of access, privacy and other legal and ethical questions that arise in Internet research.
Attribute/Distribution: SS

JOUR 211 Reporting 4 Credits
Principles and practice of news reporting; techniques for gathering, organizing and writing news. Emphasis on interviewing, research, and clear, concise writing. Students develop and write numerous stories to gain understanding of fundamental reporting concepts, including use of sources, accuracy, fairness and responsibility.
Prerequisites: (JOUR 011 or JOUR 123) and JOUR 013
Attribute/Distribution: SS

JOUR 212 Feature Writing 4 Credits
Conceiving and developing feature stories for newspapers and magazines and websites; interviewing techniques; study of and practice in writing non-fiction using the techniques of the novelist.
Prerequisites: (JOUR 011 or JOUR 123) and JOUR 013
Attribute/Distribution: ND

JOUR 216 First-Person Narrative Non-Fiction Writing 4 Credits
Based on the premise that each of us has a story worth telling, first-person narrative nonfiction writing is a time-tested genre that encompasses everything from the short personal essay to book-length memoir. This intensive writing course explores the art and craft of first-person narrative in a workshop setting with the intent of producing pieces ready for publication.
Prerequisites: JOUR 021 or JOUR 023 or JOUR 024
Attribute/Distribution: HU

JOUR 218 Freelance Writing 4 Credits
Practice in writing for magazines, newspapers and websites. Finding the right approach for a publication and writing in that publication’s style. Practice in analyzing content and audiences, and in writing. Learn research and interviewing skills and read works by well-known writers.
Prerequisites: (JOUR 011 or JOUR 123) and (JOUR 013)
Attribute/Distribution: ND

JOUR 230 Multimedia Storytelling 4 Credits
An introduction to storytelling across multimedia styles such as video, audio, photography, social media, and written word. Stresses experiential learning with emphasis on complementary story packaging and publishing. Students do in-class assignments and team reporting on issues of concern to local residents. Prerequisites: JOUR 23, JOUR 24.
Prerequisites: JOUR 023 and JOUR 024
Attribute/Distribution: SS

JOUR 231 Science Writing Practicum 1-4 Credits
Onsite experience as accredited science reporter at major scientific meetings, or writing and research in university laboratories as part of science writing field research program. Must have junior standing. Consent of instructor required.
Repeat Status: Course may be repeated.
Prerequisites: JOUR 011 or JOUR 123 or JOUR 311
Attribute/Distribution: ND

JOUR 232 Journalism Practicum 1-4 Credits
Credit for supervised on- and off-campus work in journalism and communication. Allows credit for internships attained by students who do not qualify for the senior-level journalism internship class. Must have completed eight hours of journalism credits or consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

JOUR 242 Web Writing & Design 4 Credits
This course examines the ways in which writing and design are influenced by online technology. Students will learn principles and practice of hypertext, Web writing and Web design and will plan and create Web sites that tell stories using the unique features of online technology.
Prerequisites: JOUR 011 or JOUR 123 or JOUR 228
Attribute/Distribution: ND

JOUR 246 (GS 246) International Communication 4 Credits
The subject matter is crucial to understanding modern life: the role of international news media in world affairs. The class studies the social, political and economic contexts that frame the reporting of international events by U.S. news media, such as politics, war, disasters, and other crises, as well as U.S. reporting on international issues, such as poverty, disease, and environmental change. The course also surveys reporting practices in nations around the world, including the varying systems of journalism and mass media and the brutal censorship and repression facing many foreign journalists.
Attribute/Distribution: SS

JOUR 275 Writing for Media II 4 Credits
This course fulfills the college junior-level writing intensive requirement and is required by the majors of Journalism and Journalism/Science Writing. Building on Writing for the Media I, the class combines essential aspects of Jour 211 Reporting, Jour 212 Feature Writing and Jour 218 Freelance Writing. Students will report and produce in-depth stories, to be published in The Brown and White, in paper and online, which will add substantially to their portfolios.
Prerequisites: JOUR 021 and JOUR 023 and JOUR 024
Attribute/Distribution: SS

JOUR 300 Apprentice Teaching 1-4 Credits
Repeat Status: Course may be repeated.

JOUR 311 Science and Technical Writing 3-4 Credits
Study of and practice in writing about scientific and technical issues for multiple audiences. Emphasis on developing effective writing and organizational skills and translating scientific information for a wide range of audiences. Similar in content to JOUR 123, but should be taken instead by upperclassmen (34 credits) and graduate students (34 credits), 4 credits for upperclassmen and 3 for graduate students.
Attribute/Distribution: SS

JOUR 312 Advanced Science Writing 3 Credits
Further practice, on individual basis, in science writing techniques.
Prerequisites: JOUR 123 or JOUR 311
Attribute/Distribution: SS

JOUR 313 Special Topics in Science Communication 1-4 Credits
Research or writing involving a topic, medium or issue in science, environmental or technical communication not covered in other courses. Must have completed eight hours in science or environmental writing or have consent of the instructor.
Attribute/Distribution: SS
JOUR 314 Technical Communication 3-4 Credits
This online course covers basic tools needed to write about all kinds of science and technical information for academic papers, term papers, proposals, reports, theses and dissertations. Involves practice with feedback on definitions, descriptions, cause-and-effect relationships, process writing, concept maps, graphics, classification, comparison and more. Taken by seniors for 4 credits and graduate students for 3 credits.
Attribute/Distribution: ND

JOUR 323 (ES 323, HMS 323, STS 323) Health and Environmental Controversies 4 Credits
Exploration of health and environmental controversies from the perspectives of scientific uncertainty and mass media coverage. Examines genetic engineering, biotechnology, environmental health risks and nanotechnology. Includes discussion of ethical and social responsibilities and interactions with the public.
Attribute/Distribution: SS

JOUR 325 Seminar in Journalism and Communication Issues 3-4 Credits
A seminar focusing on contemporary issues and problems facing the mass media. Topics vary. Taken by seniors for 4 credits and graduate students for 3 credits. Open to senior journalism or senior journalism/science writing majors or have consent of the instructor.
Attribute/Distribution: SS

JOUR 327 (SOC 327) Mass Communication and Society 4 Credits
A review of theories and research on the relationship of mass communication to social processes. Intensive analysis of selected media products.
Prerequisites: ANTH 011 or SOC 001
Attribute/Distribution: SS

JOUR 330 Critical Studies in Journalism 4 Credits
This course prepares students to be critical news consumers by giving them tools to understand how journalism works. Theoretical perspectives by and about journalists help students analyze news in historical, global, political, economic and social contexts.
Attribute/Distribution: SS

JOUR 334 Technical Writing for Engineers 3,4 Credits
This online course is for upper-class and graduate students who plan to work in engineering and environmental services. The course covers basic grammar, punctuation, style rules, organization and clarity issues that engineers face when writing reports and proposals, including executive summaries, introductions, site descriptions, project backgrounds and research findings. Must have junior status or have consent of the instructor.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS

JOUR 361 Internship 4 Credits
Professionally supervised work on newspapers, magazines, Web sites radio and television stations, or with public relations organizations. Some internships involve science writing. Must have senior standing and declared major in journalism or science writing.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

JOUR 366 Online Journalism 3-4 Credits
The course examines the social, cultural, political, legal and economic influence of online technology on journalism and the role of journalism in society. Emphasizing critical thinking and analysis, the course studies the ways in which digital technology has changed the way journalists research, write, edit and design. Taken by seniors for 4 credits and graduate students for 3 credits. Consent of department chair.
Prerequisites: (JOUR 011 or JOUR 123) and JOUR 122
Attribute/Distribution: ND

JOUR 389 College Scholar Project 1-8 Credits
Opportunity for college scholars to pursue an extended project. College wide course designation. Transcript will identify department in which project was completed. Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

JOUR 390 Honors Thesis 1-4 Credits
Directed undergraduate research thesis required of students who apply for and qualify for graduation with departmental honors.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

JOUR 391 Special Topics in Journalism and Communication 1-4 Credits
Directed research or writing involving a subject or issue in journalism not covered in other courses. Must have completed twelve hours in journalism or have consent of the instructor.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

Latin American Studies

Program Director: Matthew Bush, Pd. D. (U. of Colorado at Boulder)
Email: matthew.bush@lehigh.edu # Phone: 610-758-3087
Website: http://las.cas2.lehigh.edu/
Supported by the Office of Interdisciplinary Programs 610-758-3996;
icasip@lehigh.edu
Williams Hall, 31 Williams Drive

Core Faculty
Matthew Bush, Ph.D. (Department of Modern Languages and Literatures); Miguel Pillado, Ph.D. (Department of Modern Languages and Literatures); Antonio Prieto, Ph.D. (Department of Modern Languages and Literatures); Ricardo Viera, M.F.A. (Department of Art, Architecture and Design); Maria Barbara Zepeda Cortés, Ph.D. (Department of History)

Latin American studies is a minor program designed for students who wish to develop an understanding of a neighboring region that is of vital importance to the United States. Courses in anthropology, archeology, foreign policy, history, language and literature, politics, sociology, visual arts and museum studies, allow students to explore various aspects of Latin American cultures and societies from an interdisciplinary perspective. The minor contributes to a liberal arts education by offering students an international vantage point from which they can examine their own society and prepares them to meet the challenges of an increasingly interdependent world. Additionally, the unprecedented movement of peoples and ideas between the American continents in recent decades makes the study of this region of the world an essential component for understanding the history and culture of the expanding U.S. Latino population. The minor in Latin American Studies complements, therefore, major concentrations in disciplines that have either an international or a domestic focus, and it enhances the relevance of a Lehigh education by preparing students to be citizens of a culturally diverse society and, more generally, of the Americas.

The Latin American Studies minor program requires 15 to 16 credit hours of coursework. In addition to regular Lehigh offerings, students may receive minor credit for appropriate courses at other LVAIC institutions, study abroad programs in Latin America, and various Lehigh faculty-led programs, such as “Lehigh in Martinique” and “Lehigh in Costa Rica” (both offered during the winter term). Students are encouraged to take advantage of extracurricular activities sponsored by the Latin American Studies Program, which include guest speakers, exhibits, films, etc. To declare a minor in Latin American Studies, students must complete a minor declaration form (http://catalog.lehigh.edu/coursesprogramsandcurricula/artsandsciences/ latinamericanstudies/2016-17_LAS_Minor_Declaration_Form.pdf).

History/Culture

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<td>or LAS 152</td>
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Electives

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<td>Afro-Latino Social Movements in Latin America &amp; the Caribbean</td>
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<td>Cuba: Race, Revolution and Culture</td>
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<td>LAS/ANTH 184</td>
<td>Indigenous Cultures of Latin America</td>
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<td>Latin American In Fact, In Fiction</td>
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<td>LAS/SPAN 211</td>
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<td>LAS/ART 227</td>
<td>Latino Visual Arts and Culture in American Art</td>
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<td>Indigenous Cultures in Spanish American Narrative</td>
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<td>LAS/SPAN 263</td>
<td>The Spanish American Short Story</td>
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<td>LAS/SPAN 265</td>
<td>Spanish and Latin American Cinema</td>
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<td>LAS/SPAN/WGSS 275</td>
<td>Introduction to Hispanic Women Writers</td>
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<td>LAS/SPAN 276</td>
<td>Contemporary Literature of the Southern Cone</td>
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<td>LAS/ENGL/MLL 302</td>
<td>Travel and Adventure in Latin American Fiction</td>
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<td>LAS/SPAN 320</td>
<td>Literature of the Spanish Caribbean</td>
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<td>The Short Novel in Contemporary Spanish American Literature</td>
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<td>LAS/SPAN 323</td>
<td>Literature and Revolution in Contemporary Cuba</td>
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<td>Hispanic Literature of the United States</td>
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<td>Tradition and Resistance: Women Writers of Latin America</td>
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<td>LAS/SOC 330</td>
<td>Society, Democracy and Revolution in Latin America</td>
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<td>The New Narrative Spanish American Literature</td>
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<td>LAS/SPAN 345</td>
<td>Testimonial Writing in the Hispanic World</td>
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<td>Contemporary Hispanic Women Writers: The Novelists</td>
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<td>LAS/ANTH 378</td>
<td>Blood, Pyramids, and the Tree of Life</td>
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<td>LAS/SPAN 391</td>
<td>Melodrama in Contemporary Spanish American Narrative</td>
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<td>LAS/SPAN 392</td>
<td>The City and the Country in Spanish American Narrative</td>
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<td>LAS/SPAN 393</td>
<td>The Boom and Beyond</td>
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<td>This Hispanic World and its Culture</td>
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<td>Latin American Political Systems</td>
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<td>POLS/WGSS/GS 342</td>
<td>Gender and Third World Development</td>
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Courses

LAS 106 (AAS 106) Race and Ethnicity in Latin America and the Spanish Speaking Caribbean 4 Credits
A sociological examination of race and a look at an individual’s experience. We consider how concepts like “race” and “ethnicity” have been defined and how they have been institutionalized in law, government, social policy, social thought, and economic structures. We consider the importance of concepts like “race,” “cultures,” and “mestizaje” to our understanding of citizenship and national identity, and we address contemporary African and indigenous movements against racial inequality.

Attribute/Distribution: SS

LAS 133 (AAS 133, FREN 133, HIST 133, MLL 133, POLS 133) Lehigh in Martinique: Globalization and Local Identity 3-4 Credits
History, culture and politics of the French Caribbean island of Martinique, from its position as a key site of the 18th century Atlantic World economy to becoming an official French department and outpost of the European Union. Interdisciplinary perspectives on the complex nature of social identity, historical memory and impact of globalization. No French is required. Offered during winter inter-term through Lehigh Study Abroad.

LAS 152 (SPAN 152) Cultural Evolution of Latin America 4 Credits
The historical and cultural evolution of Latin America. Discussion of representative literary works in their cultural and historical contexts. Prerequisite as listed below or consent of instructor.

Prerequisites: SPAN 141

Attribute/Distribution: HU

LAS 155 (AAS 155, SOC 155) Afro-Latino Social Movements in Latin America & the Caribbean 4 Credits
This course focuses on Afro-Latinos who make up nearly 70% of the population of the Americas. Despite the large amount of people of African descent living in the Americas, Afro-Latinos are an understudied population who face significant amounts of racial discrimination in their countries. Who are Afro-Latinos? Where do they live? How are they challenging the racism that they face? These are questions we will tackle in this course.

Attribute/Distribution: SS

LAS 177 (AAS 177, SOC 177) Cuba: Race, Revolution and Culture 4 Credits
This course analyzes the role of race & “culture” in the Afro Cuban struggle for equality. By focusing on the arts: particularly music, film & literature, this course will analyze the development of race during Cuba’s colonial period; the Afro Cuban challenge to the “race blind” political and cultural movements of the Cuban Republic. We will then wrap up the semester by addressing the significance of contemporary cultural movements that challenge the social issues currently facing Afro Cubans.

Attribute/Distribution: SS

1 Elective courses (7-8 credits) chosen from the following LAS cross-listed courses or collateral courses. Credit may be received for other courses, in consultation with the Program Director.

2 Special topic courses in Art and History may be applicable electives to the Latin American Studies minor. Refer to course listings for Special Topics in Art History (ART 269), Special Topics in Studio Practice (ART 273), Special Topics in Museum and Curatorial Studies (ART 370), Museum Internship (ART 375) Themes in History (HIST 104), Topics in History (HIST 303) and Special Topics In History (HIST 372). Spanish Special Topics (SPAN 290) may also be applied as a LAS elective. Students should consult with the Program Director for approval of any of the previous listed courses.

ELECTIVE and Collateral COURSES

Each semester, a complete list of Latin American Studies course offerings can be found on the web site or in the Office of Interdisciplinary Programs, Williams Hall, Suite 101.
LAS 184 (ANTH 184) Indigenous Cultures of Latin America 4 Credits
This examines social change in Latin America from the perspective of indigenous peoples. Main goals are to develop an appreciation for the diversity of cultures found in Latin America, explore anthropological concepts like cultural ecology, ethnicity, acculturation, and religious syncretism, and to apply these concepts to contemporary issues, including cultural survival, human rights, and environmental sustainability.
Attribute/Distribution: SS

LAS 202 (ENGL 202, GS 202, MLL 202) Latin American In Fact, In Fiction 4 Credits
This class couples a survey of Latin American literature in translation with an interdisciplinary approach to the study of Latin America. Departing initially from readings of literary and cinematographic works, our analyses will engage methodologies from multiple disciplines including history, sociology, and cultural studies. Accordingly, this course will examine critical developments in Latin American aesthetics along with the cultural climates in which they matured. This course assumes no prior study of Spanish, Portuguese, or Latin American culture.
Attribute/Distribution: HU

LAS 211 (SPAN 211) Business Spanish 4 Credits
Prerequisites: SPAN 141
Attribute/Distribution: HU

LAS 213 (SPAN 213) Introduction to Hispanic Literature and Film 4 Credits
An introduction to the analysis of Latin American and Spanish cultural productions (mainly literature and film).

LAS 227 (ART 227) Latino Visual Arts and Culture in American Art 4 Credits
Because art has no country, but the artist does, is contemporary art a product of globalization? Is Latino and Latin American art, culture and art criticism a nationalistic platform of cultures. Who’s who in the current Latino and Latin American art world? Students will utilize works from the university (LUAG) collection and/or research and interview a contemporary artist at his or her studio (if possible) for essays or media projects.
Attribute/Distribution: HU

LAS 228 (ART 228) 4 Credits
A history of photography in an in-situ class, at the LUAG Teaching Collection Visual Laboratories and Integrated Open Storage classroom. The course will explore the power of photographs as a dominant 21st Century universal visual art form, emphasizing Latino and Latin American photography. The students will progressively work their way through today’s explosive array of digital, one channel video, photobase and conceptual discourses of our remix culture through evolutionary image-making of the 20th and 19th Century, and the uses of photographic processes that have enriched our perceptions and our world. Readings, group discussions and individual research. The course will conclude with a final project/paper: a one figure or theme paper and a small group/team project (to be determined later). This will constitute the transformative approach to study the state of photography today.
Attribute/Distribution: HU

LAS 243 (SPAN 243) Indigenous Cultures in Spanish American Narrative 4 Credits
A survey of Spanish American narratives that deal with the relationship between indigenous and occidental cultures. While examining works created from the late 19th century up until present day, we analyze the construction of cultural identity in several countries including Bolivia, Ecuador, and Mexico. Analysis will include works of poetry, short story, novel, essay, and film by several influential artists: Clorinda Matto de Turner, Jorge Icaza and José María Arguedas, to name just a few.

LAS 263 (SPAN 263) The Spanish American Short Story 4 Credits
Comparative study of representative works by major writers such as Quiroga, Borges, and Cortazar, among others.

LAS 265 (SPAN 265) Spanish and Latin American Cinema 4 Credits
Prerequisites: SPAN 141
Attribute/Distribution: HU

LAS 275 (SPAN 275, WGSS 275) Introduction to Hispanic Women Writers 4 Credits
The objective of this class is to introduce students to Hispanic contemporary female authors from Latin America, Spain, and the United States through the analysis of all literary genres (novel, short story, poetry, essay, and drama). This class provides students with a solid introduction to Hispanic women's writing from the last years of the Nineteenth Century to the present, as well as to feminist literary theory.
Attribute/Distribution: HU

LAS 276 (SPAN 276) Contemporary Literature of the Southern Cone 4 Credits
This course focuses on the literature of Argentina, Chile, and Uruguay from the beginning of the 20th Century to the present. It analyzes the works of major authors through different genres studying how they represent history and culture, particularly during periods of political instability and state violence. Texts by Jorge Luis Borges, Pablo Neruda, Manuel Puig, Griselda Gambaro, Cristina Peri Rossi, and Antonio Skarmeta, among others, are studied.
Attribute/Distribution: HU

LAS 302 (ENGL 302, GS 302, MLL 302) Travel and Adventure in Latin American Fiction 4 Credits
Centering on a corpus of works presenting tales of travel and adventure, this class offers an overview of Latin American narrative genres (including “fantastic” narrative, magical realism, and postmodern fiction) from the mid 20th century to present day. Through close readings of works by Adolfo Bioy Casares and Roberto Bolaño, among others, and the analysis of filmic representations of travel in Latin America, we will examine differing modes of perceiving the region defined as Latin America.
Attribute/Distribution: HU

LAS 320 (SPAN 320) Literature of the Spanish Caribbean 4 Credits
Study of representative works with emphasis on Cuba and Puerto Rico. Writers include Baroń, Carpenter, Sánchez, and Rodríguez Juliá.
Prerequisites: LAS 152 or SPAN 152
Attribute/Distribution: HU

LAS 321 (SPAN 321) Children and Adolescents in Contemporary Spanish American Literature 4 Credits
Discussion of narrative techniques and the category of the self as they relate to the images of adolescence and childhood in works by such authors as Vargas Llosa, Reinaldo Arenas, José Bianco, Silvina Ocampo.
Prerequisites: LAS 152 or SPAN 152
Attribute/Distribution: HU

LAS 322 (SPAN 322) The Short Novel in Contemporary Spanish American Literature 4 Credits
Reading and discussion of representative works by García Márquez, Onetti, Rulfo, and Biocasares, among others.
Prerequisites: LAS 152 or SPAN 152
Attribute/Distribution: HU

LAS 323 (SPAN 323) Literature and Revolution in Contemporary Cuba 4 Credits
Study of works written after 1959 by dissident, nondissident, and exiled authors (Desnoes, Norberto Fuentes, Benítez Rojo, and Pedro Juan Gutiérrez, among others).
Attribute/Distribution: HU

LAS 325 (SPAN 325) Hispanic Literature of the United States 4 Credits
Discussion of fiction, poetry, drama, and film from the main groups in the U.S. Hispanic population. Discussion of Hispanic ethnic identity, bilingualism, and minority issues.
Prerequisites: LAS 152 or SPAN 152
Attribute/Distribution: HU
LAS 326 (SPAN 326, WGSS 326) Tradition and Resistance: Women Writers of Latin America 4 Credits
Study of poetry and narrative works by Latin American women writers. Authors include Rosario Ferré, Rosario Castellanos, Elena Poniatowska, Cristina Peri Rossi, among others.
Prerequisites: SPAN 152
Attribute/Distribution: HU

LAS 330 (SOC 330) Society, Democracy and Revolution in Latin America 4 Credits
Latin America is a region filled with protest and armed guerrilla movements. Since the fall of the Soviet Union in 1989, at least 5 nations in the region elected openly socialist or communist candidates, many of whom are still in power today. What is happening in Latin America? This course will focus on Latin American perspectives on democracy and social revolution. For many Latin American countries, the move to the 'left,' and the rejection of American capitalism is not that Latin American people embrace socialism, but rather it is a reflection of larger social dynamics at play... or is it?
Attribute/Distribution: HU

LAS 342 (SPAN 342) The New Narrative Spanish American Literature 4 Credits
Critical evaluation of distinguished works of Spanish American prose fiction of the 1960's and 70's. Readings by Donoso, Fuentes, García Márquez, and Vargas Llosa, among others.
Prerequisites: LAS 152 or SPAN 152
Attribute/Distribution: HU

LAS 345 (SPAN 345) Testimonial Writing in the Hispanic World 4 Credits
This course explores the genre testimonio, which confronts the official history of the Latin American and Spanish dictatorships and portrays the experiences and struggles of those who suffered political repression. The course focuses on the analysis of both literary and visual testimonios from the Hispanic world, as well as on theoretical issues concerning discourses of truth.
Attribute/Distribution: HU

LAS 346 (SPAN 346, WGSS 346) Contemporary Hispanic Women Writers: The Novelists 4 Credits
This course explores the works of Hispanic women writers who have been oppositional to hegemonic cultural politics during the Twentieth Century in Latin America and Spain. Within their particular contexts, we examine issues these writers define as important in their work, their literary and political impact, use of literature to empower minority positions, and their narratives' effects on the changing literary canon. Selected topics include: historical interpretations, exile, forms of violence and repression, expressions of desire, and sexuality.
Attribute/Distribution: HU

LAS 378 (ANTH 378) Blood, Pyramids, and the Tree of Life 4 Credits
This course explores the ways of life of the Maya people. We will take a close look at their religion, their foods, their family life, music, medicine, festivals, etc. An important part of this class explores the history of the Maya, making connections between the modern Maya and the Maya of their past.
Attribute/Distribution: SS

LAS 391 (SPAN 391) Melodrama in Contemporary Spanish American Narrative 4 Credits
From the earliest works of Latin American narrative onward, melodrama has served as a fundamental tool for the structuring of dramatic conflict. Ranging from the programmatic social novel to the most parodic contemporary works, we will carefully examine the aims of melodramatic narration in works by Roberto Arlt and Mario Vargas Llosa, among others, as well as in various films and telenovelas.
Attribute/Distribution: HU

LAS 392 (SPAN 392) The City and the Country in Spanish American Narrative 4 Credits
Across the history of the region defined as Latin America, urbanization, on the one hand, and the isolation of national interiors, on the other, have contributed to a problematic relationship between the city and the country. In examining works by the likes of Roberto Arlt, José Donoso, and Mario Bellatin, among others, this course examines the dialogue between the ostensibly separate environs of city and country, and questions they ways in which they influence one another.
Attribute/Distribution: HU

LAS 393 (SPAN 393) The Boom and Beyond 4 Credits
This course will examine works from the so-called Boom of Spanish American literature in the 1960s alongside texts produced following this crucial moment of artistic and social change throughout Latin America. Moving from the Boom toward the postmodern, we will consider works by Gabriel García Márquez, Manuel Puig, and Mario Lovo, among others.
Attribute/Distribution: HU

Law

Every CBE student is required to take Law 201 as part of the CBE Core.
The following undergraduate law courses are offered through the Perella Department of Finance:
Course descriptions for the College of Business and Economics graduate courses can be found in the Courses tab. Prerequisite: consent of sponsoring instructor.

Courses

LAW 101 Introduction to Law 3 Credits
A study of the nature and function of law and the legal system, the study of legal reasoning through the use of the case method.

LAW 102 Sports Law 3 Credits
The study of legal relationships and legal topics of individuals, organizations, society, and the government as they relate to sports. The case method will be used to examine landmark cases and current day examples of legal principles and precedent.

LAW 201 Legal Environment of Business 3 Credits
This course examines the legal relationships between business and government, business and society, and the individual and society. A significant focus of the course is on the structure of the U.S. legal system, the role of the courts in the legal system, and contract law as the principal mechanism for the private allocation of resources and risk allocation. The course also focuses on business ethics with particular emphasis on corporate social responsibility. Junior standing is required.
Prerequisites: (ECO 001)

LAW 202 Business Law 3 Credits
The law of agency, business organizations, secured transactions, bankruptcy and negotiable instruments.
Prerequisites: (LAW 201)

LAW 300 Apprentice Teaching 1-3 Credits
Repeat Status: Course may be repeated.

LAW 371 Directed Readings 1-3 Credits
Readings in various fields of law, designed for students who have a special interest in a field of law. Consent of sponsoring instructor required.

LAW 372 Special Topics 1-3 Credits
Special problems and issues in commercial law.

LAW 417 Regulatory Environment of Business 2 Credits
This course is designed to provide students with a basic understanding of the various legal, regulatory, and market constraints in which business operates. Students are introduced to the interaction between legislation, regulations, and court decisions in establishing the regulatory environment in which a business operates as well as the allocation of power among federal and state authorities. Conflict of law issues will also be explored for businesses that operate internationally. Contract law, forms of business, and ethics are covered in depth.
Loewy Institute

Loewy Institute (formerly Institute for Metal Forming) 5 E. Packer Avenue; 758-4252

Wojciech Z. Misiilek Sc.D., director, Ahmad Chamanfar, Ph.D., Xuanhong Cheng, Ph.D., John P. Coulter, Ph.D., John DuPont, Ph.D., Sabrina Jedlicka Ph.D., Christopher Kiely Ph.D., Laura Moyer, Ph.D., Alparlslan Oztekin, Ph.D., Sudhakar Neti, Ph.D., Herman F. Nied, Ph.D., Michael Rex, Brian C. Siocum, Jean Toulouse, Ph.D., Kemal Tuza Ph.D., Richard P. Vinci, Ph.D., Masashi Watanabe Ph.D.

The Loewy Institute continues tradition of the Institute for Metal Forming, which was established in 1970 to teach the principles and applications of metal forming technology to graduate and undergraduate students, to provide instructions and equipment for graduate research in metal forming processes, and to assist industry with solutions to problems in metal forming.

The main objective of the institute’s research is to conduct cross-disciplinary process engineering studies to better understand and control manufacturing processes and their impact on the microstructural response of a material. The material microstructure developed during processing is responsible for physical properties of the material. Recently, classical metal forming research has been expanded to include projects in powder processing including additive manufacturing, microstructure characterization and analysis, as well as forming and processing technologies for polymers, glasses, and ceramics.

The study of the forming processes encompasses physical and numerical modeling; simulation of microstructure response to process parameters. Computer enhanced analysis of material flow also allows us to optimize tooling design in many manufacturing processes. The combined quantitative results of these techniques may then be compared with experimental data obtained from instrumented metal forming laboratories (such as those maintained at the institute), or from our research partners in industry.

RESEARCH ACTIVITIES

Current research areas include: deformation and processing of metals, metal and ceramic powders, glasses, polymers, light-optical and electron-optical micro-texture characterization, tooling design and tooling materials, thermo-mechanical processing of metals, rapid prototyping and rapid tooling aka additive manufacturing, and machinability of the sintered powder materials. Additionally new research projects have been initiated in development of materials for medical and energy applications.

EDUCATIONAL OPPORTUNITIES

Students interested in metal forming should refer to course offerings in the departments of materials science and engineering, mechanical engineering and mechanics, and industrial and manufacturing systems engineering.

For more information contact Wojciech Z. Misiilek, Director, Institute for Metal Forming, 242 Whitaker Laboratory, Lehigh University, 5 East Packer Avenue, Bethlehem, PA 18015

Management

The Management major introduces management practices to students who wish to work in human resource management, management consulting, or in small business and non-profit organizations. There are two distinct tracks to the major.

• Managing Human Resources: This track prepares students to work as human resource professionals or in management consulting organizations or to broaden their interpersonal skills.

• Small Business and Non Profit Management: This track prepares students specifically to work in small businesses including family owned businesses, nonprofit organizations, startups, and in rapid growth environments.

Professors. Michael D. Santoro, PhD (Rutgers University); Susan A. Sherrer, PhD (University of Pennsylvania); Robert J. Trent, PhD (Michigan State University); Yuliang Yao, PhD (University of Maryland College Park)

Associate Professors. Liuba Y. Belkin, PhD (Rutgers University); William Forster, PhD (University of Virginia); Douglas M. Mahony, PhD (Rutgers University); Corinne A. Post, PhD (Rutgers University Newark); Catherine M. Ridings, PhD (Drexel University); Andrew John Ward, PhD (University of Pennsylvania); Zach G. Zacharia, PhD (University of Tennessee Knoxville)

Assistant Professors. Ozias A. Moore, MSE (University of Pennsylvania); Naomi B. Rothman, PhD (New York University); Charles E. Stevens, PhD (Ohio State University); Dawei Zhang, PhD (University of Calgary)

Lecturer. Chitra S. Nayar, MBA (University of Iowa)

Professors Of Practice. Joshua Walter Ehrig, MA (Lehigh University); Dale F. Falcinelli, MS (Lehigh University); Robert Kuchta, MS (New Jersey Institute of Technology); Paul Myerson, MBA (Temple University)

Emeriti. Richard W Barse, PhD (University of Minnesota); Alden S. Bean, PhD (Northwestern University); John W. Bonge, PhD (Northwestern University); Michael G. Kolchin, DBA (Indiana State University); Peter P. Poole, PhD (The Pennsylvania State University); Theodore W. Schie, PhD (Northwestern University); John E. Stevens, PhD (University of Cincinnati)

Each track of the Management Major is comprised of 5 courses (15 credits). All Management Majors are required to take MGT 342 Managing in the International Organization.

MANAGING HUMAN RESOURCES

Required

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MGT 333</td>
<td>Human Resource Management</td>
<td>3</td>
</tr>
<tr>
<td>MGT/SCM 328</td>
<td>Negotiations and Conflict Management</td>
<td>3</td>
</tr>
<tr>
<td>MGT 342</td>
<td>Managing in the International Organization</td>
<td>3</td>
</tr>
<tr>
<td>MGT 363</td>
<td>Diversity and Inclusion in the Workplace</td>
<td>3</td>
</tr>
</tbody>
</table>

Plus 1 from the following courses: 3

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MGT 314</td>
<td>Small Business Consulting</td>
</tr>
<tr>
<td>ECO 235</td>
<td>Labor Economics</td>
</tr>
</tbody>
</table>

Total Credits 15

SMALL BUSINESS AND NON-PROFIT MANAGEMENT

Required

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MGT 342</td>
<td>Managing in the International Organization</td>
<td>3</td>
</tr>
<tr>
<td>MGT 306</td>
<td>Decision Making in Small Business and Non-profit Enterprise</td>
<td>3</td>
</tr>
<tr>
<td>MGT 314</td>
<td>Small Business Consulting</td>
<td>3</td>
</tr>
</tbody>
</table>

Plus 2 from the following courses: 6

<table>
<thead>
<tr>
<th>Course</th>
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<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MGT/SCM 328</td>
<td>Negotiations and Conflict Management</td>
<td></td>
</tr>
<tr>
<td>MGT 333</td>
<td>Human Resource Management</td>
<td></td>
</tr>
<tr>
<td>FIN 328</td>
<td>Corporate Financial Policy</td>
<td></td>
</tr>
<tr>
<td>BIS 335</td>
<td>Application Development for Business</td>
<td></td>
</tr>
<tr>
<td>MKT 319</td>
<td>Development and Marketing of New Products</td>
<td></td>
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</tbody>
</table>

Total Credits 15

1 MGT 342 Managing in the International Organization fulfills the CBE Global Requirement

2 MGT 363 Diversity and Inclusion in the Workplace fulfills the CBE Diversity Requirement

MANAGEMENT MINOR

This minor provides an overview of management program. It is designed to expose students to the field of management and to provide them with an opportunity to build and enhance their professional and leadership skills through a formal course of study. This minor is open available only to students with a declared major in the College of Business and Economics and/or students enrolled in either the IBE or CSB programs. CBE students cannot receive overlapping credit between CBE major and minor courses or overlapping credit between CBE minor courses.
Program of Studies: The Management Minor consists of 3 courses equalling 9 credit hours from the following courses:

MGT 328 Negotiations
MGT 333 Human Resource Management
MGT 342 Managing in the International Organization
MGT 363 Managing Diversity and Inclusion in the Workplace

Course descriptions for the College of Business and Economics graduate courses can be found under Business and Economics Graduate Courses (p. 110).

Course descriptions for the College of Business and Economics graduate courses can be found in this section under the heading of Business and Economics Graduate Courses.

Courses

MGT 143 Managing and Leading People in Organizations 3 Credits
Introduction to human behavior in organizations. Emphasis on conceptual and applied organizational behavior and human resource topics such as: individual differences; perception and judgment; decision making; motivation; teams and groups; leadership; conflict; ethics; diversity; and culture. Must have sophomore or junior standing.

MGT 300 Apprentice Teaching 1-3 Credits

MGT 301 Strategic Management in a Global Environment 3 Credits
The capstone business class, integrating concepts and practices from the core business classes, utilizing an organizationwide strategic perspective and examining the relationship among firm strategy, structure and environment. The course emphasizes strategic analysis strategy formulation, and strategy implementation so as to achieve sustainable competitive advantage. Corporate governance, corporate social responsibility and business ethics are incorporated into the strategic perspective. Case analyses and competitive simulation game are the central learning components. Must have senior standing in the College of Business and Economics, and completion of the college core.

Prerequisites: (MKT 111 or MKT 211) and (ECO 115 or ECO 146 or ECO 105) and (LAW 201) and (FIN 125 or FIN 225) and (MGT 186 or CSB 186) and (MGT 143 or MGT 243 or CSB 311 or CSB 312) and (BIS 211 or BIS 111 or ACCT 311 or CSB 311) and (ECO 029 or ECO 129) and ACCT 152 and (BUS 001 or BUS 097) and (BUS 005 or CSB 311)

MGT 306 (ENTP 306) Decision Making in Small Business and Non-Profit Enterprise 3 Credits
Formulation of strategies, policies and decisions unique to family owned businesses, non profit organizations, start up ventures, and organizations experiencing rapid growth. Lectures and case studies.

Prerequisites: FIN 125 and MKT 111

MGT 314 (ENTP 314) Small Business Consulting 3 Credits
A field of studies course providing management assistance to small businesses in the Lehigh Valley. Students work in small groups under faculty supervision on a direct basis with owners. Problem solving and experience in applying marketing, accounting, finance, and/or management concepts to business.

Attribute/Distribution: ND

MGT 328 (SCM 328) Negotiations and Conflict Management 3 Credits
This course covers the theory and processes of negotiation in a variety of settings including facetoface, virtual and crosscultural business environments. Students will learn negotiating skills by preparing and simulating a broad mixture of negotiations, ranging from onenone, to threeperson, to multiparty and team negotiations. They will learn to analyze outcomes and strategies during the debriefing sessions and will have an opportunity to compare results of their negotiations to the results of other people in class.

MGT 333 Human Resource Management 3 Credits
Analysis and resolution of personnel problems in organizations. Human resource planning, recruitment, selection, orientation, training, appraisal, compensation, and development.

Prerequisites: MGT 143 or MGT 243

MGT 342 Managing in the International Organization 3 Credits
This course introduces students to the challenges of managing and leading organizations whose operations and activities span national boundaries. Particular attention will be given to the critical human resource issues confronting managers in the global marketplace. Topics discussed include: contemporary and emerging international organizational structures; fostering a global mindset; managing across cultures; developing global leaders; reward systems; performance management; and managing global careers. Junior standing is required.

MGT 350 (BIS 350) Project Management 3 Credits
Key processes and tenets of project management including scope, time, cost, quality, human resources, communications, risk, procurement, and integration management. Both technical and behavioral aspects of project management are applied within the context of either IS management, HR management, Supply Chain Process Management, Small Business Management. Topics include: expectations management, change management and consulting engagement management. Introduces both software project monitoring tools and project team collaboration techniques and tools. Must have completion of all other courses in either BIS or Management major.

Prerequisites: (MGT 321 and MGT 333) or (MGT 321 and MGT 311 and MGT 306) or (MGT 321 and BIS 311 and BIS 324) or (MGT 321 and (SCM 328 or SCM 340 or SCM 342 or SCM 309 or SCM 354),

MGT 363 Managing Diversity and Inclusion in the Workplace 3 Credits
This 3-credit course focuses on the complex dynamics that emerge in diverse groups and environments, explains how diversity and inclusion affect individual and organizational performance, relates diversity and inclusion to career development and success and to the management of human resources. This course also aims to develop skills and competencies for effectively managing diversity and its effects in the workplace. Diversity and Inclusion in the Workplace will be taught with a combination of lectures, self-assessments, class discussions, group exercises, self-reflections.

MGT 371 Directed Readings 1-3 Credits
Readings in various fields of management designed for the student who has a special interest in some field of management not covered by the regularly scheduled courses. Consent of department chair required.

Repeat Status: Course may be repeated.

MGT 372 Special Topics 1-3 Credits
Special problems and issues in management for which no regularly scheduled course work exists. Consent of department chair required.

Repeat Status: Course may be repeated.

MGT 373 Management Internship 1-3 Credits
A sponsoring faculty member shall direct readings, projects, and other assignments including a comprehensive final report in conjunction with an industry-sponsored internship. The work experience itself, whether paid or unpaid, is not the basis for academic credit. Intellectual development in the context of a field study learning experience will be the determining factor in awarding academic credit. This course cannot be used to satisfy requirements of the Management major. Consent of department chair required. Must have junior standing.

MGT 416 Managing Talent 3 Credits
The course is fundamentally about understanding and improving the behavior and performance of individuals in the workplace. As such, we will draw upon key theories in organizational behavior to address human resource issues arising from the employment relationship. Topics will address key areas in the talent pipeline from sourcing and selection, training and development, motivation and performance management, to talent management metrics and analytics.
Management Science and Engineering

The Management Science and Engineering program is directed toward integrating scientific methods with the functional aspects of organizations by investigating the application of quantitative methodology and systems analysis in the context of decision making, risk analysis, economics and cost analysis, production management, and supply chain logistics. This integration provides the students with a broader perspective toward managerial decision-making in both private enterprise and public administration.

Midcareer professionals and recent graduates with a background in engineering, mathematics, and physical sciences who intend to seek managerial, consulting or systems analyst positions are appropriate candidates. In particular, those candidates who intend to seek positions demanding both technical and management skills find the management science background advantageous in dealing with the complex problems of industrial, commercial, and public service organizations.

The Industrial and Systems Engineering Department administers the Management Science and Engineering program. To be admitted to the program a candidate must demonstrate basic competence in calculus, statistics, linear algebra, introductory operations research, accounting, production and economics. A candidate lacking appropriate background may be required to take background courses. The minimum program consists of 30 credit hours of course work, of which at least 18 credit hours must be in the 400-level. The ISE graduate faculty coordinator must approve all course work. No more than 9 credit hours may be taken from the College of Business and Economics.

M.S. IN MANAGEMENT SCIENCE AND ENGINEERING

The minimum program for the master of science degree in Management Science & Engineering consists of 24 credit-hours of approved courses and completion of a satisfactory 6 credit thesis. A faculty member must supervise the thesis. Courses from outside the ISE department usually include other engineering disciplines, mathematics, computer science, and business and economics.

M.ENG. IN MANAGEMENT SCIENCE AND ENGINEERING

The minimum program for the master of engineering degree in Management Science & Engineering consists of 30 credit-hours of coursework (which can include a 3 credit-hour project). This program of study is for those whose interests are geared toward engineering design rather than research. A faculty member must supervise the project.

MANAGEMENT SCIENCE AND ENGINEERING CORE COURSES

Each student is required to complete at least 12 credit hours of courses selected from the following set of Management Science and Engineering Core Courses.

Select four of the following: 1

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISE 339</td>
<td>Stochastic Models and Applications</td>
</tr>
<tr>
<td>ISE/ECO 358</td>
<td>Game Theory</td>
</tr>
<tr>
<td>ISE 404</td>
<td>Simulation</td>
</tr>
<tr>
<td>ISE 409</td>
<td>Time Series Analysis</td>
</tr>
<tr>
<td>ISE 410</td>
<td>Design of Experiments</td>
</tr>
<tr>
<td>ISE 414</td>
<td>Heuristic Methods in Combinatorial Optimization</td>
</tr>
<tr>
<td>ISE 416</td>
<td>Dynamic Programming</td>
</tr>
<tr>
<td>ISE 419</td>
<td>Planning and Scheduling in Manufacturing and Services</td>
</tr>
</tbody>
</table>

Total Credits 12

1 At least 6 credits must be IE courses.

AREAS OF CONCENTRATION

A student may elect to concentrate coursework in specific areas, but there is no requirement to do so. A set of recommended courses in each of eight areas can be found in materials for the Management Science and Engineering program available at the ISE office and at the following Master's Program web page: (https://ise.lehigh.edu/content/masters-programs-courses/#Management)

Manufacturing Systems Engineering

Program director, Keith M. Gardiner, Ph.D. (Manchester, England), professor of industrial and systems engineering.

The world renowned, cross-disciplinary manufacturing systems engineering program develops engineers who can design, install, operate, and modify systems involving materials, processes, equipment, facilities, logistics and people using leading edge technologies. It integrates systems perspectives with interdisciplinary course offerings from Lehigh’s colleges of engineering and applied science, and business and economics.

Lehigh’s award-winning graduate program leading to the cross-disciplinary master of science degree in manufacturing systems engineering (MSE) is administered by the Center for Manufacturing Systems Engineering within the P.C. Rossin College of Engineering and Applied Science. In addition, the College of Business and Economics participates in teaching accounting, business, finance, management, and marketing aspects affecting manufacturing systems.

DISTANCE EDUCATION

It is possible for distance students to earn the MS in MSE degree remotely.

MAJOR REQUIREMENTS

For further information contact: Carolyn Jones, MSE Program Coordinator, 200 West Packer Avenue, Bethlehem, PA 18015 (610) 758-5157, FAX (610) 758-6527, Email ccj1@Lehigh.edu

The degree requires completion of 30 credits of graduate level work, including:

ADMISSION REQUIREMENTS

- A bachelor’s degree in engineering or an appropriate science is required.
- All candidates must have at least six months work experience in industry.
- All candidates must follow admission procedures and standards established by Lehigh University.

ccj1@Lehigh.edu or visit the MSE web site at https://mse.lehigh.edu
Courses

MSE 356 Micromanufacturing Systems & Technologies 3 Credits
Manufacturing engineering in microelectronics, microelectromechanical, nano-, opto- and micro-scale manufacturing. Examination of systems design, equipment, process and operational issues and linkages to business strategies. Crystal growth, thin film deposition processes and patterning, removal processes, vacuum engineering, contamination control, clean room practices etc. Individual research assignments. Note: 300 level course may not be repeated at the 400 level for credit.

MSE 362 (ISE 362) Logistics and Supply Chain Management 3 Credits
Modeling and analysis of supply chain design, operations, and management. Analytical framework for logistics and supply chains, demand and supply planning, inventory control and warehouse management, transportation, logistics network design, supply chain coordination, and financial factors. Industry case studies and a comprehensive final project.

MSE 401 (ME 401) Integrated Product Development 3 Credits
An integrated and interdisciplinary approach to engineering design, concurrent engineering, design for manufacturing, industrial design and business of product development. Design methods, philosophy and practice, the role of modeling and simulation, decision making, risk, cost, materials and manufacturing process selection, platform and modular design, mass customization, quality, planning and scheduling, business issues, teamwork, group dynamics, creativity and innovation. Case studies and team projects with geographically dispersed team members.

MSE 402 Introduction to the Organization and Its Environment 2 Credits
Designed to provide a thorough understanding of business organizations by examining strategies middle and senior managers use to create and sustain organizational competitive advantage. The course examines the organization from an overall perspective within the context of the firm's internal and external environment. The second aspect of the course deals with the ability to communicate effectively in today's business environment. Students will examine and practice communications strategies and skills that are essential to their success in business.

MSE 403 1 Credit
Experimental projects in selected fields of manufacturing systems engineering, approved by the instructor that discuss the global competitive environment in the context of material covered in MBA 401/ MSE 402.

Repeat Status: Course may be repeated.

MSE 431 Marketing & the Invention to Innovation Process 3 Credits
Organizational issues and decision-making for capital investments in new technologies. The commercialization process is traced from research and development and marketing activities through the implementation phase involving the manufacturing function. Term project is a commercialization plan for a new manufacturing technology.

MSE 438 Agile Organizations & Manufacturing Systems 3 Credits
Analysis of the factors contributing to the success of manufacturing enterprises in an environment characterized by continuous and unpredictable change. Fundamentals of lean production: aspects of systems design, value stream analysis, flow, set-up and cycle time reduction, kaizen, elimination of waste. Fundamentals of agility: global enterprises, virtual organizations, adapting to change, mass customization, manufacturing flexibility, activity-based management.

MSE 443 (ISE 443) Automation and Production Systems 3 Credits
Principles and analysis of manual and automated production systems for discrete parts and products. Cellular manufacturing, flexible manufacturing systems, transfer line, manual and automated assembly systems, and quality control systems.

MSE 446 International Supply Chain Management 3 Credits
Financial and managerial issues. Evaluation, selection, development and management of suppliers; business models, financial reporting Stratagism, earnings, quality, risk assessment and internal control, team based new product development. Selected readings, case studies, discussions, lectures, group projects, and presentations.

MSE 451 Manufacturing Systems Engineering Project 1-3 Credits
MSE 456 Micromanufacturing Systems & Technologies 3 Credits
Manufacturing engineering in microelectronics, microelectromechanical, nano-, opto- and micro-scale manufacturing. Examination of systems design, equipment, process and operational issues and linkages to business strategies. Crystal growth, thin film deposition processes and patterning, removal processes, vacuum engineering, contamination control, clean room practices etc. Individual research assignments. Note: 300 level course may not be repeated at the 400 level for credit.

MSE 472 Special Topics 1-3 Credits
Special Topics 1-3 credits.

MSE 481 (GBUS 481) Technology, Operations & Competitive Strategy 3 Credits
Interrelationships among advanced manufacturing management, technology and competitive strategy of the firm. Industry analysis and competitiveness; competitive strategy formulation and implementation; value chain analysis; manufacturing and technology strategy; manufacturing’s contribution to competitive advantage in quality, cost, variety and new product availability; segmentation and substitution; vertical integration.

MSE 482 Aspects of Sustainable Systems Design 3 Credits
Design of sustainable systems for manufacturing that fulfill human needs and generate wealth. Demographic, ecological, economic, environmental, ergonomic, health and global or local socio-political impacts on design and operation of future systems. Conservation of resources in the design, manufacture and use of products, processes, and implementation systems; life cycle engineering, reclamation, recycling, remanufacture. Research-based term paper.

MSE 490 Manufacturing Systems Engineering Thesis 1-6 Credits
MSE 499 Dissertation 0-15 Credits
Marketing

Marketing Department Web page: www.lehigh.edu/cbemarketing
Marketing is a critical success factor in any business. Marketing is more than just selling or advertising. It is understanding a product. It is focusing on the needs of the consumers. It encompasses new product development, pricing, promotion and distribution considerations. Marketing influences virtually all strategic business plans and decisions and its scope ranges from government and not-for-profit organizations to free enterprise. Marketing plays a major role in the management of any business.

Lehigh’s marketing major is a rigorous and highly relevant curriculum of instruction. Students are taught to recognize the strong linkages between theory and practice and to appreciate the need for teamwork, leadership, and communication skills. Activities that encourage students to acquire professional-level competency throughout the curriculum include: developing integrated advertising campaigns, designing and implementing marketing research projects, conducting customer analyses, as well as a wide variety of practice-based projects.

Students are encouraged to explore the potential enhancement of their educational experience through study abroad programs, internships with business, and research projects with faculty members.

Participation in the Marketing Club student organization is an extracurricular activity that offers a professional orientation program and the enjoyment of socializing with other students from across the campus.

Professors. David A. Griffith, PhD (Kent State University); K. Sivakumar, PhD (Syracuse University)
Associate Professors. Ravindra Chitturi, PhD (University Texas, Austin); Beibei Dong, PhD (University of Missouri, Columbia); Nevena Taneva Koukova, PhD (University of Maryland); James M. Maskulka, DBA (Kent State University)
Assistant Professors. Keith A. Botner, PhD (University of Utah); Taewan Kim, PhD (Syracuse University); Ju-Yeon Lee, PhD (University of Washington); Marina Puzakova, PhD (Drexel University); Rebecca Jen-Hui Wang, MSEM (Dartmouth College)
Professors Of Practice. Michael R Catalano, MBA (Cornell University); Steven L. Savino, MBA (Wake Forest University)
Marketing

Emeriti. James Edward Hansz, PhD (University of Cincinnati); Bruce M. Smacey, PhD (Rensselaer Polytechnic Institute)

MARKETING MAJOR
The marketing major offered by the Department of Marketing consists of 18 credit hours from the following courses:

Required courses
- MKT 311 Consumer Behavior 3
- MKT 312 Marketing Research 3
- MKT 387 Marketing Strategy 3

Elective courses
Select three of the following: 9
- MKT 313 Advertising & Sales Promotion Strategy
- MKT 314 Digital and Social Media
- MKT 319 Development and Marketing of New Products
- MKT 320 Global Marketing
- MKT 325 Consumer Insights through Data Analysis
- MKT 326 Marketing Analytics in a Digital Space
- MKT 327 Retail Marketing
- MKT 347 Strategic Brand Management
- MKT 330 Professional Selling
- MKT 332 Sales Management
- MKT 366 Services Retailing and Marketing
- MKT 371 Directed Readings
- MKT 372 Special Topics

Total Credits 18

MARKETING MINOR
The purpose of the marketing minor program is to enable non-CBE students to pursue a course of marketing studies that will enable them to supplement their major studies and make them more marketable. The overall learning objective of the program is to provide non-CBE students with the knowledge and skills with which to make more informed marketing decisions.

Program of Studies:
A Marketing Minor consists of 12 credits. Students wishing to earn a Marketing Minor must take MKT 111, and then select three other marketing courses from the marketing curriculum (with the exclusion of MKT 360 and MKT 371).

Program Admission Requirements:
Each Spring semester, a limited number of students will be accepted into the Marketing Minor Program for the following Fall semester. Applications to the program will be made by students and submitted to the program director by the last Friday in January. An admissions committee comprised of the Marketing Minor Program director and set of marketing faculty will make admission decisions based on G.P.A., experience, and interest in pursuing marketing opportunities upon graduation from Lehigh (to be evaluated on the basis of a written essay), and capacity. Students will be notified of admissions decisions prior to registration for the Fall semester. MKT 111 open to registration for all students in the Marketing Minor Program. Email inquiries should be directed to the Director of the Marketing Minor Program, inmarketing@lehigh.edu.

Required prerequisite course:
Eco 001– Principles of Economics

GRADUATE COURSES
Course descriptions for the College of Business and Economics graduate courses can be found in this section under the heading of Business and Economics Graduate Courses.

Courses
MKT 111 Principles of Marketing 3 Credits
The purpose of this course is to give an overview of the entire marketing function. The objective is to take a broad-based approach to expose students to the meaning of marketing, the terminology of marketing, the activities involved in marketing, how managers make and implement decisions in marketing, and how they evaluate the results. The role of marketing in the broader society will also be discussed. At the end of this course, students will be able to understand the meaning of the marketing concept, various marketing terminologies, how firms develop and evaluate marketing strategies related to product, place, price, and promotions, how marketing strategies are related to other strategies of the firm, and what internal and external factors influence the marketing decisions. The outcome of the course will be assessed by a series of multiple choice and short essay questions, and other suitable assignments decided by the instructor.
Prerequisites: ECO 001

MKT 300 Apprentice Teaching 1-3 Credits
Repeat Status: Course may be repeated.

MKT 311 Consumer Behavior 3 Credits
This course focuses on the theory and tools necessary to analyze and understand consumer buyers and business buyers, as well as other organizational and governmental buyers, in the context of the global information age. The topics covered include, but are not limited to, diffusion of innovations; market segmentation and product positioning; the multiattribute model and the theory of reasoned action; group and individual decision making processes of buyers; and buyer conditioning and learning processes. Throughout the course, the relevance of the covered theory and tools will be illustrated by using cutting edge examples of what businesses and consumers are doing today. At the end of this class, students will be able to demonstrate an understanding of the theories and tools of buyer behavior. In addition, they will be able to analyze buyers and develop appropriate marketing strategies. The achievement of course objectives will be measured through the use of examinations, as well as a variety of application level tools, including in-class projects, case analyses, and a term project.
Prerequisites: MKT 111

MKT 312 Marketing Research 3 Credits
The objective of this course is to offer a managerial approach toward conducting and using research for marketing decisions. The focus will be on the relevance and usefulness of systematic research for decision making, the process and steps involved in conducting effective marketing research, analysis and interpretation of the information for decision making, and the presentation of research results to help managers arrive at sound marketing decisions. Particular emphasis will be placed on the context of technological advances in the collection, dissemination, and use of marketing information, the applicability of marketing research principles for a wide variety of organizations and individuals in the global context, and ethical issues involved in marketing research. At the end of this course, students will have an understanding of the costs and benefits of marketing research, be able to conduct marketing research using a systematic set of procedures, know how to develop research instruments such as questionnaires, have the knowledge to analyze the data, and present the conclusions to other managers. In addition to periodic testing of their knowledge of marketing research by means of examinations (multiple choice, short essay questions, and hands-on problems), the course will involve a marketing research project from problem formulation to presentation of findings.
Prerequisites: (ECO 145 or ECO 045) and MKT 111

MKT 313 Advertising & Sales Promotion Strategy 3 Credits
The basic principles of advertising are covered in this course through the mechanism of an advertising campaign. Emphasis is on the advertising and promotions planning framework including but not limited to: targeting of advertising, types of media, types of promotions, media planning and buying, creative planning, and the basic creative formats appropriate for each medium. As part of a specific advertising campaign, the student must estimate the campaign's budget and evaluate the campaign's overall performance following its conclusion.
Prerequisites: MKT 111

304 Marketing
MKT 314 3 Credits
The focus of this course will be on understanding social and digital media, how to build social/digital media marketing strategies, and how to track their effectiveness. The key course objectives include: (1) evaluate what companies have done or are currently doing and learn what makes some marketing communications strategies succeed but others fail; (2) stay abreast of recent and current trends and innovations in social and digital media; and (3) learn about how customers interact socially.
Prerequisites: MKT 111

MKT 319 Development and Marketing of New Products 3 Credits
This course adopts the marketing philosophy that new products and services will be profitable if the extended product provides customers with highly valued benefits. The goal is to help students learn how to use state-of-the-art management techniques to identify markets, develop new product ideas, measure customer benefits, and design profitable new products. The course provides techniques to interface the marketing function with the functions of R&D, design engineering, and manufacturing.
Prerequisites: MKT 111

MKT 320 Global Marketing 3 Credits
Understanding the process of globalization and its impact on the firm’s marketing activities. Whether an organization operates in the domestic market or in the global market place, it cannot ignore competitive pressures and market opportunities at the global level. This course will focus on topics such as the changes in global environment and their impact on marketing activities, development of global marketing strategies based on sound marketing research, and the role of technology in global marketing strategies.
Prerequisites: MKT 111

MKT 325 (ECO 325) Consumer Insights through Data Analysis 3 Credits
Explores marketing analytic approaches aimed to improve the understanding of customer and customer perceptions thereby enhancing the effectiveness of marketing decision making and implementation. Foundational data analysis techniques are examined in such areas as advertising, customer acquisition and retention (customer relationship management), segmentation, customer loyalty, lifetime-value analysis of the customer, pricing, sales force management, sales promotions and new products. The development, implementation, and utilization of quantitative models on customer data are emphasized. Prerequisites as noted below.
Prerequisites: MKT 111 and ECO 146

MKT 326 Marketing Analytics in a Digital Space 3 Credits
This course provides a quantitative approach to understanding and harnessing marketing data (e.g., online advertising, social media) to meet marketing objectives. Students will learn how to design, run, evaluate and improve online marketing efforts to meet specific business objective like customer acquisition, increased brand awareness, etc. This course will cover basic marketing and statistical concepts, provide an introduction to different online marketing tools (e.g., inbound marketing, SEO/SEM and social media analytics), and techniques pertaining to visual representation of marketing data.
Prerequisites: MKT 111
Attribute/Distribution: ND

MKT 327 Retail Marketing 3 Credits
This course provides an overview of the retailing industry. Primary focus will be on the customer-facing activities of retailers, such as assortment planning, private-label development and the management of in-store operations, and the back-door activities that support customer interaction. In addition, current issues facing retailers, such as customer relationship management, industry consolidation and supplier relations, will be examined.
Prerequisites: MKT 111

MKT 330 Professional Selling 3 Credits
The course provides students with basic preparation for business-to-business personal selling and careers in sales. The course utilizes role-playing, experiential exercises, lectures and projects designed to teach the latest strategies and tactics in lead generation and prospecting, qualifying leads for high potentials, seeding, cold-calling, formal sales presentations, handling objections, negotiating for final proposal, closing techniques and service after the sale.
Prerequisites: MKT 111

MKT 332 Sales Management 3 Credits
This course is an integrative approach to sales management including formulation of strategically sound sales programs, implementation of sales programs, and evaluation and control of the organization’s sales activities. Illustrative topics include the role of the sales manager in the divergent demands of multiple constituencies; the development of effective sales organizations; salesperson’s motivations and the development of flexible motivational plans; the variety of financial and non-financial rewards used by sales managers; forecasting sales costs and evaluating performance by person, territory, customer, market, and industry; and coordination of the sales activities with other elements in a firm’s marketing program.
Prerequisites: MKT 211 or MKT 111

MKT 347 3 Credits
In this class you will be introduced to concepts pertaining to brand development and its relationship with technology, design, emotions and the financial performance of firms. Our goal is to help you learn how to use state-of-the-art branding techniques. Our focus is brand equity and its contributions to shareholder wealth. The course will be relevant to students who expect to work directly in brand or product management.
Prerequisites: MKT 111

MKT 360 Marketing Practicum 3 Credits
The marketing practicum combines formal class work on marketing problem formulation and business communications with an intensive internship or consulting engagement with a business. Students work with client firms to develop individual or team projects, which focus on marketing activities such as market research, strategy development, sales management, and promotion management. Upon completion of the project, students submit a written report and make a formal presentation to clients. This course cannot be used to satisfy marketing major requirements. Summer only.
Prerequisites: MKT 111 and MKT 312 and MKT 311

MKT 366 Services Retailing and Marketing 3 Credits
While manufacturing giants all consider themselves service-related companies, services are moving to the forefront of industry value proposition offerings. This course focuses on issues related to service design and marketing on a broad basis, and its implication to retailing in particular. The course enables students to gain an understanding of the special challenges evident in marketing services and to acquire a unique set of knowledge and skills beyond the traditional strategies designed for product goods. Illustrative topics include fundamental differences.
Prerequisites: MKT 111

MKT 371 Directed Readings 1-3 Credits
Readings in various fields of marketing designed for the student who has a special interest in some field of marketing not covered in regularly scheduled courses. Consent of department chair required.
Repeat Status: Course may be repeated.

MKT 372 Special Topics 1-3 Credits
Special problems and issues in marketing for which no regularly scheduled course work exists. When offered as group study or internship, coverage will vary according to the interests of the instructor and students. Consent of department chair required.
Repeat Status: Course may be repeated.
MKT 373 Marketing Internship 1 Credit
Based on a student’s work experience, a sponsoring faculty member shall direct readings, projects, and other assignments—including a “capstone report.” It should be noted that the work experience (at least 80 hours), by itself, is not the basis for academic credit. The faculty directed activity must be provided concurrent with the work. Course registration and related arrangements must be made in advance of the work engagement. This course must be taken Pass/Fail and cannot be used to satisfy marketing major requirements. Must have junior standing. Consent of department chair required. Declaration of a marketing major.

Repeat Status: Course may be repeated.

Prerequisites: MKT 111

MKT 387 Marketing Strategy 3 Credits
The objective of this capstone course is to synthesize the marketing principles introduced in other marketing courses and thus provide students an integrative framework to marketing decision-making. Our review indicates that this integrative closure for the marketing coursework is a common practice at some of the better business schools. It will focus on how marketing strategy supports the overall corporate strategy. The course will emphasize that Marketing does not operate in vacuum. What is done in other functional areas will impact marketing strategy profoundly, and vice versa. The will address traditional strategic issues such as identification of organizational strengths, weaknesses and environmental opportunities in the context of developing marketing strategies, but will also emphasize the importance of embracing a customer centric orientation throughout the organization. Incorporating a customer centric orientation is an essential component of marketing strategy today as it captures the dynamic and evolving nature of marketing. Every company employee is important to the marketing function, every employee contact with a customer is a form of marketing communication, the increasing number of customer-initiated contacts with the firm are as important as firm-initiated contacts, and customer relationships now take precedence over sales transactions. Specific emphasis will be placed on applying theoretical principles in realistic scenarios by means of case studies of how marketing strategy is impacted by the overall corporate strategy and other functional strategies. Student performance will be evaluated by his/her ability to prepare and present case analyses. Senior Standing.

Prerequisites: MKT 311 and MKT 312

MKT 389 Honors Project 1-6 Credits

MKT 415 Marketing Foundations 3 Credits
This course is designed to provide students with a comprehensive analytical framework to develop, implement and evaluate competitive marketing strategies that achieve organizational goals and objectives. It explores the functional marketing operations of organizations and examines the key elements of a marketing manager’s decision making process. Examples of learning modules include: customer and market analysis, segmentation, targeting and positioning, marketing mix decisions (product, price, placement and promotion).

Prerequisites: Must have Excel competency

MKT 425 Brand Strategy 2 Credits
This course is fundamentally about understanding how Brand Equity is built and managed. The course builds on the marketing principles and theories covered in Marketing Foundations, while enabling students to delve into the strategic components that go into building brands and managing brand equity. The course focuses on theories, models and tools that enable managers to develop new and manage existing brands.

Prerequisites: MKT 415

Master of Engineering in Technical Entrepreneurship
Lehigh's one-year, 30-credit, full-time professional Master's program (M.Eng.) in technical entrepreneurship helps young entrepreneurs to develop an entrepreneurial mindset through a process we call “Learn by Doing, Learn by Making and Learn by Launching.” Entrepreneurial minded students from any undergraduate major are encouraged to apply. Students in the program learn by experiencing the idea-to-venture process in an educational environment that features a dedicated curriculum offered by a dedicated faculty in a dedicated, intellectual property secure maker space. The business community -- from young start-ups to the Fortune 500 -- recognizes the need for curious, creative and innovative young minds with the skills to lead and manage product development teams to create social and economic value. Graduates of the TE MEng program will find themselves well-positioned to take on complex product development roles and assignments in both large and small companies.

Graduate TE Course Sequence
The TE academic calendar begins with the start of the second summer session with 5 credits. Students complete 10 credits each during the fall and spring semesters and complete their 30 credits with the final two courses during the first summer session of the following year. Students complete five credits in the second summer session, ten credits in the fall, ten credits in the spring and then five credits in summer session 1

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Total Credits: 30

Further information can be obtained from: http://www.lehigh.edu/innovate/

Prof. John Ochs
Director
P.C. Rossin College of Engineering & Applied Science
(610) 758-4593

Ms. Jodie Johnson
Coordinator
P.C. Rossin College of Engineering & Applied Science
(610) 758-4789

Courses
TE 211 Capstone Design Projects-1 3 Credits
Students work in cross disciplinary teams on conceptual design projects with realistic constraints including marketing, financial and economic planning, and economic and technical feasibility including industrial, business and engineering standards for new products. Teams typically work on projects from industry or entrepreneurial start-ups. Oral presentations and written reports.

TE 212 Capstone Design Projects-2 2 Credits
Students work in cross disciplinary teams on the detailed design, including fabrication and testing of a prototype following industrial, business and engineering standards for the new products or processes designed in Capstone Design Experiences-1. Additional deliverables include a detailed production plan, marketing plan, and base-case financial models. Teams typically work on projects from industry or entrepreneurial start-ups. Oral presentations and written reports.

Prerequisites: TE 211

Attribute/Distribution: ND

TE 250 (EN TP) 250 Systematic Creativity Techniques 3 Credits
ENTP 250/TE 250 -- Systematic creativity methods including anthropological research, painstoming, bisociation, the Kano model, trimming technique, DeBono’s Six Hats technique, biomimcry, lateral benchmarking, Blue Ocean Strategy, & the art of tinkering, along with other innovation methods. This course includes hands-on labs, individual & team projects, & the creation of a creativity portfolio. Open to students in any college and major. (ND).

Attribute/Distribution: ND
TE 301 Creativity and Systematic Innovation Methods 3 Credits
Creativity methods, anthropological research, painstorming, bisociation, the Kano model, axiomatic design, the trimming technique, parameter analysis, decomposition, nonlinear design, Taguchi's method, DeBono's Six Hats technique, biomimicry, TRIZ, lateral benchmarking, Blue Ocean Strategy, the art of tinkering and other innovation methods. Hands-on labs, individual and team projects.

TE 302 Methods in Visual Thinking 2 Credits
Visualization techniques, visual thinking and envisioning information as taught by Edward Tufte and others, multimedia tools and methods. Appropriate use of technology as applied to new product development, no programming required.

TE 303 Methods in Prototyping, Modeling and Testing 2 Credits
Generation of mock-ups and looks-like prototypes, electro-mechanical-digital hardware design, fabricate, build and test multiple generations of prototypes, computer modeling methods, shop methods, testing, sensors and data collection.

TE 304 (CSB 304, ENTP 304) Software Ventures 3 Credits
Designed from the perspective of a functional leader, this course provides students with a holistic perspective of developing a successful software venture in an interdisciplinary and experiential environment. Students will develop a software-oriented idea concurrent with module delivery that will contain best practices, case studies, and subject-matter experts. Examination will include business model fundamentals, customer discovery, translating requirements to a minimum viable product, agile development, user acquisition, and traction. Prior programming experience preferred, but not required. Open to any major.
Prerequisites: ENGR 010 or CSE 002 or BIS 111

TE 401 Integrated Product Development (IPD) Process-1 3 Credits
An integrated and interdisciplinary approach to engineering design, concurrent engineering, design for manufacturing, industrial design and the business of new product development. Topics include design methods, philosophy and practice, the role of modeling and simulation, decision making, risk, cost, material and manufacturing process selection, platform and modular design, mass customization, quality, planning and scheduling, business issues, teamwork, group dynamics, creativity and innovation. Case studies and semester-long team projects.
Prerequisites: TE 301 and TE 407

TE 402 Integrated Product Development (IPD) Process-2 3 Credits
Continuation of TE 401, the parallel development of the product, the development of the marketing and manufacturing system, manufacturing and marketing launch, sales, service and customer support. Case studies and semester-long team projects.
Prerequisites: TE 401

TE 403 Entrepreneurial Startup Process-1 3 Credits
Key aspects surrounding company startups, including feasibility analysis, business model development and evaluation, formation of new venture teams, financial forecasts, sources of financing. Readings, financial templates, live case studies and guest entrepreneurs.
Prerequisites: TE 301 and TE 407

TE 404 Entrepreneurial Startup Process-2 3 Credits
Continuation of TE 403, integration of key business components to form and launch your venture: industry analysis, marketing plan and sales strategy; mobilization of the new venture team; operations, including space, legal and insurance consideration; and financial management. Selected topics related to respective venture types (i.e. social entrepreneurship, family business, franchising, immigrant entrepreneurs). Lectures, workshops and guest entrepreneurs.
Prerequisites: TE 403

TE 405 Entrepreneurial Startup Projects-1 2 Credits
Applying the concepts and processes developed in TE 403. Developing your business platform including business model, start-up team, and financial plan to launch and grow your venture.
Prerequisites: TE 403 and TE 302 and TE 303

TE 406 Entrepreneurial Startup Projects-2 3 Credits
Applying the concepts off entrepreneurial startup process, building upon the business model, entrepreneurial team and financing plan developed in TE 405. Developing a comprehensive business plan and investor's pitch, finalize the steps necessary to launch the company and start operations.
Prerequisites: TE 404 and TE 405

TE 407 Intellectual Property (IP) Creation and Management 2 Credits
Intellectual property issues: confidentiality, nondisclosure, agreement not to compete, founders agreements, patents, copyrights, trademarks, trade secrets both domestic and international.
Prerequisites: TE 302 and TE 303 and TE 403

TE 461 Integrated Product Development (IPD) Projects-1 2 Credits
Technical and economic feasibility study of new products. Selection and content of the project is determined by the faculty project adviser in consultation with the student, progress and final reports, oral and poster presentations. Consent of the program director and faculty project adviser required.
Prerequisites: TE 401 and TE 302 and TE 303

TE 462 Integrated Product Development (IPD) Projects-2 2 Credits
Detailed design specification, fabrication, building and testing prototype new products and plan for production, selection and content of the project is determined by the faculty project advisor in consultation with individual students or student teams. Progress and final reports, oral and poster presentations. Consent of program director and faculty project adviser required.
Prerequisites: TE 461 and TE 402

Materials Science and Engineering

As science and technology advance in the 21st century, progress in many fields will depend on the discovery and development of new materials, processed in more complex ways, and with new kinds of properties. It is widely recognized that the progress of history has been divided into periods characterized by the materials that mankind has used, e.g., the stone age, the bronze age, the iron age. Today, materials science and engineering is critical to all other fields of engineering, and advances in other fields are often limited by advances in materials.

Interest in new materials for solid-state devices, space technology, and superconductivity, as well as a better understanding of the behavior of materials in the design of structures, automobiles and aircraft, plant processing equipment, electronic devices, biomedical devices, etc., have increased the need for people trained in science and technology of materials.

Education for this field of engineering requires basic studies in mathematics, chemistry, physics and mechanics, plus a general background in engineering principles, followed by intensive training in the application of these principles to the development and use of materials in a technological society.

Professors: Helen M. Chan, PhD (Imperial College London); Vollmar R. Dierolf, PhD (University of Utah); John N. DuPont, PhD (Lehigh University); Martin P. Harmer, DSc (University of Leeds); Himanshu Jain, EngScD (Columbia University); Christopher J. Kiely, PhD (University of Bristol); Charles E. Lyman, PhD (Massachusetts Institute of Technology); Wojciech Z. Misiolek, DSc (AGH University of Science & Technology); Raymond A. Pearson, PhD (University of Michigan Ann Arbor); Jeffrey M. Rickman, PhD (Carnegie Mellon University); Richard P. Vinci, PhD (Stanford University)

Associate Professors: Xuanhong Cheng, PhD (University of Washington); Sabrina S. Jedlicka, PhD (Purdue University); Masashi Watanabe, PhD (Kyushu University)

Assistant Professors: Lesley A. Chow, PhD (Northwestern University); Siddha Pimpukat, PhD; Nicholas Strandwitz, PhD (University of California Santa Barbara)
Emeriti. Betzalel Avitzur, PhD (University of Michigan Ann Arbor); Sidney R. Butler, PhD (The Pennsylvania State University); G. Slade Cargill, III, PhD (Harvard University); Ye T. Chou, PhD (Carnegie Mellon University); John Alwyn Eades, PhD (University of Cambridge); Richard W. Hertzberg, PhD (Lehigh University); Arnold R. Marder, PhD (Lehigh University); Michael R. Notsis, PhD (Lehigh University); Alan W. Pense, PhD (Lehigh University); Stephen K. Tarby, PhD (Carnegie Mellon University); David A. Thomas, DSc (Massachusetts Institute of Technology); David B. Williams, PhD (University of Cambridge)

B.S. IN MATERIALS SCIENCE AND ENGINEERING
The undergraduate program is designed to prepare graduates for research, development, operations, management, and sales careers in industry or for graduate study in various specialties of the field, including the improvement of properties in metals, ceramics, polymers, composites, and electronic materials. While some graduates go directly into materials-producing companies, most serve as engineers in the transportation, electronics, chemical, communications, space, and other industries. A number of students pursue graduate study leading to careers in research and teaching, medicine, or the law.

Materials Science and Engineering majors have opportunities to gain valuable experience in related fields, including other areas of engineering or science, by choosing to concentrate elective courses in one of these areas. Requirements for the Minor include acquiring at least 15 course credits in that area, which may be taken as technical or free electives in the student's major. It is particularly straightforward for students to obtain a minor in Chemical Engineering, in Manufacturing Engineering, in Nanotechnology, or in Polymer Science and Engineering.

Materials Science and Engineering majors can also participate in undergraduate research at universities in Great Britain and elsewhere during the summer between the Junior and Senior years. The Materials Science and Engineering Industrial Option program enables students to gain work experience during the Senior Year. The Materials Science and Engineering Research Option program provides senior undergraduates with research experience.

Five-Year programs are available to broaden the Materials Science and Engineering undergraduate experience. One such program is the Arts-Engineering Program, in which students can earn both the Bachelor of Science degree in Materials Science and Engineering and the Bachelor of Arts degree in some area within the College of Arts and Sciences, such as biology, physics, chemistry, or history. Another is the B.S./M.Ed. Program, which leads (in five years of study and internships) to the B.S. degree in Materials Science and Engineering and a masters degree (M.Ed.) in Education, with elementary or secondary teacher certification.

MINOR IN MATERIALS SCIENCE AND ENGINEERING
The Department of Materials Science and Engineering offers minors to students majoring in other subjects. The Department is enthusiastic in its support of students who wish to broaden their education by taking a minor. To obtain a minor in Materials Science and Engineering, a student must complete:

MAT 033 Engineering Materials and Processes 3
Four other three-credit courses that may be chosen from a long list of 200 and 300 level courses relevant to various engineering disciplines 12

Total Credits 15

MINOR IN NANOTECHNOLOGY
Materials for nanotechnology applications have new properties unavailable in bulk materials. The synthesis, processing, and characterization of these materials require facility with concepts beyond those needed for typical engineering materials. This minor requires:

MAT 355 Materials for Nanotechnology 3
One course on crystallography and band theory 3
Additional electives 9

Total Credits 15

EDUCATIONAL MISSION
The Materials Science and Engineering undergraduate program's mission is to provide its students an excellent education in a scholarly environment.

PROGRAM EDUCATIONAL OBJECTIVES
• Graduates will have the knowledge and experience to pursue successful careers;
• Graduates will meet the expectations of employers;
• Qualified graduates will be admitted to highly ranked advanced degree programs; and
• Successful careers will be reflected in professional recognition, advancement in responsibility, and awards.

STUDENT OUTCOMES
The MS&E undergraduate Student Outcomes declare that graduates should have:

(a) an ability to apply knowledge of mathematics, science, and engineering;
(b) an ability to design and conduct experiments, as well as to analyze and interpret data;
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
(d) an ability to function on multidisciplinary teams;
(e) an ability to identify, formulate, and solve engineering problems;
(f) an understanding of professional and ethical responsibility;
(g) an ability to communicate effectively;
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;
(i) a recognition of the need for, and an ability to engage in life-long learning;
(j) a knowledge of contemporary issues;
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

MAJOR REQUIREMENTS
The recommended sequence of courses is shown below. A total of 132 credits or more is required to graduate.

First Year

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Second Year

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<td>Humanities or Social Science Elective</td>
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Select one of the following: 4
### PROGRAM OPTIONS

Recognizing that the field of materials science and engineering may be pursued in either an industrial setting or a research setting, the department offers three elective options to prepare students for these careers: The Co-Op Program, the Industrial Option, and the Research Option.

#### Co-Op Program

The department's optional Co-Op program, operated within the College of Engineering and Applied Science, provides opportunities for integration of academic studies with significant periods of engineering practice. The program provides eight months of paid, full-time work at selected companies, while still allowing the student to graduate in four years. To be considered for this program, the student should discuss application requirements with his or her advisor.

#### Industrial Option

The Industrial Option introduces students to the work of materials engineers in industry. The emphasis is a team approach to the solution of actual plant problems. The courses are conducted in cooperation with local industries. 20 hours per week are spent at the plant of the cooperating industry on investigations of selected problems. The option is limited to a small group of seniors, selected by the Department from those who apply. Summer employment is provided when possible for those who elect to initiate the program during the summer preceding the senior year.

### Electives

Electives for the sophomore, junior, and senior years must be distributed as follows:

- Humanities and Social Sciences: 13-15 credit hours.
- Free Electives: 9 credit hours in any department.
- Approved Elective (3 credit hours) and Engineering Science Electives (6 credit hours) must be selected from a specific list supplied by the Materials Science and Engineering Department. The list includes the Industrial Option and the Research Option.

#### Special Programs and Opportunities

The department has established specific recommended programs for the M.S., the M.Eng., and the Ph.D., emphasizing the following areas: metals processing and performance, ceramics and glass processing and properties, electronic and photonic materials and packaging, electron microscopy and microstructural characterization, and archaeometallurgy. These programs are flexible and often interdisciplinary.

#### Major Requirements

A candidate for the M.S. completes a thesis, unless fully funded by industry, in which case a thesis is not required. M.S. thesis research normally represents six of the 30 semester hours required for this degree. Candidates for the M.Eng. complete a three-credit engineering project.

A candidate for the Ph.D. prepares a preliminary program of courses and research, providing for specialization in some field (largely through research) in consultation with the advisor. Prior to formal establishment of the doctoral program by the special committee and its approval by the college, the student passes a qualifying examination that must be taken in the first or second year of doctoral work. The department does not require a foreign language. It does require preparation and defense of a research proposal as a portion of the general examination.

Of the courses listed only those in the 300 series are available for graduate credit. There are many additional offerings in materials under the listings of other departments.

Most graduate students receive some form of financial aid. Several kinds of fellowships and assistantships are available. This type of aid generally provides for tuition, and a stipend. For details of graduate scholarships,
fellows, and assistantships, please refer to the Financial Aid (p. 36) section.

Research Activities
Graduate students conduct their research in facilities located in the Department, or the Center for Advanced Materials and Nanotechnology, or other centers and institutes. The following list describes current Materials Science and Engineering research activities:

Metals Processing and Performance
Joining of metals and alloys, laser engineered net shaping, solidification modeling, corrosion and coatings, deformation processing, grain boundary cohesion, bulk metallic glasses.

Ceramics and Glass Processing and Properties
Fundamental studies of sintering and grain growth, novel reaction-based processing for bulk and thin film ceramics, microstructure and properties of oxides for environmental coatings, growth of single crystal piezoelectric ceramics, creep and grain boundary chemistry of alumina, dielectric and electrical properties of glasses, corrosion of glass.

Electronic and Photonic Materials and Packaging
Electromigration, degradation processes in light-emitting semiconductors, mechanical behavior of thin metal films, reliability of MEMS materials, processing and performance of advanced solder alloys, polymer packaging materials, glass nanostructure and chemistry, glasses for nonlinear optical applications, transparent glassceramics, photoinduced phenomena.

Microstructural Characterization
Transmission electron microscopy, scanning electron microscopy, nanoscale compositional mapping, cathodoluminescence microscopy and spectroscopy, x-ray diffraction and fluorescence, x-ray microanalysis, electron-loss spectrometry, extended x-ray absorption and electron energy loss fine structure (EXAFS and EXELFS).

Archaeometallurgy
Reconstruction of ancient smelting and fabrication processes, artifact analysis using modern analytical methods, history of materials.

Courses

MAT 010 Materials Laboratory 2 Credits
Introduction to experimental methods used to fabricate and measure the structure and properties of materials. Thermal and mechanical processing and properties are emphasized. Specimen preparation and examination by light optical microscopy.
Prerequisites: MAT 033
Can be taken Concurrently: MAT 033

MAT 020 Computational Methods in Materials Science 3 Credits
The use of computers and computational methods to solve problems in materials science and engineering. Students will employ both commercial packages and their own code in order to complete assignments. Students will utilize word processing and display packages to present results of projects.
Prerequisites: ENGR 010

MAT 028 Silicon, Steel, or Styrofoam? Designing with Materials 3 Credits
A systematic methodology for selecting materials and fabrication processes in engineering design; case studies in which this methodology is used; overview of engineering materials and their properties; development of material performance indices; materials for environmentally conscious and sustainable design; industrial design considerations; design-directed development of new materials. No previous engineering experience required.
Prerequisites: PHY 009 and PHY 010 or PHY 011
Can be taken Concurrently: PHY 009, PHY 010, PHY 011

MAT 033 Engineering Materials and Processes 3 Credits
Application of physical and chemical principles to understanding, selection, and fabrication of engineering materials. Materials considered include metals, polymers, ceramics, composites, and electronic materials. Case studies of materials used range from transportation systems to microelectronic devices.

MAT 101 Professional Development 2 Credits
The role and purpose of engineering in society; the meaning of being a professional; engineering ethics; environmental issues; safety issues; communications and decision-making in the engineering process; expectations and problems of young engineers; personal goals; choosing a career. Required reading. Written reports based on library research. Must have junior standing.

MAT 107 Special Topics in Materials 1-3 Credits
A study of selected topics in materials science and engineering not covered in other formal courses. Consent of instructor required.

MAT 201 Physical Properties of Materials 3 Credits
Basic concepts of modern physics and quantum mechanics needed for an understanding of electrons in solids. The experimental development leading to wave mechanics is emphasized. Uses of the Schrodinger equation as the basis for the free electron theory of metals and band theory. Optical properties are developed leading to a discussion of lasers.
Prerequisites: (PHY 021 and MAT 033 and MATH 023)

MAT 203 Materials Structure at the Nanoscale 4 Credits
The structure of metals, ceramics, semiconductors, and polymers at the atomic scale. Crystalline, amorphous (glassy) states. Fundamental aspects of formal crystallography and crystal structures. Point, line, and planar crystal defects. Materials characterization by x-ray diffraction, light microscopy, and electron microscopy.
Prerequisites: (CHM 030 and MAT 033) and MAT 010
Can be taken Concurrently: MAT 033

MAT 204 Processing and Properties of Polymeric Materials 3 Credits
The structure-property relationships in polymers will be developed, emphasizing the glass transition, rubber elasticity, crystallinity, and mechanical behavior. Elements of polymer processing. Extrusion of plastics and films, and fiber spinning operations.
Prerequisites: MAT 033

MAT 205 Thermodynamics of Macro/Nanoscale Materials 3 Credits
The three laws of thermodynamics. Gibbs free energy and conditions of equilibrium. Effects of scale on material behavior. Binary and ternary equilibrium phase diagrams. Application of thermodynamics to materials problems, with examples from nanotechnology, biotechnology, and structural materials.
Prerequisites: MATH 023 and MAT 033
Can be taken Concurrently: MATH 023, MAT 033

MAT 206 Processing and Properties of Metals 3 Credits
The production and purification of metals, their fabrication, and control of their properties. Includes topics such as precipitation hardening, hot and cold working, and casting.
Prerequisites: (MAT 218 and MAT 216)

MAT 214 Processing and Properties of Ceramic Materials 3 Credits
Prerequisites: MAT 033

MAT 216 Diffusion and Phase Transformations 3 Credits
Fundamental diffusion equations; liquid-solid transformations; solid-solid transformations; transformation kinetics; metastable transformations; diffusionless transformations; examples of various transformations in different materials and their effect on properties.
Prerequisites: (MAT 203 and MAT 205)

MAT 218 Mechanical Behavior of Macro/Nanoscale Materials 3 Credits
Elasticity, plasticity, and fracture of metals, ceramics, polymers, and composites. The roles of defects and size scale on mechanical response. Strengthening and toughening mechanisms in solids. Statics and time-dependent failures from microstructural and fracture mechanics viewpoints. Lectures and laboratories.
Prerequisites: MAT 033 and MAT 010
MAT 221 (STS 221) Materials in the Development of Man 3 Credits
Development of materials technology and engineering from the stone age to atomic age as an example of the interaction between technology and society. In-class demonstration laboratories on composition and structure of materials. Term projects using archaeological materials and alloys. Course intended for, but not limited to, students in the humanities and secondary science education. Engineering students may not use this course for engineering science or technical elective credit.

MAT 252 Electronic Properties of Materials 3 Credits
Electronic structure of materials, i.e., band and zone theory, is presented from a physical point of view. Electrical conductivity in metals, semiconductors, insulators and superconductors discussed. Simple semiconductor devices reviewed. Magnetic properties examined in the context of domain theory and applications. Optical and dielectric properties of semiconductors and ferroelectrics are considered.
Prerequisites: MAT 201 and MAT 203

MAT 268 Failure Analysis Reports 3 Credits
Application of chemical and mechanical failure concepts, microstructural analysis, and fracture surface characterization to the analysis and prevention of engineering component failures. Materials selection from databases of AISI standard alloys. Laboratory investigations on component failures using ASTM standard testing methods. Written and oral presentations of the results. Must have senior standing.
Prerequisites: MAT 204 and MAT 206 and MAT 214 and MAT 252

MAT 300 Apprentice Teaching 3 Credits

MAT 309 (ME 309) Composite Materials 3 Credits
The principles and technology of composite materials. Processing, properties, and structural applications of composites, with emphasis on fiber-reinforced polymers. Lectures and some field trips or laboratories.
Prerequisites: (MAT 033 or MECH 003)

MAT 310 Independent Study in Materials 1-3 Credits
Provides an opportunity for advanced, independent study of selected topics in materials science and engineering not covered in other formal courses.
Repeat Status: Course may be repeated.

MAT 312 Fundamentals of Corrosion 3 Credits
Prerequisites: MAT 205 or CHM 942

MAT 314 (ME 314) Metal Forming Processes 3 Credits
Prerequisites: MAT 206

MAT 315 Physical Properties of Structural and Electronic Ceramics 3 Credits
Structure-property relationships in ceramics. Mechanical behavior including plasticity, hardness, elasticity, strength and toughening mechanisms. Thermal behavior including specific heat, thermal expansion, thermal conduction and thermal shock. Electrical behavior including application of tensors and crystal physics to electroceramics.
Prerequisites: MAT 214

MAT 316 Optical Properties of Materials 3 Credits
Interaction of electromagnetic waves with solid, liquid, and gaseous matter: reflection, refraction, polarization, diffraction, scattering, absorption, and luminescence. Factors determining the perceived color of metals, ceramics, polymers, semiconductors, biomaterials, and various nanostructured materials. Overview of the technological applications of optical materials in coatings, lighting, display technologies, lasers, solar cells, and optical communications. Credit will not be given for both MAT 316 and MAT 416.
Prerequisites: MAT 033

MAT 317 Imperfections in Crystals 3 Credits
The major types of crystal defects and their role in controlling the properties of materials. Point, line and planar defects, their atomic configurations and experimental techniques to study their characteristics. Emphasis on the role of dislocations and grain boundaries in the control of mechanical properties.
Prerequisites: MAT 203

MAT 319 Current Topics in Materials Science 3 Credits
Selected topics of current interest in the field of materials engineering but not covered in the regular courses. Consent of department required.
Repeat Status: Course may be repeated.

MAT 320 Analytical Methods in Materials Science 3 Credits
Selected topics in modern analysis and their application to materials problems in such areas as thermodynamics, crystallography, deformation and fracture, diffusion.
Prerequisites: MATH 231 or MATH 205

MAT 324 (BIOE 324) Introduction to Organic Biomaterials 3 Credits
Property, characterization, fabrication and modification of organic materials for biomedical and biological applications; host responses to materials on the molecular, cellular and system level; general introduction to biosensors, drug delivery devices and tissue engineering. Consent of instructor required.
Prerequisites: BIOE 110 or MAT 204

MAT 325 (BIOE 325) Inorganic Biomaterials 3 Credits
Fabrication methods for biomedical implant and devices. Selection of metals and ceramics with specific bulk and surface physical as well as chemical properties. The role of materials chemistry and microstructure. Biocompatibility. Case studies (dental and orthopedic implants, stents, nonporous ceramic filters for kidney dialysis).
Prerequisites: MAT 033

MAT 326 (BIOE 326) Biomimetic and Bio-enabled Materials 3 Credits
The structure, function, properties and use of biopolymers, biocomposites, and biomaterials. Biomimetic materials design, including colloids, interfaces, macromolecules, and applications of such materials. Environmental and ethical considerations, such as degradation products when using biomimetic materials. Closed to students who have taken MAT 426 (BioE 426).
Prerequisites: MAT 033 or BIOE 110
Attribute/Distribution: ND

MAT 327 Industrial Project 4 Credits
Restricted to a small group of seniors and graduate students selected by the department from those who apply. Two full days per week are spent on development projects at the plant of an area industry, under the direction of a plant engineer and with faculty supervision.

MAT 329 Industrial Project 4 Credits
To be taken concurrently with MAT 327. material is the same as MAT 327.

MAT 332 Basics of Materials Science and Engineering 3 Credits
Physical and chemical principles applied to understanding the structure, properties, selection, fabrication, and use of engineering materials: metals, polymers, ceramics, composites and electronic materials. Case studies of materials used ranged from transportation systems to microelectronic devices. Lectures and individual study assigned by graduate advisor. Must have graduate student status. Consent of department required. Not available to students who have taken MAT 033 or equivalent.

MAT 333 Crystallography and Diffraction 3 Credits
Introduction to crystal symmetry, point groups, and space groups. Emphasis on materials characterization by x-ray diffraction and electron diffraction. Specific topics include crystallographic notation, stereographic projections, orientation of single crystal, textures, phase identification, quantitative analysis, stress measurement, electron diffraction, ring and spot patterns, convergent beam electron diffraction (CBED), and space group determination. Applications in mineralogy, metallurgy, ceramics, microelectronics, polymers, and catalysts. Lectures and laboratory work. Senior standing in chemistry.
Prerequisites: MAT 203 or EES 135
MAT 334 (CHE 334) Electron Microscopy and Microanalysis 4 Credits
Fundamentals and experimental methods in electron optical techniques including scanning electron microscopy (SEM), conventional transmission (TEM) and scanning transmission (STEM) electron microscopy. Specific topics covered will include electron optics, electron beam interactions with solids, electron diffraction and chemical microanalysis. Applications to the study of the structure of materials are given. Consent of department required.

MAT 340 Research Techniques 3 Credits
Study and application of research techniques in materials science and engineering. Research opportunities, design of experimental programs, analysis of data, presentation of results. Selection of research topic and preparation and defense of research proposal. Restricted to a small number of students selected by the department from those who apply.

MAT 341 Undergraduate research 3 Credits
Application of research techniques to a project in materials science and engineering selected in consultation with the faculty. Normally preceded by MAT 340.

MAT 342 Inorganic Glasses 3 Credits
Definition, formation and structure of glass; common glass systems; manufacturing processes; optical, mechanical, electrical and dielectric properties; chemical durability; glass fibers and glass ceramics. Lectures and laboratories.
Prerequisites: MAT 303

MAT 344 (ISE 344, ME 344) Metal Machining Analysis 3 Credits
Intensive study of metal cutting emphasizing forces, energy, temperature, tool materials, tool life, and surface integrity. Abrasive processes. Laboratory and project work.
Prerequisites: ISE 215 or IE 215 or ME 240 or MAT 206

MAT 345 Powder Metallurgy 3 Credits
Metal powder fabrication and characterization methods. Powder processing including powder compaction, theory of compacting, press and die design, sintering, and hot consolidation. Microstructure and properties of sintered materials and their relationship to processing conditions. Industrial applications. Emerging powder metallurgy technologies. Credit will not be given for both MAT 345 and MAT 445.
Prerequisites: MAT 206

MAT 346 Physical Metallurgy of Welding 3 Credits
Prerequisites: MAT 216

MAT 355 Materials for Nanotechnology 3 Credits
An introduction to the nanoworld and how we observe the nanoworld through transmission electron microscopy. Other topics include: probing nanosurfaces, carbon as a nanomaterial, fullerenes, carbon nanotubes, metal clusters, metal nanoparticle preparation, and directed self-assembly of nanoparticles. Also discussed are the thermal, chemical, electronic, optical, and magnetic properties of metal nanoparticles, nanowires, semiconductor nanoparticles, and inorganic nanoparticles.

MAT 356 Strategies for Nanocharacterization 3 Credits
Lectures describe various nanocharacterization techniques in terms of which technique is best for specific measurements on nanostructures less than 100 nm in extent. Special attention is paid to spatial resolution and detection limits for SEM, TEM, X-ray analysis, diffraction analysis, ion beam techniques, surface techniques, AFM and other SPMs, and light microscopies and spectroscopies.

MAT 359 Thin Film Deposition, Processing, and Characterization 3 Credits
Thin films are at the heart of electronics, optics, medicine, and nanotechnology. Fundamental and applied aspects of thin film deposition, processing, and characterization. Growth methods including physical and chemical deposition techniques. Equipment and hardware for deposition and analysis. Structural, mechanical, electronic, and chemical properties of films. Processing methods and their relationship to specific applications.
Prerequisites: MAT 033

MAT 363 Computational Methods in Science and Engineering 3 Credits
Computer simulation of systems at various length and time scales. Atomistic simulation (molecular dynamics and Monte Carlo) methods are presented and applied to models described by simple interatomic potentials. Mesoscale simulation is described in the context of domain growth and, at the continuum scale, finite-difference and finite-element methods are employed to model heat conduction and mass diffusion. Lecture and computer laboratory sessions. Credit will not be given for both MAT 363 and MAT 463.

MAT 386 Polymer Nanocomposites 3 Credits
Synthesis, morphology and properties of polymer nanocomposites. Comparisons with traditional particulate composites will be made and models predicting properties will be emphasized. Melt viscosity, mechanical properties, barrier properties and flame retardancy will be discussed. Credit is not given for both MAT 386 and MAT 486.
Prerequisites: MAT 204 or MAT 393

MAT 388 (CHE 388, CHM 388) Polymer Synthesis and Characterization Laboratory 3 Credits
Techniques include: free radical and condensation polymerization; molecular weight distribution by gel chromatography; crystallinity and order by differential scanning calorimetry; pyrolysis and gas chromatography; dynamic mechanical and dielectric behavior; morphology and microscopy; surface properties. Must have senior level standing in chemical engineering, chemistry, or materials science and engineering.
Prerequisites: CHM 341 and CHM 110

MAT 393 (CHE 393, CHM 393) Physical Polymer Science 3 Credits
Structural and physical aspects of polymers (organic, inorganic, natural). Molecular and atomic basis for polymer properties and behavior. Characteristics of glassy, crystalline, and paracrystalline states (including viscoelastic and relaxation behavior) for single-and multi-component systems. Thermodynamics and kinetics of transition phenomena. Structure, morphology, and behavior. Must have senior level standing in CHE, CHEM, or MAT.

MAT 401 Thermodynamics and Kinetics 4 Credits
Integrated treatment of the fundamentals of thermodynamics, diffusion and kinetics, as related to materials processes including both hard and soft materials. Laws of thermodynamics, conditions of equilibrium, free energies, statistical thermodynamics, thermodynamics of surfaces, bulk and grain-boundary diffusion, nucleation, spinodal decomposition, and reaction kinetics.

MAT 402 (ME 402) Advanced Manufacturing Science 3 Credits
The course focuses on the fundamental science-base underlying manufacturing processes, and applying that science base to develop knowledge and tools suitable for industrial utilization. Selected manufacturing processes representing the general classes of material removal, material deformation, material phase change, material flow, and material joining are addressed. Students create computer-based process simulation tools independently as well as utilize leading commercial process simulation packages. Laboratory experiences are included throughout the course.

MAT 403 Structure/Property Relations 4 Credits
Structure of materials and relationship to properties. Crystal structures and crystalline defects, structure in biological systems, amorphous materials, microstructure, and relationships to mechanical and other properties.
MAT 406 Solidification 3 Credits
Structure, theory and properties of liquids. Homogeneous and heterogeneous nucleation theory and experimental results. Solidification phenomena in pure, single and multiphase materials including the nature of the freezing interface, segregation, constitutional super-cooling, dendritic growth, crystallographic effects, the origin of defects, crystal growing, zone processes. Consent of department chair required.

MAT 409 Current Topics in Materials 3 Credits
Recent practical and theoretical developments in materials. This course may be repeated for credit if new material is covered. Consent of department required.

Repeat Status: Course may be repeated.

MAT 414 Metal Forming Processes 3 Credits

Prerequisites: MAT 206

MAT 415 Mechanical Behavior of Ceramic Solids 3 Credits
Strength, elasticity, creep, thermal stress fracture, hardness, abrasion and high-temperature deformation characteristics of single- and multicomponent brittle ceramic solids. Statistical theories of strength, static and cyclic fatigue, crack propagation, fracture toughness. Correlation of mechanical behavior, microstructure, and processing parameters.

MAT 416 Optical Properties of Materials 3 Credits
Interaction of electromagnetic waves with solid, liquid, and gaseous matter: reflection, refraction, polarization, diffraction, scattering, absorption, and luminescence. Factors determining the perceived color of metals, ceramics, polymers, semiconductors, biomaterials, and various nanostructured materials. Overview of the technological applications of optical materials in coatings, lighting, display technologies, lasers, solar cells, and optical communications. Additional coursework work will be required of students seeking the graduate level qualification. Credit will not be given for both MAT 316 and MAT 416.

Prerequisites: MAT 033

MAT 423 Advanced Transmission Electron Microscopy 4 Credits
The theory and practice of operation of the transmission and scanning transmission electron microscope. Techniques covered include bright field, high resolution and weak-beam dark field, lattice imaging, diffraction pattern indexing and Kikuchi line analysis. The theory of diffraction contrast is applied to the interpretation of electron micrographs. Specimen preparation techniques.

Prerequisites: MAT 344

MAT 424 (BIOE 424) Introduction to Organic Biomaterials 3 Credits
Property, characterization, fabrication, and modification of organic materials for biomedical and biological applications; host responses to biomaterials on the molecular, cellular, and system level; general introduction to biosensors, drug delivery, and tissue engineering. Graduate version of MAT 324 requiring additional assignments. Credit is not given for both MAT 324 (BIOE 324) and MAT 424 (BIOE 424).

Prerequisites: MAT 033

MAT 425 (BIOE 425) Inorganic Biomaterials 3 Credits
Fabrication methods for biomedical implant and devices. Selection of metals and ceramics with specific bulk and surface physical as well as chemical properties. The role of materials chemistry and microstructure. Biocompatibility. Case studies (dental and orthopedic implants, stents, nonporous ceramic filters for kidney dialysis). Graduate version of MAT 325; credit will not be given for both MAT 325 and MAT 425.

Prerequisites: MAT 033

MAT 426 (BIOE 426) Biomimetic and Bio-enabled Materials 3 Credits
This course is a graduate version of MAT 326 (BIOE 326). While the lecture content will be the same as the 300-level course, students enrolled in MAT 426 (BIOE 426) will have more advanced assignments. Closed to students who have taken MAT 326 (BIOE 326). Requirements: Graduate standing in Bioengineering or Materials Science and Engineering.

Attribute/Distribution: ND

MAT 427 Advanced Scanning Electron Microscopy 4 Credits
The theory and practice of operation of the scanning electron microscope and electron microprobe. Techniques covered will include high-resolution scanning, quantitative electron probe microanalysis. Electron beam sample interactions, X-ray spectrometry, and electron optics will be discussed in detail.

Prerequisites: MAT 334

MAT 430 Glass Science 3 Credits
Definition and formation of glass. Structure of common inorganic (including metallic) and polymeric glass systems. Methods of glass making. Phase separation of devitrification. Physical properties including diffusion, electrical conductivity, chemical durability, and optical and mechanical properties. Special products including glass ceramics, optical fibers, photosensitive glasses, etc. Visit to a glass manufacturing plant may also be included.

MAT 431 Sintering Theory and Practice 3 Credits
Science and technology of the sintering of solid-state materials. Driving force and variables. Critical review of the sintering models. Coverage of single phase, multiphase and composite systems. Special sintering techniques such as fast firing, rate controlled sintering, hot pressing and transient second-phase sintering. Sintering of specific ceramic and metal systems.

MAT 442 Inorganic Glasses 3 Credits
Definition, formation and structure of glass; common glass systems; manufacturing processes; optical, mechanical, electrical and dielectric properties; chemical durability; glass fibers and glass ceramics. Lectures and laboratories. Credit is not given for both MAT 342 and MAT 442.

MAT 443 (CHM 443) Solid-State Chemistry 3 Credits
Crystal structure, diffraction in crystals and on surfaces, bonding and energy spectra in solids, dielectrics, surface states and surface fields in crystals. Must have completed one course in linear algebra and one course in quantum mechanics.

MAT 445 Powder Metallurgy 3 Credits
Metal powder fabrication and characterization methods. Powder processing including powder compaction, theory of compacting, press and die design, sintering, and hot consolidation. Microstructure and properties of sintered materials and their relationship to processing conditions. Industrial applications. Emerging powder metallurgy technologies. Graduate version of MAT 345 requiring additional assignments. Credit is not given for both MAT 345 and MAT 445.

MAT 455 Materials for Nanotechnology 3 Credits
An introduction to the nanoworld and how we observe the nanoworld through transmission electron microscopy. Other topics include: probing nanosurfaces, carbon as a nanomaterial, fullerenes, carbon nanotubes, metal clusters, metal nanoparticle preparation, and directed self-assembly of nanoparticles. Also discussed are the thermal, chemical, electronic, optical, and magnetic properties of metal nanoparticles, nanowires, semiconductor nanoparticles, and inorganic nanoparticles.

MAT 456 Strategies for Nanocharacterization 3 Credits
Lectures describe various nanocharacterization techniques in terms of which technique is best for specific measurements on nanostructures less than 100 nm in extent. Special attention is paid to spatial resolution and detection limits for SEM, TEM, X-ray analysis, diffraction analysis, ion beam techniques, surface techniques, AFM and other SPMs, and light microscopies and spectrosopies.
MAT 459 Thin Film Deposition, Processing, and Characterization 3 Credits
Thin films are at the heart of electronics, optics, medicine, and nanotechnology. Fundamental and applied aspects of thin film deposition, processing, and characterization. Growth methods including physical and chemical deposition techniques. Equipment and hardware for deposition and analysis. Structural, mechanical, electronic, and chemical properties of films. Processing methods and their relationship to specific applications. Graduate version of MAT 359 with extra assignments for graduate students. Credit will not be given for both MAT 359 and MAT 459.
Prerequisites: MAT 332 or MAT 332

MAT 460 Engineering Project 1-3 Credits
In-depth study of a problem in the area of materials engineering or design. The study is to lead to specific conclusions and be embodied in a written report. Intended for candidates for the M.Eng.
Repeat Status: Course may be repeated.

MAT 462 Independent Study 1-3 Credits
An intensive study, with report, of a topic in materials science and engineering which is not treated in other courses. Consent of instructor required.
Repeat Status: Course may be repeated.

MAT 463 Computational Methods in Science and Engineering 3 Credits
Computer simulation of systems at various length and time scales. Atomistic simulation (molecular dynamics and Monte Carlo) methods are presented and applied to models described by simple interatomic potentials. Mesoscale simulation is described in the context of domain growth and, at the continuum scale, finite-difference and finite-element methods are employed to model heat conduction and mass diffusion. Lecture and computer laboratory sessions. Extra assignments provided to graduate students. Credit will not be given for both MAT363 and MAT463.

MAT 482 (CHE 482, CHM 482) Mechanical Behaviors of Polymers 3 Credits
A treatment of the mechanical behavior of polymers. Characterization of experimentally observed viscoelastic response of polymeric solids with the aid of mechanical model analogs. Topics include time-temperature superposition, experimental characterization of large deformation and fracture processes, polymer adhesion, and the effects of fillers, plasticizers, moisture and aging on mechanical behavior.

MAT 485 (CHE 485, CHM 485) Polymer Blends and Composites 3 Credits
Synthesis, morphology, and mechanical behavior of polymer blends and composites. Mechanical blends, block and graft copolymers, interpenetrating polymer networks, polymer impregnated concrete, and fiber and particulate reinforced polymers are emphasized. Must have completed any introductory polymer course or equivalent.

MAT 486 Polymer Nanocomposites 3 Credits
Synthesis, morphology and properties of polymer nanocomposites. Comparisons with traditional particulate composites will be made and models predicting properties will be emphasized. Melt viscosity, mechanical properties, barrier properties and flame retardancy will be discussed. This course is a version of MAT 386 for graduate students, with additional research projects and advanced assignments. Closed to students who have taken MAT 386. Credit is not given for both MAT 386 and MAT 486.
Prerequisites: MAT 204 or MAT 393

MAT 490 Thesis 1-6 Credits
Repeat Status: Course may be repeated.

MAT 492 (CHE 492, CHM 492) Topics in Polymer Science 1-3 Credits
Intensive study of topics selected from areas of current research interest such as morphology and mechanical behavior, thermodynamics and kinetics of crystallization, new analytical techniques, molecular weight distribution, non-Newtonian flow behavior, second-order transition phenomena, novel polymer structures. Credit above three hours is granted only when different material is covered.

MAT 499 Dissertation 1-15 Credits
Repeat Status: Course may be repeated.

Mathematics
Mathematics is a subject of great intrinsic power and beauty. It is the universal language of science, and is essential for a clear and complete understanding of virtually all phenomena. Mathematical training prepares a student to express and analyze problems and relationships in a logical manner in a wide variety of disciplines including the physical, engineering, social, biological, and medical sciences, business, and pure mathematics itself. This is a principal reason behind the perpetual need and demand for mathematicians in education, research centers, government, and industry.

The department offers three major programs leading to the degrees of bachelor of arts in mathematics, bachelor of science in mathematics (with a general mathematics and an applied mathematics option), and bachelor of science in statistics. It also offers several minor programs for undergraduates.

At the graduate level, it offers programs leading to the degrees of master of science in mathematics, master of science in applied mathematics, master of science in statistics, doctor of philosophy in mathematics, and doctor of philosophy in applied mathematics.

The Division of Applied Mathematics and Statistics is a part of the Department of Mathematics.

CALCULUS SEQUENCES
Many degree programs throughout the university include a mathematics requirement consisting of a sequence in calculus. The Department of Mathematics offers three calculus sequences:

MATH 021 & MATH 022 & MATH 023
Calculus I and Calculus II and Calculus III

MATH 031 & MATH 032 & MATH 033
Honors Calculus I and Honors Calculus II and Honors Calculus III

MATH 051 & MATH 052
Survey of Calculus I and Survey of Calculus II

The MATH 021, MATH 022, MATH 023 sequence is a systematic development of calculus. Most students of mathematics, science, engineering, and business will take some or all of this sequence.

As an honors sequence, the MATH 031, MATH 032, MATH 033 sequence covers essentially the same material but in greater depth and with more attention to rigor and proof. This sequence should be considered by students who have demonstrated exceptional ability in mathematics. Students who are contemplating a major in mathematics are strongly encouraged to consider this sequence.

The MATH 051, MATH 052 sequence is a survey of calculus. MATH 081 is a survey course with business applications. This sequence is not sufficient preparation for most subsequent mathematics courses.

Students contemplating further study in mathematics should consider MATH 021, MATH 022 instead.

MATH 075, MATH 076 is a two-semester sequence that substitutes for MATH 021, covering the same material but at a slower pace.

The MATH 031, MATH 032, MATH 033 sequence will be accepted in place of the other two sequences. MATH 021, MATH 022 will be accepted in place of MATH 051, MATH 052. Credit will be awarded for only one course in each of the following groups:

Group 1
MATH 021 Calculus I 4
MATH 075/076 Calculus I, Part A 2
MATH 031 Honors Calculus I 4
MATH 051 Survey of Calculus I 4
MATH 081 Calculus with Business Applications 4

Group 2
MATH 022 Calculus II 4
MATH 032 Honors Calculus II 4
MATH 052 Survey of Calculus II 3
Group 3  
MATH 023  Calculus III  4  
MATH 033  Honors Calculus III  4  

If two courses in the same group are taken, credit will be awarded for the more advanced course; 3x is the most advanced, while 5x is the least advanced.

Professors. Huai-Dong Cao, PhD (Princeton University); Donald M Davis, PhD (Stanford University); Bennett Eisenberg, PhD (Massachusetts Institute of Technology); Wei-Min Huang, PhD (University of Rochester); Garth Isaak, PhD (Rutgers University); David L Johnson, PhD (Massachusetts Institute of Technology); Terrence J Napier, PhD (University of Chicago); Eric P. Salathe, PhD (Brown University); Lee J. Stanley, PhD (University of California Berkeley); Steven H. Weintraub, PhD (Princeton University); Joseph E. Yukich, PhD (Massachusetts Institute of Technology)

Associate Professors. Bruce A. Dodson, PhD (Stony Brook University); Robert W. Neel, PhD (Harvard University); Mark Skandera, PhD (Massachusetts Institute of Technology); Xiaofeng Sun, PhD (Stanford University); Susan Szczepanski, PhD (Rutgers University New Brunswick); Ping-Shi Wu, PhD (University of California Davis); Linghai Zhang, PhD (University of Minnesota)

Assistant Professors. Sourir Bandyopadhyay, PhD (Texas A&M University); Daniel Conus, PhD (Swiss Federal Institute of Technology); Angela Hicks, PhD (University of California San Diego); Yue Yu, DA (Brown University)

Professors Of Practice. Vincent E Coll, PhD (University of Pennsylvania); Miranda Ijang Teboh Ewungkem, PhD (Lehigh University)

Emeriti. Samir A. Khabbaz, PhD (University of Kansas); Jerry P. King, PhD (University of Kentucky Fort Knox); Clifford S. Queen, PhD (Ohio State University); Andrew K Snyder, PhD (Lehigh University); Ramamirtham Venkataraman, PhD (Brown University); Albert Wilansky, PhD (Brown University)

UNDERGRADUATE DEGREE PROGRAMS

The Department of Mathematics offers degree programs in Mathematics and Statistics. These programs have the flexibility and versatility needed to prepare students for a wide variety of careers in government, industry, research, and education.

Students in the degree programs in mathematics must satisfy three types of requirements beyond those required by the college: Core Mathematics Requirements, Major Requirements, and General Electives. The Core Mathematics Requirement ensures a common core of knowledge appropriate for students in each program. The Major Program Electives consist of courses with specific mathematical or statistical content chosen by the student in consultation with the major advisor to complement the student's interest and career aspirations. With these further breadth and greater depth of knowledge are achieved. The General Electives consist of additional courses chosen from among those offered by the university faculty. Students can use these electives to pursue interests beyond the major, or may use these to expand upon the basic requirements of the degree program. Students are strongly encouraged to use some of these electives to earn a minor in another discipline.

Students in the degree program in statistics must satisfy four types of requirements beyond those required by the college: Required Major Courses, Major Electives, Professional Electives, and Free Electives.

Each student is provided a faculty advisor to guide an individual program and supervise the selection of electives.

B.A. WITH A MAJOR IN MATHEMATICS

The B.A. program in mathematics emphasizes fundamental principles as well as the mastery of techniques required for the effective use of mathematics. The program provides a solid foundation for those who wish to pursue a mathematically oriented career or advanced study in any mathematically oriented field.

Requirements

College Distribution Requirements excluding mathematics

Core Mathematics Requirements

Select one of the following:  

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 021</td>
<td>Calculus I</td>
<td>12</td>
</tr>
<tr>
<td>&amp; MATH 022</td>
<td>and Calculus II</td>
<td></td>
</tr>
<tr>
<td>&amp; MATH 023</td>
<td>and Calculus III</td>
<td></td>
</tr>
<tr>
<td>MATH 031</td>
<td>Honors Calculus I</td>
<td>3</td>
</tr>
<tr>
<td>&amp; MATH 032</td>
<td>and Honors Calculus II</td>
<td></td>
</tr>
<tr>
<td>&amp; MATH 033</td>
<td>and Honors Calculus III</td>
<td></td>
</tr>
</tbody>
</table>

MATH 163 Introductory Seminar 3  
MATH 231 Probability and Statistics 3  
MATH 301 Principles of Analysis I 3  
MATH 302 Ordinary Differential Equations 3  
MATH 309 Theory of Probability 3  
MATH 242 Linear Algebra 3  
MATH 243 Linear Methods 3  
MATH 244 Linear Algebra 3  
MATH 301 Principles of Analysis I 3  
MATH 302 Ordinary Differential Equations 3  
MATH 309 Theory of Probability 3  
MATH 310 Complex Variables 3  
MATH 311 Complex Analysis 3  
MATH 312 Complex Variables 3  
MATH 313 Complex Analysis 3  

This program requires a total of 120 credit hours.

A student must achieve an average of 2.0 or higher in major courses.

B.S. IN MATHEMATICS

The BS in Mathematics program provides a more extensive and intensive study of mathematics and its applications. Students can pursue the General Mathematics Option or the Applied Mathematics Option. These programs are especially recommended for students intending to pursue advanced study in mathematics or applied mathematics. The General Mathematics Option is recommended for students who wish to pursue mathematics either by itself or in combination with a related field (e.g., physics, computer science or economics). The Applied Mathematics Option provides a broad background in the major areas of applicable mathematics.

General Mathematics Option

Requirements

College Distribution Requirements excluding mathematics

Core Mathematics Requirements

Select one of the following:  

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 021</td>
<td>Calculus I</td>
<td>12</td>
</tr>
<tr>
<td>&amp; MATH 022</td>
<td>and Calculus II</td>
<td></td>
</tr>
<tr>
<td>&amp; MATH 023</td>
<td>and Calculus III</td>
<td></td>
</tr>
<tr>
<td>MATH 031</td>
<td>Honors Calculus I</td>
<td>3</td>
</tr>
<tr>
<td>&amp; MATH 032</td>
<td>and Honors Calculus II</td>
<td></td>
</tr>
<tr>
<td>&amp; MATH 033</td>
<td>and Honors Calculus III</td>
<td></td>
</tr>
</tbody>
</table>

MATH 163 Introductory Seminar 3  
MATH 231 Probability and Statistics 3  
MATH 301 Principles of Analysis I 3  
MATH 302 Ordinary Differential Equations 3  
MATH 309 Theory of Probability 3  
MATH 242 Linear Algebra 3  
MATH 243 Linear Methods 3  
MATH 244 Linear Algebra 3  
MATH 301 Principles of Analysis I 3  
MATH 302 Ordinary Differential Equations 3  
MATH 309 Theory of Probability 3  
MATH 310 Complex Variables 3  
MATH 311 Complex Analysis 3  
MATH 312 Complex Variables 3  
MATH 313 Complex Analysis 3  

Total Credits 111-123

This program requires a total of 120 credit hours.

A student must achieve an average of 2.0 or higher in major courses.
Select four elective courses (at least 14 credits) at or above the 200 level. At most two courses may be taken outside the department.

Two approved CSE courses. (CSE 1 and CSE 2 are NOT sufficient to satisfy this requirement.)

**General Electives**

Select electives in consultation with faculty advisor

**Total Credits**  
110-124

This program requires a total of 120 credit hours.

A student must achieve an average of 2.0 or higher in major courses.

**Applied Mathematics Option**

**Requirements**

**College Distribution Requirements excluding mathematics**  
31-34 credits

**Core Mathematics Requirements**

Select one of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 021</td>
<td>3</td>
</tr>
<tr>
<td>MATH 022</td>
<td>3</td>
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<tr>
<td>MATH 023</td>
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<td>MATH 031</td>
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<td>MATH 032</td>
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<tr>
<td>MATH 033</td>
<td>3</td>
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<tr>
<td>MATH 163</td>
<td>3</td>
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<tr>
<td>MATH 231</td>
<td>3</td>
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<tr>
<td>MATH 309</td>
<td>3</td>
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<tr>
<td>MATH 242</td>
<td>3-4</td>
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<tr>
<td>MATH 205</td>
<td>3</td>
</tr>
<tr>
<td>MATH 301</td>
<td>3-4</td>
</tr>
<tr>
<td>MATH 208</td>
<td>3</td>
</tr>
<tr>
<td>MATH 316</td>
<td>3</td>
</tr>
</tbody>
</table>

**Major Requirements**

Select five elective courses (at least 17 credits) at or above the 200 level chosen in consultation with the major advisor to establish a concentration as described below. At most two courses may be taken outside the department.

Two approved CSE courses. (CSE 1 and CSE 2 are NOT sufficient to satisfy this requirement.)

**General Electives**

Select electives in consultation with faculty advisor

**Total Credits**  
68-77

In consultation with the major advisor, a student must establish a concentration in a particular area of applied mathematics. The courses chosen must have specific mathematical or statistical content and together constitute a coherent program. At most two courses may be taken outside the Department of Mathematics. Students, in consultation with the major advisor, can design a concentration which reflects a particular area of interest or choose to pursue one of the following:

**Concentration in Applied Analysis**

Electives must include:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 230</td>
<td>3</td>
</tr>
<tr>
<td>MATH 322</td>
<td>3</td>
</tr>
<tr>
<td>MATH 341</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Credits**  
9

**Concentration in Discrete Mathematics and Theoretical Computer Science**

Electives must include:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MATH 305</td>
<td>3</td>
</tr>
<tr>
<td>MATH 311</td>
<td>3</td>
</tr>
<tr>
<td>MATH 329</td>
<td>3</td>
</tr>
</tbody>
</table>

**Electives**

Select at least three of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 305</td>
<td>3</td>
</tr>
<tr>
<td>MATH 311</td>
<td>3</td>
</tr>
<tr>
<td>MATH 329</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Credits**  
9-10

**Concentration in Probability and Statistics**

Electives must include:

Select at least three of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 309</td>
<td>3</td>
</tr>
<tr>
<td>MATH 310</td>
<td>3</td>
</tr>
<tr>
<td>MATH 312</td>
<td>3</td>
</tr>
<tr>
<td>MATH 334</td>
<td>3</td>
</tr>
<tr>
<td>MATH 338</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Credits**  
9-11

This program requires a total of 120 credit hours.

A student must achieve an average of 2.0 or higher in major courses.

**B.S. IN STATISTICS**

Statistics provides a body of principles for designing the process of data collection, for summarizing and interpreting data, and for drawing valid conclusions from data. It thus forms a fundamental tool in the natural and social sciences as well as business, medicine, and other areas of research. Mathematical principles, especially probability theory, underlie all statistical analyses.

**College Distribution Requirements excluding mathematics**  
31-34 credits

**Required Major courses**

Select one of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 021</td>
<td>3</td>
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<tr>
<td>MATH 022</td>
<td>3</td>
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<td>MATH 023</td>
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<tr>
<td>MATH 032</td>
<td>3</td>
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<tr>
<td>MATH 033</td>
<td>3</td>
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<tr>
<td>MATH 043</td>
<td>3</td>
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<tr>
<td>MATH 205</td>
<td>3</td>
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<tr>
<td>MATH 242</td>
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<td>MATH 309</td>
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<td>MATH 334</td>
<td>3</td>
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<tr>
<td>MATH 338</td>
<td>3</td>
</tr>
<tr>
<td>MATH 374</td>
<td>3</td>
</tr>
</tbody>
</table>

Two approved CSE courses. (CSE 1 and CSE 2 are NOT sufficient to satisfy this requirement.)

**Major Electives**

At least three courses with specific mathematical or statistical content chosen with the approval of the faculty advisor

**Professional Electives**

Courses selected from two or three fields of application of statistics and probability

**Free Electives**

Select 6-11 credits in free electives

**Total Credits**  
112-127

**CONCENTRATION IN ACTUARIAL SCIENCE**

Major Electives must include:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MATH 202</td>
<td>3</td>
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<tr>
<td>MATH 203</td>
<td>3</td>
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</tbody>
</table>

Professional Electives (21 credit hours) must include:

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>MATH 305</td>
<td>3</td>
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<tr>
<td>MATH 311</td>
<td>3</td>
</tr>
<tr>
<td>MATH 329</td>
<td>3</td>
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</tbody>
</table>

**Total Credits**  
9-10

Electives must include:

Select at least three of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 309</td>
<td>3</td>
</tr>
<tr>
<td>MATH 310</td>
<td>3</td>
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<tr>
<td>MATH 312</td>
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<tr>
<td>MATH 334</td>
<td>3</td>
</tr>
<tr>
<td>MATH 338</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Credits**  
9-11

This program requires a total of 120 credit hours.

A student must achieve an average of 2.0 or higher in major courses.

**B.S. IN MATHEMATICS**

Mathematics provides a body of principles for designing the process of data collection, for summarizing and interpreting data, and for drawing valid conclusions from data. It thus forms a fundamental tool in the natural and social sciences as well as business, medicine, and other areas of research. Mathematical principles, especially probability theory, underlie all statistical analyses.

**College Distribution Requirements excluding mathematics**  
31-34 credits

**Required Major courses**

Select one of the following:

<table>
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<tr>
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<td>MATH 032</td>
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<tr>
<td>MATH 033</td>
<td>3</td>
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<tr>
<td>MATH 043</td>
<td>3</td>
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<tr>
<td>MATH 205</td>
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<tr>
<td>MATH 338</td>
<td>3</td>
</tr>
<tr>
<td>MATH 374</td>
<td>3</td>
</tr>
</tbody>
</table>

Two approved CSE courses. (CSE 1 and CSE 2 are NOT sufficient to satisfy this requirement.)

**Major Electives**

At least three courses with specific mathematical or statistical content chosen with the approval of the faculty advisor

**Professional Electives**

Courses selected from two or three fields of application of statistics and probability

**Free Electives**

Select 6-11 credits in free electives

**Total Credits**  
112-127
ACCT 151  Introduction to Financial Accounting  3
ECO 029  Money, Banking, and Financial Markets  3
ECO 119  Intermediate Macroeconomic Analysis  3
FIN 125  Introduction to Finance  3

DEPARTMENTAL HONORS
Students may earn departmental honors by writing a thesis during their senior year. Students are accepted into the program during their junior year by the department chairperson. This acceptance is based upon the student's grades and a thesis proposal, which the student must prepare in conjunction with a thesis advisor selected by the student. An oral presentation as well as a written thesis are required for completion of the program.

MINOR PROGRAMS
The department offers minor programs in different branches of the mathematical sciences. The requirement consists of MATH 023 or MATH 033 and four additional courses shown below for each of the programs. At most one of these five courses in the minor program may also be required in the major program. For substitutions, the student should consult the chairperson.

Minor in Pure Mathematics
MATH 242  Linear Algebra  3-4
MATH 243  Algebra  3-4
MATH 301  Principles of Analysis I  3-4
Select one of the following:  3-4
  MATH 302  Principles of Analysis II
  MATH 303  Mathematical Logic
  MATH 307  General Topology I
  MATH 316  Complex Analysis
  MATH 342  Number Theory

Total Credits  12-16

Minor in Applied Mathematics
Select three of the following:  9-10
  MATH 205  Linear Methods
  MATH 208  Complex Variables
  MATH 230  Numerical Methods
  MATH 231  Probability and Statistics
  MATH 242  Linear Algebra
  MATH 320  Ordinary Differential Equations
  MATH 322  Methods of Applied Analysis I
  MATH 323  Methods of Applied Analysis II
  MATH 341  Mathematical Models and Their Formulation

Total Credits  12-13

Minor in Probability and Statistics
MATH 012  Basic Statistics  4
or MATH 231  Probability and Statistics
MATH 309  Theory of Probability  3
Select two of the following:  6-8
  MATH 310  Random Processes and Applications
  MATH 312  Statistical Computing and Applications
  MATH 334  Mathematical Statistics
  MATH 338  Linear Models in Statistics with Applications

Total Credits  13-15

Minor in Actuarial Science
MATH 309  Theory of Probability  3
MATH 310  Random Processes and Applications  3-4
MATH 202  Actuarial Exam I  1
or MATH 203  Actuarial Exam II - Financial Mathematics
ACCT 108  Fundamentals of Accounting  3

or ACCT 151  Introduction to Financial Accounting
ECO 105  Intermediate Microeconomic Analysis  3
or ECO 119  Intermediate Macroeconomic Analysis

Total Credits  13-14

For information on examinations of actuarial societies, students may consult their minor advisor.

GRADUATE PROGRAMS IN MATHEMATICS
The department offers graduate programs leading to the degrees of master of science in mathematics, applied mathematics, or statistics, and the doctor of philosophy in mathematics or applied mathematics.

The Department does not offer a doctorate in statistics. However, students may choose statistics or mathematical statistics as a concentration in the doctor of philosophy programs in mathematics and applied mathematics. The Department is a part of the interdisciplinary program in Analytical Finance. For details on the Master of Science in Analytical Finance see the Interdisciplinary Graduate Study and Research, Analytical Finance section.

To begin graduate work in mathematics a student must present evidence of adequate undergraduate preparation. The undergraduate program should have included a year of advanced calculus, a semester of linear algebra, and a semester of abstract algebra.

M.S. in Mathematics or Applied Mathematics
The master’s program requires 30 credit hours of graduate courses with at least 18 hours at the 400 level. With the permission of the chairperson, up to six hours of these courses can be replaced by a thesis. All students in the master's program must also pass a comprehensive examination. The M.S. degree can serve both as a final degree in mathematics or as an appropriate background for the Ph.D. degree.

M.S. in Statistics
This program requires 30 credit hours of graduate courses with at least 18 hours of 400-level STAT or MATH courses. The choice of courses must be approved by the graduate advisor, and up to six hours of coursework may be replaced with a thesis. All students in the program must also pass a comprehensive examination.

The M.S. program in statistics has two tracks:

statistics track
The statistics track has recommended courses:

MATH 309  Theory of Probability  3
STAT 412  Statistical Computing and Applications  3
STAT 434  Mathematical Statistics  3
MATH 462  Modern Nonparametric Methods in Statistics  3

Electives
STAT 410  Random Processes and Applications  3
STAT 438  Linear Models In Statistics with Applications  3
STAT 461  Topics In Mathematical Statistics  3
Select three other possible electives:  9
  STAT 408  Seminar in Statistics and Probability
  STAT 409  Seminar in Statistics and Probability
  EDUC 411  Multivariate Statistical Models
  ISE 332  Product Quality
  ISE 409  Time Series Analysis
  ISE 410  Design of Experiments
  ECO 460  Time Series Analysis
  ECO 463  Topics in Game Theory
  CSE 411  Advanced Programming Techniques
  MECH 445  Nondeterministic Models in Engineering

Total Credits  30

stochastic modeling track
MATH 309  Theory of Probability  3
Ph.D. in Mathematics
The plan of work toward the doctor of philosophy degree will include a comprehensive examination, a qualifying examination, and an advanced topic examination. A language exam may be required at the discretion of the thesis committee. The qualifying examination tests the student’s command of algebra and real analysis. The content of the advanced topic examination is determined by a department committee. A general examination, the doctoral dissertation and its defense complete the work for the Ph.D. degree.

Each candidate’s plan of work must be approved by a special committee of the department. A Ph.D. student is required to have 18 credits of approved graduate level course work beyond the master’s level. Successful completion of MATH 316 and MATH 307 is required of all students. After completion of 18 credits a student is required to take at least one course per academic year other than MATH 409, MATH 410, and MATH 499.

Ph.D. in Applied Mathematics
The plan of work toward the doctor of philosophy degree will include a comprehensive examination, a qualifying examination, and an advanced topic examination. A language examination may be required at the discretion of the thesis committee. The Ph.D. in Applied Mathematics qualifying examination tests the student’s command of Statistics and Applied Probability or of Real Analysis and Differential Equations. The content of the advanced topic examination is determined by a department committee. A general examination, the doctoral dissertation and its defense complete the work for the Ph.D. degree.

Each candidate’s plan of work must be approved by a special committee of the department. A Ph.D. student is required to have 18 credits of approved graduate level course work beyond the master’s level. After completion of 18 credits a student is required to take at least one course per academic year other than MATH 409, MATH 410, and MATH 499.

Mathematics Courses

MATH 000 Preparation for Calculus 2 Credits
Intensive review of fundamental concepts in mathematics utilized in calculus, including functions and graphs, exponentials and logarithms, and trigonometry. This course is for students who need to take MATH 51 or 21, but who require remediation in precalculus. In particular, students who fail the MATH 51 Readiness Exam must pass MATH 0 before being admitted to MATH 51. The credits for this course do not count toward graduation, but do count toward GPA and current credit count. Consent of department required.
Attribute/Distribution: MA

MATH 005 Introduction to Mathematical Thought 3 Credits
Meaning, content, and methods of mathematical thought illustrated by topics that may be chosen from number theory, abstract algebra, combinatorics, finite or nonEuclidean geometries, game theory, mathematical logic, set theory, topology.
Attribute/Distribution: MA

MATH 009 Introduction to Finite Mathematics 4 Credits
Systems of linear equations, matrices, introduction to linear programming. Sets, counting methods, probability, random variables, introduction to Markov chains.
Attribute/Distribution: MA

MATH 012 Basic Statistics 4 Credits
The plan of work toward the doctor of philosophy degree will include a comprehensive examination, a qualifying examination, and an advanced topic examination. A language exam may be required at the discretion of the thesis committee. The qualifying examination tests the student’s command of algebra and real analysis. The content of the advanced topic examination is determined by a department committee. A general examination, the doctoral dissertation and its defense complete the work for the Ph.D. degree.

Each candidate’s plan of work must be approved by a special committee of the department. A Ph.D. student is required to have 18 credits of approved graduate level course work beyond the master’s level. Successful completion of MATH 316 and MATH 307 is required of all students. After completion of 18 credits a student is required to take at least one course per academic year other than MATH 409, MATH 410, and MATH 499.

Ph.D. in Mathematics
The plan of work toward the doctor of philosophy degree will include a comprehensive examination, a qualifying examination, and an advanced topic examination. A language exam may be required at the discretion of the thesis committee. The Ph.D. in Applied Mathematics qualifying examination tests the student’s command of Statistics and Applied Probability or of Real Analysis and Differential Equations. The content of the advanced topic examination is determined by a department committee. A general examination, the doctoral dissertation and its defense complete the work for the Ph.D. degree.

Each candidate’s plan of work must be approved by a special committee of the department. A Ph.D. student is required to have 18 credits of approved graduate level course work beyond the master’s level. After completion of 18 credits a student is required to take at least one course per academic year other than MATH 409, MATH 410, and MATH 499.

Mathematics Courses

MATH 000 Preparation for Calculus 2 Credits
Intensive review of fundamental concepts in mathematics utilized in calculus, including functions and graphs, exponentials and logarithms, and trigonometry. This course is for students who need to take MATH 51 or 21, but who require remediation in precalculus. In particular, students who fail the MATH 51 Readiness Exam must pass MATH 0 before being admitted to MATH 51. The credits for this course do not count toward graduation, but do count toward GPA and current credit count. Consent of department required.
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Attribute/Distribution: MA

MATH 012 Basic Statistics 4 Credits
The plan of work toward the doctor of philosophy degree will include a comprehensive examination, a qualifying examination, and an advanced topic examination. A language exam may be required at the discretion of the thesis committee. The qualifying examination tests the student’s command of algebra and real analysis. The content of the advanced topic examination is determined by a department committee. A general examination, the doctoral dissertation and its defense complete the work for the Ph.D. degree.

Each candidate’s plan of work must be approved by a special committee of the department. A Ph.D. student is required to have 18 credits of approved graduate level course work beyond the master’s level. Successful completion of MATH 316 and MATH 307 is required of all students. After completion of 18 credits a student is required to take at least one course per academic year other than MATH 409, MATH 410, and MATH 499.

Ph.D. in Mathematics
The plan of work toward the doctor of philosophy degree will include a comprehensive examination, a qualifying examination, and an advanced topic examination. A language exam may be required at the discretion of the thesis committee. The qualifying examination tests the student’s command of algebra and real analysis. The content of the advanced topic examination is determined by a department committee. A general examination, the doctoral dissertation and its defense complete the work for the Ph.D. degree.

Each candidate’s plan of work must be approved by a special committee of the department. A Ph.D. student is required to have 18 credits of approved graduate level course work beyond the master’s level. Successful completion of MATH 316 and MATH 307 is required of all students. After completion of 18 credits a student is required to take at least one course per academic year other than MATH 409, MATH 410, and MATH 499.
MATH 051 Survey of Calculus I 4 Credits
Limits. The derivative and applications to extrema, approximation, and related rates. Exponential and logarithm functions, growth and decay. Integration. Trigonometric functions and related derivatives and integrals.
Attribute/Distribution: MA

MATH 052 Survey of Calculus II 3 Credits
Prerequisites: MATH 051 or MATH 021 or MATH 031 or MATH 076 or MATH 097 or MATH 081
Attribute/Distribution: MA

MATH 075 Calculus I, Part A 2 Credits
Covers the same material as the first half of MATH 021. Meets three hours per week, allowing more class time for each topic than does MATH 021.
Attribute/Distribution: MA

MATH 076 Calculus I, Part B 2 Credits
Continuation of MATH 075, covering the second half of MATH 021. Meets three hours per week. Final exam for this course is similar to the MATH 021 final.
Prerequisites: MATH 075
Attribute/Distribution: MA

MATH 081 Calculus with Business Applications 4 Credits
Limits and continuity; exponential, logarithmic and trigonometric functions; derivatives; extrema; approximations; indefinite and definite integrals. Applications with emphasis on business and economics.
Attribute/Distribution: MA

MATH 114 (PHIL 114) Symbolic Logic 4 Credits
A first course in logical theory, introducing the notions of logical consequence and proof, as well as related concepts such as consistency and contingency. Formal systems taught may include: term, sentence logic, and predicate logic.
Attribute/Distribution: MA

MATH 130 (BIOS 130) Biostatistics 4 Credits
Elements of statistics and probability with emphasis on biological applications. Statistical analysis of experimental and observational data.
Prerequisites: MATH 052 or MATH 022

MATH 163 Introductory Seminar 3 Credits
An introduction to the discipline of mathematics designed for students considering a major in mathematics. The course will provide an introduction to rigorous mathematical reasoning and will survey some area of mathematics. Topics covered will vary.
Attribute/Distribution: MA

MATH 171 Readings 1-3 Credits
Study of a topic in mathematics under individual supervision. Intended for students with specific interests in areas not covered in the listed courses. Consent of department chair required.
Attribute/Distribution: MA

MATH 201 Problem Solving 1 Credit
Practice in solving problems from mathematical contests using a variety of techniques. Permission of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: MA

MATH 202 Actuarial Exam I 1 Credit
Preparation for the first actuarial exam – probability. Problems in calculus and probability with insurance applications.
Prerequisites: (MATH 023 or MATH 033) and (MATH 231)
Attribute/Distribution: MA

MATH 203 Actuarial Exam II - Financial Mathematics 2 Credits
Preparation for the second actuarial exam - financial mathematics. Mathematics of interest and investments, interest rate measurement, present value, annuities, loan repayment schemes, bond valuation, introduction to derivative securities. Practice in solving problems from past exams.
Prerequisites: MATH 022
Attribute/Distribution: MA

MATH 205 Linear Methods 3 Credits
Linear differential equations and applications; matrices and systems of linear equations; vector spaces; eigenvalues and application to linear systems of differential equations.
Prerequisites: MATH 022 or MATH 096 or MATH 032
Attribute/Distribution: MA

MATH 208 Complex Variables 3 Credits
Functions of a complex variable; calculus of residues; contour integration; applications to conformal mapping and Laplace transforms.
Prerequisites: MATH 023 or MATH 033
Attribute/Distribution: MA

MATH 214 (PHIL 214) Topics in Philosophical Logic 4 Credits
Topics may include the many systems of non-classical logic, truth theory, the impact of incompleteness and undecidability results on philosophy, the foundational projects of various philosophers/mathematicians, or the work of an important figure in the history of philosophical logic. Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: MA

MATH 229 Geometry 3,4 Credits
Discussion of geometry as an axiomatic system. Euclid's postulates. History of and equivalent versions of Euclid's fifth postulate. Finite projective geometries. NonEuclidean geometries based upon negation of the fifth postulate: Geometry on the sphere; Hyperbolic and elliptic geometries. Examination of the concepts of “straight”, angle, parallel, symmetry and duality in each of these geometries. Applications of the different geometries will be considered.
Attribute/Distribution: MA

MATH 230 Numerical Methods 3 Credits
Representation of numbers and rounding error; polynomial and spline interpolation; numerical differentiation and integration; numerical solution of nonlinear systems; Fast Fourier Transformation; numerical solution of initial and boundary value problems; Monte Carlo methods. Knowledge of MATLAB or PYTHON or C required.
Prerequisites: MATH 205
Attribute/Distribution: MA

MATH 231 Probability and Statistics 3 Credits
Probability and distribution of random variables; populations and random sampling; chisquare and t distributions; estimation and tests of hypotheses; correlation and regression theory of two variables.
Prerequisites: MATH 022 or MATH 096 or MATH 032 or MATH 052
Attribute/Distribution: MA

MATH 234 Fractal Geometry 3 Credits
Metric spaces and iterated function systems; various types of fractal dimension: Julia and Mandelbrot sets. Other topics such as chaos may be included. Small amount of computer use.
Prerequisites: MATH 023 or MATH 033
Attribute/Distribution: MA

MATH 242 Linear Algebra 3-4 Credits
Solution of systems of linear equations, matrices, vector spaces, bases, linear transformations, eigenvalues, eigenvectors, additional topics as time permits.
Prerequisites: MATH 022 or MATH 096 or MATH 032
Attribute/Distribution: MA

MATH 243 Algebra 3,4 Credits
Introduction to basic concepts of modern algebra: groups, rings, and fields.
Prerequisites: (MATH 163 or MATH 261) and (MATH 242 or MATH 205)
Attribute/Distribution: MA

MATH 261 (CSE 261) Discrete Structures 3 Credits
Topics in discrete mathematical structures chosen for their applicability to computer science and engineering. Sets, propositions, induction, recursion; combinatorics; binary relations and functions; ordering, lattices and Boolean algebra; graphs and trees; groups and homomorphisms.
Prerequisites: (MATH 021 or MATH 031 or MATH 076)
Attribute/Distribution: MA
MATH 271 Readings 1-3 Credits
Study of a topic in mathematics under individual supervision. Intended for students with specific interests in areas not covered in the listed courses. Consent of department chair required.
Repeat Status: Course may be repeated.
Attribute/Distribution: MA

MATH 291 Undergraduate Research 1-4 Credits
Research in mathematics or statistics under the direction of a faculty member. Department permission required.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

MATH 301 Principles of Analysis I 3-4 Credits
Existence of limits, continuity and uniform continuity; Heine-Borel Theorem; existence of extreme values; mean value theorem and applications; conditions for the existence of the Riemann integral; absolute and uniform convergence; emphasis on theoretical material from the calculus of one variable.
Prerequisites: MATH 023 or MATH 033
Attribute/Distribution: MA

MATH 302 Principles of Analysis II 3-4 Credits
Continuation of MATH 301. Functions of several variables; the implicit function theorem, and further topics with applications to analysis and geometry.
Prerequisites: MATH 301
Attribute/Distribution: MA

MATH 303 (PHIL 303) Mathematical Logic 3-4 Credits
Detailed proofs are given for the basic mathematical results relating the syntax and semantics of first-order logic (predicate logic): the Soundness and Completeness (and Compactness) Theorems, followed by a brief exposition of the celebrated limitative results of Gödel, Turing, and Church on incompleteness and undecidability. The material is conceptually rigorous and mathematically mature; the necessary background is a certain degree of mathematical sophistication or a basic knowledge of symbolic logic. Consent of instructor required.
Attribute/Distribution: MA

MATH 304 Axiomatic Set Theory 3-4 Credits
A development of set theory from axioms; relations and functions; ordinal and cardinal arithmetic; recursion theorem; axiom of choice; independence questions. Consent of instructor required.
Attribute/Distribution: MA

MATH 305 Enumerative Combinatorics 3 Credits
An introduction to basic theoretical results and techniques of enumerative combinatorics such as combinatorial identities, generating functions, inclusion/exclusion, recurrence relations, bijective proofs and permutations. Additional topics will be covered as time permits.
Prerequisites: MATH 242 and (MATH 163 or MATH 261 or CSE 261)
Attribute/Distribution: MA

MATH 306 Introduction to Biomedical Engineering and Mathematical Biology 3 Credits
Prerequisites: MATH 205
Attribute/Distribution: MA

MATH 307 General Topology I 3-4 Credits
An introductory study of topological spaces, including metric spaces, separation and countability axioms, connectedness, compactness, product spaces, quotient spaces, function spaces.
Prerequisites: MATH 301
Attribute/Distribution: MA

MATH 309 Theory of Probability 3 Credits
Probabilities of events on discrete and continuous sample spaces; random variables and probability distributions; expectations; transformations; simplest kind of law of large numbers and central limit theorem. The theory is applied to problems in physical and biological sciences.
Prerequisites: MATH 023 or MATH 033 or MATH 052
Attribute/Distribution: MA

MATH 310 Random Processes and Applications 3-4 Credits
Prerequisites: MATH 309 or MATH 231
Attribute/Distribution: MA

MATH 311 Graph Theory 3 Credits
An introduction to basic theoretical results and techniques of graph theory such as trees, connectivity, matchings, coloring, planar graphs and Hamiltonicity. Additional topics will be covered as time permits.
Prerequisites: MATH 163 or MATH 261
Attribute/Distribution: MA

MATH 312 Statistical Computing and Applications 3-4 Credits
Use of statistical computing packages; exploratory data analysis; Monte Carlo methods; randomization and resampling, application and interpretation of a variety of statistical methods in real world problems.
Prerequisites: MATH 012 or MATH 231
Attribute/Distribution: MA

MATH 316 Complex Analysis 3-4 Credits
Concept of analytic function from the points of view of the Cauchy-Riemann equations, power series, complex integration, and conformal mapping.
Prerequisites: MATH 301
Attribute/Distribution: MA

MATH 320 Ordinary Differential Equations 3-4 Credits
The analytical and geometric theory of ordinary differential equations, including such topics as linear systems, systems in the complex plane, oscillation theory, stability theory, geometric theory of nonlinear systems, finite difference methods, general dynamical systems.
Prerequisites: MATH 205 or (MATH 023 or MATH 033) and (MATH 242)
Attribute/Distribution: MA

MATH 321 Topics in Discrete Mathematics 3 Credits
Selected topics in areas of discrete mathematics. Consent of department chair required.
Repeat Status: Course may be repeated.
Attribute/Distribution: MA

MATH 322 Methods of Applied Analysis I 3 Credits
Fourier series, eigenfunction expansions, Sturm-Liouville problems, Fourier integrals and their application to partial differential equations; special functions. Emphasis is on a wide variety of formal applications rather than logical development.
Prerequisites: MATH 205
Attribute/Distribution: MA

MATH 323 Methods of Applied Analysis II 3 Credits
Green’s functions; integral equations; variational methods; asymptotic expansions, method of saddle points; calculus of vector fields, exterior differential calculus.
Prerequisites: MATH 322
Attribute/Distribution: MA

MATH 327 Groups and Rings 3,4 Credits
An intensive study of the concepts of group theory including the Sylow theorems, and of ring theory including unique factorization domains and polynomial rings.
Prerequisites: MATH 242 and MATH 243
Attribute/Distribution: MA
MATH 329 Computability Theory 3-4 Credits
Core development of classical computability theory: enumeration, index and recursion theorems, various models of computation and Church's Thesis, incomputability results, introduction to reducibilities and their degrees (in particular, Turing degrees, or degrees of incomputability), computable operators and their fixed points.
Attribute/Distribution: MA

MATH 331 Differential Geometry of Curves and Surfaces 3 Credits
Local and global differential geometry of curves and surfaces in Euclidean 3-space. Frenet formulas for curves, isoperimetric inequality, 4-vertex theorem; regular surfaces, first fundamental form, Gauss map, second fundamental form; curvatures for curves and surfaces and their relations; The GaussBonnet theorem.
Prerequisites: MATH 023 or MATH 033
Attribute/Distribution: MA

MATH 334 Mathematical Statistics 3,4 Credits
Populations and random sampling; sampling distributions; theory of statistical estimation; criteria and methods of point and interval estimation; theory of testing statistical hypotheses.
Prerequisites: MATH 309
Attribute/Distribution: MA

MATH 338 Linear Models in Statistics with Applications 3,4 Credits
Least square principles in multiple regression and their interpretations; estimation, hypotheses testing, confidence and prediction intervals, modeling, regression diagnostic, multicollinearity, model selection, analysis of variance and covariance; logistic regression. Introduction to topics in time series analysis such as ARMA, ARCH, and GARCH models. Applications to natural sciences, finance and economics. Use of computer packages.
Prerequisites: (MATH 012 or MATH 231) and (MATH 043 or MATH 205 or MATH 242).
Attribute/Distribution: MA

MATH 340 (CSE 340) Design and Analysis of Algorithms 3 Credits
Algorithms for searching, sorting, manipulating graphs and trees, finding shortest paths and minimum spanning trees, scheduling tasks, etc.; proofs of their correctness and analysis of their asymptotic runtime and memory demands. Designing algorithms: recursion, divide-and-conquer, greediness, dynamic programming. Limits on algorithm efficiency using elementary NP-completeness theory. Credit will not be given for both MATH 340 (CSE 340) and MATH 441 (CSE 441).
Prerequisites: (MATH 022 or MATH 096 or MATH 032) and (CSE 261 or MATH 261)
Attribute/Distribution: MA

MATH 341 Mathematical Models and Their Formulation 3 Credits
Mathematical modeling of engineering and physical systems with examples drawn from diverse disciplines. Emphasis is on building models of real world problems rather than learning mathematical techniques.
Prerequisites: MATH 205
Attribute/Distribution: MA

MATH 342 Number Theory 3-4 Credits
Basic concepts and results in number theory, including such topics as primes, the Euclidean algorithm, Diophantine equations, congruences, quadratic residues, quadratic reciprocity, primitive roots, number-theoretic functions, distribution of primes, Pell’s equation, Fermat’s theorem, partitions. Consent of instructor required.
Attribute/Distribution: MA

MATH 343 Introduction To Cryptography 3,4 Credits
Attribute/Distribution: MA

MATH 350 Special Topics 3 Credits
A course covering special topics not sufficiently covered in listed courses. Consent of department chair required.
Repeat Status: Course may be repeated.
Attribute/Distribution: MA

MATH 371 Readings 1-3 Credits
The study of a topic in mathematics under appropriate supervision, designed for the individual student who has studied extensively and whose interests lie in areas not covered in the listed courses. Consent of department chair required.
Repeat Status: Course may be repeated.
Attribute/Distribution: MA

MATH 374 Statistical Project 3 Credits
Supervised field project or independent reading in statistics or probability. Consent of department chair required.
Attributed/Distribution: MA

MATH 391 Senior Honors Thesis 3 Credits
Independent research under faculty supervision, culminating in a thesis presented for departmental honor. Consent of department chair required.
Repeat Status: Course may be repeated.
Attribute/Distribution: MA

MATH 401 Real Analysis I 3 Credits
Set theory, real numbers; introduction to measures, Lebesgue measure; integration, general convergence theorems; differentiation, functions of bounded variation, absolute continuity; Lp spaces.
Prerequisites: MATH 301

MATH 402 Real Analysis II 3 Credits
Metric spaces; introduction to Banach and Hilbert space theory; Fourier series and Fejer operators; general measure and integration theory, RadonNikodym and Riesz representation and theorems; Lebesgue-Stieltjes integral.
Prerequisites: MATH 307 or MATH 401

MATH 403 Topics in Real Analysis 3 Credits
Intensive study of topics in analysis with emphasis on recent developments. Requires permission of the department chair.
Repeat Status: Course may be repeated.

MATH 404 Topics in Mathematical Logic 3 Credits
Intensive study of topics in mathematical logic. Consent of instructor required.
Repeat Status: Course may be repeated.

MATH 405 Partial Differential Equations I 3 Credits
Continuation of the field of study in MATH 409 or the intensive study of a different field. Consent of department chair required.

MATH 406 Partial Differential Equations II 3 Credits
Continuation of MATH 405. Emphasis on second order equations with variable coefficients and systems of first order partial differential equations.

MATH 408 Algebraic Topology I 3 Credits
Polyhedra; fundamental groups; simplicial and singular homology.

MATH 409 Mathematics Seminar 1-6 Credits
The study of a topic in mathematics under appropriate supervision, designed for the individual student who has studied extensively and whose interests lie in areas not covered in the listed courses. Consent of department chair required.
Repeat Status: Course may be repeated.

MATH 410 Mathematics Seminar 1-6 Credits
Continuation of the field of study in MATH 409 or the intensive study of a different field. Consent of department chair required.

MATH 416 Complex Function Theory 3 Credits
Continuation of MATH 316.
MATH 421 Introduction To Wavelets 3 Credits
Continuous and discrete signals; review of Fourier analysis; discrete wavelets; time frequency spaces; Haar and Walsh systems; multisresolution analysis; Hilbert spaces; quadratic mirror filters; fast wavelet transforms; computer code; applications to filtering, compression, and imaging.
Prerequisites: ECE 108 or MATH 205

MATH 423 Differential Geometry I 3 Credits
Differential manifolds, tangent vectors and differentials, submanifolds and the implicit function theorem. Lie groups and Lie algebras, homogeneous spaces. Tensor and exterior algebras, tensor fields and differential forms, de Rham cohomology, Stokes' theorem, the Hodge theorem. Must have completed MATH 301, or MATH 243 or MATH 205 with permission of instructor.

MATH 424 Differential Geometry II 3 Credits
Curves and surfaces in Euclidean space; mean and Gaussian curvatures, covariant differentiation, parallelism, geodesics, Gauss-Bonnet formula, Riemannian metrics, connections, sectional curvature, generalized Gauss-Bonnet theorem. Further topics.
Prerequisites: MATH 423

MATH 428 Fields And Modules 3 Credits
Field theory, including an introduction to Galois theory; the theory of modules, including tensor products and classical algebras.
Prerequisites: MATH 327 or MATH 327

MATH 430 Numerical Analysis 3 Credits
Multistep methods for ordinary differential equations; finite difference methods for partial differential equations; numerical approximation of functions. Use of computer required.

MATH 435 Functional Analysis I 3 Credits
Banach spaces and linear operators; separation and extension theorems; open mapping and uniform boundedness principles; weak topologies; local convexity and duality; Banach algebras; spectral theory of operators; and compact operators.

MATH 441 (CSE 441) Advanced Algorithms 3 Credits
Algorithms for searching, sorting, manipulating graphs and trees, scheduling tasks, finding shortest path, matching patterns in strings, cryptography, matroid theory, linear programming, max-flow, etc., and their correctness proofs and analysis of their time and space complexity. Strategies for designing algorithms, e.g., recursion, divide-and-conquer, greediness, dynamic programming. Limits on algorithm efficiency are explored through NP completeness theory. Quantum computing is briefly introduced. Credit will not be given for both CSE 340 (MATH 340) and CSE 441 (MATH 441).

MATH 444 Algebraic Topology II 3 Credits
Continuation of MATH 408. Cohomology theory, products, duality.

MATH 445 Topics in Algebra 3 Credits
Selected topics reflecting the interests of the professor and the students.

MATH 449 Topics In Algebra 3 Credits
Intensive study of topics in algebra with emphasis on recent developments. Consent of department chair required.
Repeat Status: Course may be repeated.

MATH 450 Special Topics 3 Credits
Intensive study of some field of the mathematical sciences not covered in listed courses. Consent of department chair required.
Repeat Status: Course may be repeated.

MATH 455 Topics In Number Theory 3 Credits
Selected topics in algebraic and/or analytic number theory. Consent of instructor required.
Repeat Status: Course may be repeated.

MATH 461 Introduction To Mathematical Statistics 3 Credits
An intensive study of one or more topics such as theory of statistical tests, statistical estimation, regression, analysis of variance, nonparametric methods, stochastic approximation, and decision theory.
Repeat Status: Course may be repeated.

MATH 462 Modern Nonparametric Methods in Statistics 3 Credits
Classical and modern methods of nonparametric statistics; order and rank statistics; tests based on runs, signs, ranks, and order statistics; distribution free statistical procedures for means, variances, correlations, and trends; relative efficiency; Kolmogorov-Smirnov statistics; statistical applications of Brownian process; modern techniques such as robust methods, nonparametric smoothing, and bootstrapping; additional topics such as nonparametric regression and dimension reduction.

MATH 463 (STAT 463) Advanced Probability 3 Credits
Measure theoretic foundations; random variables, integration in a measure space, expectations; convergence of random variables and probability measures; conditional expectations; characteristic functions; sums of random variables, limit theorems.

MATH 464 Advanced Stochastic Process 3 Credits
Theory of stochastic processes; stopping times; martingales; Markov processes; Brownian motion; stochastic calculus; Brownian bridge, laws of suprema; Gaussian processes.

MATH 465 Topics in Probability 3 Credits
Selected topics in probability. Consent of department chair required.
Repeat Status: Course may be repeated.

MATH 467 Financial Calculus I 3 Credits
Basic mathematical concepts behind derivative pricing and portfolio management of derivative securities. Development of hedging and pricing by arbitrage in the discrete time setting of binary trees and Black-Scholes model. Introduction to the theory of Stochastic Calculus, Martingale representation theorem, and change of measure. Applications of the developed theory to a variety of actual financial instruments.

MATH 468 Financial Calculus II 3 Credits
Models and mathematical concepts behind the interest rates markets. Heath-Jarrow-Morton model for random evolution of the term structure of interest rates and short rate models. Applications of the theory to a variety of interest rates contracts including swaps, caps, floors, swaptions. Development of multidimensional stochastic calculus and applications to multiple stock models, quants, and foreign currency interestrate models.
Prerequisites: MATH 467

MATH 470 Proseminar 3 Credits
Preparation for entering the mathematics profession. Seminar will concentrate on methods of teaching mathematics, and will include other topics such as duties of a professor and searching for a job. Consent of department chair required.

MATH 471 Homological Algebra 3 Credits
Modules, tensor products, categories and functors, homology functors, projective and injective modules.

MATH 472 Group Representations 3 Credits
Linear representations and character theory with emphasis on the finite and compact cases.

MATH 475 Topics in Geometry 3 Credits
Selected topics in geometry, such as geometric analysis, algebraic geometry, complex geometry, characteristic classes, geometric flows or geometric measure theory, with emphasis on recent developments. Consent of department chair required.
Repeat Status: Course may be repeated.

MATH 485 Topics in Financial Mathematics 3 Credits
Selected topics in financial mathematics. Consent of department chair required.
Repeat Status: Course may be repeated.

MATH 499 Dissertation 1-15 Credits
Statistics Courses

STAT 342 Linear Algebra 3 Credits
Solution of systems of linear equations, matrices, vector spaces, bases, linear transformations, eigenvalues, eigenvectors, additional topics as time permits. Restricted to graduate students in the MS in Statistics program. Prerequisites as noted below or consent of instructor. Credit may not be received for both MATH 242 and STAT 342.

STAT 408 Seminar in Statistics and Probability 1-6 Credits
Intensive study of some field of statistics or probability not offered in another course. Consent of department required.

STAT 409 Seminar in Statistics and Probability 1-6 Credits
Intensive study of some field of statistics or probability not offered in another course. Consent of department required.

STAT 410 Random Processes and Applications 3 Credits
See MATH 310.

STAT 412 Statistical Computing and Applications 3 Credits
See MATH 312.

STAT 434 Mathematical Statistics 3 Credits
See MATH 334.

STAT 438 Linear Models In Statistics with Applications 3 Credits
See MATH 338.

Prerequisites: (MATH 012 or MATH 231) and (MATH 043 or MATH 205 or MATH 242)

STAT 461 Topics In Mathematical Statistics 3 Credits
See MATH 461.

STAT 462 Modern Nonparametric Methods in Statistics 3 Credits
See MATH 462.

STAT 463 (MATH 463) Advanced Probability 3 Credits
See MATH 463.

STAT 464 Advanced Stochastic Processes 3 Credits
See MATH 464.

Mechanical Engineering and Mechanics

OUR MISSION
The mission of the Department of Mechanical Engineering and Mechanics is to provide quality education and training to undergraduate and graduate students, to develop new knowledge and engineering methodology through research, and to provide service to industry and society at large.

STUDENT ENROLLMENT AND GRADUATION DATA
The Mechanical Engineering undergraduate program is accredited by the Engineering Accreditation Commission of ABET (http://www.abet.org) and is the largest undergraduate program within Lehigh’s P.C. Rossin College of Engineering and Applied Science. Our enrollment and graduation figures can be found in this table. (http://www.lehigh.edu/engineering/academics/accredited/#mechanical)

PROGRAM OBJECTIVES
In harmony with the mission stated above, the department has adopted three Program Educational Objectives (PEOs) for the undergraduate program in Mechanical Engineering.

Program graduates are expected, three to five years from graduation, to:

1. Successfully practice mechanical engineering and/or pursue advanced education, possibly towards other professions such as law, medicine, business, etc.

2. Participate at varying degrees in research and development, and other creative efforts in science, engineering, technology and/or technological entrepreneurship.

3. Engage in activities that demonstrate a commitment to professionalism and personal development and possibly demonstrate leadership qualities.

In order to achieve these objectives the ME program ensures that its graduates are capable of the eleven Student Outcomes (a-k) proposed by the accreditation organization ABET and adopted verbatim by the Lehigh University ME program. These outcomes are:

a. Ability to apply knowledge of mathematics, science and engineering.

b. Ability to design and conduct experiments, as well as to analyze and interpret data.

c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

d. Ability to function on multi-disciplinary teams.

e. Ability to identify, formulate, and solve engineering problems.

f. Understanding of professional and ethical responsibility.

g. Ability to communicate effectively.

h. Broad education necessary to understand the impact of engineering solution in a global and societal context.
i. Recognition of the need for, and an ability to engage in lifelong learning.

j. Knowledge of contemporary issues.
k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Achievement of the aforementioned educational objectives is served first through a sound education in mathematics, physics, and engineering sciences; second, by exposure to the engineering process (creation, innovation, analysis, and judgment) through design courses, projects, laboratories, and a choice of technical electives that permits a degree of specialization; and third, by the development of cultural awareness through courses in humanities and social sciences. Students may also take elective courses that transcend traditional disciplinary lines, while still satisfying the requirements for mechanical engineering.

The undergraduate program provides students with the basic education they will need to function in an engineering environment, pursue graduate studies, continue their professional development, and establish an awareness of the culture and society in which we live. Because of technological innovations and the long term demands of global competition, the department seeks to prepare our students to adapt to the rapid advances and changes in technology, and to serve as agents and leaders in effecting these changes, while being cognizant of the needs and concerns of the society at large.

The graduate program bridges between the generalized undergraduate studies and the more focused research and remarkable accomplishments of our faculty. New graduate students participate in research by working closely with their faculty advisors; however, they are quickly encouraged to work and think independently, assuming greater responsibility for critical research functions. This learning process prepares the students for future research and development positions in industry or academia, where they can contribute toward the improvement and advancement of the community and society at large.

Professors. John P. Coulter, PhD (University of Delaware); John N. DuPont, PhD (Lehigh University); Patrick V. Farrell, PhD (University of Michigan Ann Arbor); Joachim L. Grenestedt, DSc (Royal Institute of Technology); D. Gary Harlow, PhD (Cornell University); Jacob Y. Kazakia, PhD (Lehigh University); Wojciech Z. Misiolek, DSc (AGH University of Science & Technology); Herman F. Nied, PhD (Lehigh University); John B. Ochs, PhD (The Pennsylvania State University); Tulga M. Ozsoy, PhD (Istanbul Technical University); Alparslan Oztekin, PhD (University of Illinois Urbana); Donald O. Rockwell, Jr., PhD (Lehigh University); Eugenio Schuster-Rosa, PhD (University of California San Diego); Arkady Voloshin, PhD (Tel Aviv University)

Associate Professors. Meng-Sang Chew, PE (University of Virginia); Yaling Liu, PhD (Northwestern University); Noel Duke Perreira, PhD (University of California Los Angeles); Edmund B. Webb, III, PhD (Rutgers University)

Assistant Professors. Arindam Banerjee, PhD (Texas A&M University); Subhrajit Bhattacharya, PhD (University of Pennsylvania); Hannah Lee Dailey, PhD (Lehigh University); Justin Jaworski, PhD (Duque University); Brandon A. Krick, PhD (University of Florida); Keith W. Moored, III, PhD (University of Virginia); Nader Motee, PhD (University of Pennsylvania); Natasha Vermaak, PhD (University of California Santa Barbara); Xiaohui Zhang, PhD (University of Miami)
**Professors Of Practice.** David C. Angstadt, PhD (Lehigh University); William Andrew Best, MS (Virginia Tech); Marc de Vinck, BFA (Parsons School of Design); Terry J. Hart, MS (Rutgers University); Michael Lehman, MD (Penn State College of Medicine); Murat Ozturk, PhD (Lehigh University)

**Emeriti.** Russell E. Benner, PhD (Lehigh University); Philip A. Blythe, PhD (University of Manchester); Forbes T. Brown, DSc (Massachusetts Institute of Technology); Terry J. Delph, PhD (Stanford University); Ronald J. Hartmanft, PhD (Lehigh University); Stanley H. Johnson, PhD (University of California Berkeley); Arturs Kalnins, PhD (University of Michigan Ann Arbor); Edward K. Levy, SCD (Massachusetts Institute of Technology); Robert A. Lucas, PhD (Lehigh University); Sudhakar Nett, PhD (University of Kentucky Lexington); Jerzy A Owczarek, PhD (University of London); Richard Roberts, PhD (Lehigh University); Robert G. Sarubbi, PhD (Lehigh University); Kenneth N. Sawyers, PhD (Brown University); George C. Sih, PhD (Lehigh University); Charles R. Smith, PhD (Stanford University); Gerald F. Smith, PhD (Brown University); Theodore A. Terry, PhD (Lehigh University); Dean P. Udupke, PhD (Brown University); Eric Varley, PhD (Brown University)

**B.S. IN MECHANICAL ENGINEERING**

Mechanical engineering is one of the broadest of the engineering professions, dealing generally with systems for energy conversion, material transport and the control of motions and forces.

Mechanical engineers may choose from among many different activities in their careers, according to their interests and the changing needs of society. Some concentrate on the conversion of thermal, nuclear, solar, chemical and electrical energy, or on the problems of air, water, and noise pollution. Some concentrate on the design of mechanical systems used in transportation, manufacturing or health care industries or by individual consumers. Some will be working, a decade from now, in fields that do not yet exist. Most will be engaged with concepts involving all four dimensions of space and time.

The curriculum leading toward the bachelor of science in mechanical engineering combines a broad base in mathematics, physical sciences, and the engineering sciences (mechanics of solids, materials, dynamics and fluid, thermal and electrical sciences), including laboratory. Special emphasis is placed on the practice of modern Integrated Product Development, combining state-of-the-art computer aided design and manufacturing methods in a business oriented framework. Several specific application fields are chosen toward the end of the program in the form of four or more courses elected from a wide variety of 300-level offerings. Courses in mechanical engineering and engineering mechanics are equally available.

The course requirements for a B.S. degree in mechanical engineering are listed below. In addition to required mathematics, physics, chemistry and basic engineering courses, the program includes a minimum of seven courses in humanities and social sciences (see humanities/social sciences), two free electives and five approved electives. The total graduation requirement is 129 credits.

**UNDERGRADUATE CURRICULUM IN MECHANICAL ENGINEERING**

### First Year

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Credits</th>
<th>Second Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 001 (Composition &amp; Literature)</td>
<td>3</td>
<td>ENGL 002 (Composition &amp; Literature II)</td>
<td>3</td>
</tr>
<tr>
<td>MATH 021 (Calculus I)</td>
<td>4</td>
<td>MATH 022 (Calculus II)</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 005 (Introduction to Engineering Practice)</td>
<td>2</td>
<td>ECO 1 or HSS elective</td>
<td>4</td>
</tr>
</tbody>
</table>

Select one of the following: 5-6

- ENGR 010 & CHM 030
- PHY 011 & PHY 012 (Introductory Physics I and Lab)

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Credits</th>
<th>Second Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>14-15</td>
<td></td>
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<td></td>
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</tbody>
</table>

### Second Year

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Credits</th>
<th>Second Semester</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>ME 010 (Graphics for Engineering Design)</td>
<td>3</td>
<td>ME 104 (Thermodynamics)</td>
<td>3</td>
</tr>
<tr>
<td>MECH 003 (Fundamentals of Engineering Mechanics)</td>
<td>3</td>
<td>MECH 012 (Strength of Materials)</td>
<td>3</td>
</tr>
<tr>
<td>ME 017 (Numerical Methods in ME)</td>
<td>2</td>
<td>MATH 205 (Linear Methods)</td>
<td>3</td>
</tr>
<tr>
<td>MAT 033 (Engineering Materials and Processes)</td>
<td>3</td>
<td>PHY 021 &amp; PHY 022 (Introductory Physics II and Lab)</td>
<td>5</td>
</tr>
<tr>
<td>MATH 023 (Calculus III)</td>
<td>4</td>
<td>HSS Elective</td>
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<table>
<thead>
<tr>
<th>Total Credits: 14-15</th>
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### Third Year

<table>
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<th>Credits</th>
<th>Second Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 021 (Mechanical Engineering Laboratory I)</td>
<td>1</td>
<td>ME 121 (Mechanical Engineering Lab II)</td>
<td>1</td>
</tr>
<tr>
<td>ME 231 (Fluid Mechanics)</td>
<td>3</td>
<td>ME 240 (Manufacturing)</td>
<td>3</td>
</tr>
<tr>
<td>MECH 102 (Dynamics)</td>
<td>3</td>
<td>TE 211</td>
<td>3</td>
</tr>
<tr>
<td>HSS Electives</td>
<td>6-8</td>
<td>ME 252 (Mechanical Elements)</td>
<td>3</td>
</tr>
</tbody>
</table>

Select one of the following: 3

- ECE 083 (Introduction to Electrical Engineering)
- ME 215 (Engineering Reliability)
- MATH 231 (Probability & Statistics)

<table>
<thead>
<tr>
<th>Total Credits: 16-18</th>
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</table>

### Fourth Year

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Credits</th>
<th>Second Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 111 (Professional Development (fall only))</td>
<td>1</td>
<td>Engineering Required/Technical-Elective courses</td>
<td>12-14</td>
</tr>
<tr>
<td>TE 212</td>
<td>2</td>
<td>HSS &amp; Free Electives</td>
<td>4</td>
</tr>
<tr>
<td>Engineering Required/Technical-Elective courses</td>
<td>6-8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HSS and Free Electives</td>
<td>4-6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Credits: 13-17</th>
</tr>
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</table>

### Total Credits: 124-135

**Total Credits Required for Graduation 129**

1. Required natural science courses, one taken fall semester and the other taken in spring
2. For ME program the preferred course in this semester is ECO 001 Principles of Economics 4 credits.
3. Total credits for HSS and free electives must be at least 19 of which at least 13 must be HSS electives (for detailed description of HSS electives see the pages of RCEAS).
4. Required HSS courses 10 credits: ECO 001 Principles of Economics 4 credits, ENGL 001 Composition and Literature 3 credits, ENGL 002 Composition and Literature II 3 credits

Senior year Required/Technical-Elective courses total 20 credits according to the following schedule:

- ME 321 Introduction to Heat Transfer (For 3 credits; available Fall or Spring) 3

<table>
<thead>
<tr>
<th>Total Credits: 16-18</th>
</tr>
</thead>
</table>
ME 207  Mechanical Engineering Laboratory III (Fall Semester)  2

Engineering Elective A: Select one of the following for 3 credits  3

MECH 302  Advanced Dynamics (Spring Semester)  3

MECH 305  Advanced Mechanics of Materials (Fall Semester)  3

ME 304  Thermodynamics II (Fall Semester)  3

ME 322  Gas Dynamics (Spring Semester)  3

ME 331  Advanced Fluid Mechanics (Fall Semester)  3

ME 343  Control Systems (Fall Semester)  3

Engineering Elective B: Select one of the following for 3 credits:  3

Any ME or MECH three-hundred-level course, excluding ME 300 and ME 310  3

Engineering Electives C: Select three courses for 9 credits  9

Any ME or MECH three-hundred-level course or an engineering/science/mathematics course, as approved by the department. ME 300 and ME 310 can count once each towards Engineering Electives C.  9

Total Credits: 20  4

4 Total Credits Required: 129

For the flow chart of the program please follow the link:

*Co-op students must take ME 021 (http://catalog.lehigh.edu/search?P=ME%20021) sophomore year, second semester (18-19 credit hours).
Co-op students will take a MATH elective (3), ME 231 (3), MECH 102(3), and a HSS elective (3-4) during the summer after the sophomore year (12-13 credit hrs.). See Co-op program for details

Co-op Program
To participate in the Co-op program students must rank in the top third of the engineering class after three semesters of study and attend a summer program between the sophomore and junior years. Students must see their advisor or contact the Co-op Faculty Liaison for further details.

B.S. IN ENGINEERING MECHANICS
The curriculum in engineering mechanics is designed to prepare students for careers in engineering research and development, and it is especially appropriate for students wishing to specialize in the analysis of engineering systems. In many industries and governmental laboratories there is a demand for men and women with broad training in the fundamentals of engineering in which engineering mechanics and applied mathematics play an important role.

The first two years of the curriculum is the same as that in mechanical engineering. One of the advantages of the curriculum is the flexibility it offers through 18 credits of technical and six credits of personal electives in the junior and senior years. Beyond the sophomore year there are required courses in dynamics, solid mechanics, fluid mechanics, heat transfer, principles of electrical engineering, mathematics, vibrations, and senior laboratories or projects. It is recommended that the electives be chosen either to concentrate in areas such as applied mathematics and computational mechanics, solid mechanics, engineering materials, and fluid mechanics or to obtain further depth in all areas. The academic advisor for the engineering mechanics program will provide guidance in formulating the student’s goals and choosing electives.

In addition to the required and elective courses in mathematics, sciences and engineering, the B.S. degree program in engineering mechanics includes a minimum of seven courses in humanities and social sciences (see humanities/social sciences). The total graduation requirement is 127 credits.

UNDERGRADUATE CURRICULUM IN ENGINEERING MECHANICS

First Year

<table>
<thead>
<tr>
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<td>ENGL 001 (Composition &amp; Literature)</td>
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<td>3</td>
</tr>
</tbody>
</table>

MATH 021 (Calculus I)  4

ENGR 005 (Introduction to Engineering Practice)  2

Select one of the following:  5-6

ENGR 010 & CHM 030  6

PHY 011 & PHY 012 (Introductory Physics I and Lab)  5

<table>
<thead>
<tr>
<th>Credits</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>14-15</td>
<td>15-17</td>
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<tr>
<td>17-18</td>
<td>17-18</td>
</tr>
<tr>
<td>13-15</td>
<td>17-18</td>
</tr>
<tr>
<td>14-16</td>
<td>13-15</td>
</tr>
</tbody>
</table>

Total Credits: 120-132

TOTAL CREDITS REQUIRED FOR GRADUATION 127

1 Required natural science courses, one taken fall semester and the other taken in spring
2 For ME/MECH programs the preferred course in this semester is ECO 001 Principles of Economics 4 credits.
MINOR IN AEROSPACE ENGINEERING

The minor in aerospace engineering provides a foundation for students who intend to pursue a career in the aerospace industry. This minor will also provide sufficient technical background in aerospace studies for undergraduates who plan to enter graduate programs in this field.

Typical recommended options:

Applied Mathematics and Computational Mechanics
- MECH 305 Advanced Mechanics of Materials (Fall Semester) 3
- MECH 312 Finite Element Analysis 3
- MATH 309 Theory of Probability 3
- MATH 322 Methods of Applied Analysis I 3
- MATH 323 Methods of Applied Analysis II 3

Solid Mechanics
- MECH 305 Advanced Mechanics of Materials 3
- MECH 307 Mechanics of Continua 3
- MECH 312 Finite Element Analysis 3
- MECH 313 Fracture Mechanics 3
- MATH 322 Methods of Applied Analysis I 3

Engineering Materials
- MECH 305 Advanced Mechanics of Materials 3
- MECH 313 Fracture Mechanics 3
- MAT 218 Mechanical Behavior of Macro/ Nanoscale Materials 3
- PHY 031 Introduction to Quantum Mechanics 3
- PHY 363 Physics of Solids 3

Fluid Mechanics
- ME 331 Advanced Fluid Mechanics 3
- ME 322 Gas Dynamics 3
- MECH 326 Aerodynamics 3
- MATH 322 Methods of Applied Analysis I 3

MINOR IN MECHANICS OF MATERIALS

The minor in mechanics of materials provides a view of mechanical strength and behavior of materials based on understanding a few basic concepts and using simplified material models. Courses selected for the minor emphasize concepts such as superposition of loadings; relation between external loads and internal stresses; factor of safety; safe design based on allowable stress or allowable loads; allowable deformation; and reliability of structures. Courses offer a wide variety of

The minor requires a minimum of 15 credits from the following course selection:

Required Courses
- ME 255 Introduction to Aerospace Engineering 3
- MECH 326 Aerodynamics 3
- MECH 328 Fundamentals of Aircraft Design 3

Elective Courses
Select two of the following:
- ME 309 Composite Materials 3
- ME 322 Gas Dynamics 3
- ME 331 Advanced Fluid Mechanics 3
- ME 333 Propulsion Systems 3
- ME 343 Control Systems 3
- ME 348 Computer-Aided Design 3
- MECH 305 Advanced Mechanics of Materials 3
- MECH 312 Finite Element Analysis 3

Total Credits 15

MINOR IN ENERGY ENGINEERING

The minor in energy engineering touches upon the technologies associated with the transformation and use of energy in various forms. Since every sector of engineering and the economy require energies of one form or another, the courses included in this minor program will permit student exposure to fossil, nuclear and renewable energy technologies. The mechanical engineering curriculum provides the fundamental knowledge in thermodynamics, fluid mechanics and other related areas leading up to the courses for the energy engineering minor. The courses offer a wide variety of topics including fundamental, analytical and design aspects of energy conservation as well as various forms of energy used in power generation, transportation and industry.

The minor in energy engineering requires a minimum of 15 credits, which must be taken from ME or MEM offerings. The minor in energy is primarily intended for ME Majors but students with other majors, particularly Chemical engineering will be able to take some or all the related courses. Four courses are required with some degree of choice and an additional course must be selected from a broader set.

Required course
- ME 304 Thermodynamics II 3

Elective Energy Courses
Select at least three of the following:
- ME 360 Nuclear Reactor Engineering 3
- ME 362 Nuclear Fusion and Radiation Protection 3
- ME 364 Renewable Energy 3
- ME 366 Engineering Principles of Clean Coal Technology 3

Additional Electives
Select one of the following:
- CHE 373 Fundamentals of Air Pollution 3
- CHE/ME 376 Energy: Issues & Technology 3
- CHE 386 Process Control 3
- ME 322 Gas Dynamics 3
- ME 331 Advanced Fluid Mechanics 3
- ME 343 Control Systems 3

Other Energy related 300 level courses with the approval of the ME Dept. Chair.

Total Credits 15
topics including analytical and numerical methods for solving mechanics problems; manufacturing and polymer processing.

The mechanics of materials minor requires a minimum of 15 credits, which must be taken from MEM offerings. Two courses are required; and three additional electives must be selected. The minor is not available for students having a major in the Department of Mechanical Engineering and Mechanics.

**Required courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MECH 003</td>
<td>Fundamentals of Engineering Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>MECH 012</td>
<td>Strength of Materials</td>
<td>3</td>
</tr>
</tbody>
</table>

**Electives**

Select three of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 010</td>
<td>Graphics for Engineering Design</td>
<td>1</td>
</tr>
<tr>
<td>ME 215</td>
<td>Engineering Reliability</td>
<td>1</td>
</tr>
<tr>
<td>ME 240</td>
<td>Manufacturing</td>
<td>1</td>
</tr>
<tr>
<td>ME 252</td>
<td>Mechanical Elements</td>
<td>1</td>
</tr>
<tr>
<td>ME/MAT/JSE 344</td>
<td>Metal Machining Analysis 1</td>
<td>1</td>
</tr>
<tr>
<td>ME 385</td>
<td>Polymer Product Manufacturing</td>
<td>1</td>
</tr>
<tr>
<td>MECH 102</td>
<td>Dynamics</td>
<td>1</td>
</tr>
<tr>
<td>MECH 305</td>
<td>Advanced Mechanics of Materials</td>
<td>1</td>
</tr>
<tr>
<td>MECH 312</td>
<td>Finite Element Analysis</td>
<td>1</td>
</tr>
<tr>
<td>MECH 313</td>
<td>Fracture Mechanics</td>
<td>1</td>
</tr>
</tbody>
</table>

Total Credits: **15**

1 This cross-listed course ME 344 counts as an elective.

**GRADUATE PROGRAMS**

The Department offers programs of study leading to the degrees of Master of Science, Master of Engineering, and Doctor of Philosophy in Mechanical Engineering and Master of Science and Doctor of Philosophy in Computational and Engineering Mechanics.

Subject to approval, courses from other engineering curricula, such as materials science and engineering, chemical, electrical, and industrial engineering, together with courses in mathematics and engineering mathematics, may be included in the degree program.

**MASTERS DEGREE PROGRAMS**

The Department of Mechanical Engineering and Mechanics offers two Masters degree programs: the Master of Engineering degree (without a thesis) and the Master of Science degree (with a thesis). Both programs require 30 credit hours of graduate work (audit courses may not be used towards the degree) and must satisfy the following University course distribution requirements, as outlined in the RCEAS Graduate Student Handbook. The minimum program for all Masters degrees includes:

- Not less than 24 credits of 300- and 400-level coursework of which at least 18 hours is at the 400-level. Thesis credits count as part of the 400-level requirement.
- Not less than 18 credit hours in Mechanical Engineering and Mechanics.
- Not less than 15 credit hours of 400-level coursework in Mechanical Engineering and Mechanics.
- No course below the 300-level in Mechanical Engineering and Mechanics can be used towards the degree; however, two courses (6 credits) outside of the department, but in the engineering field, at level 200 and above, may apply, with approval from a student's advisor and the Departmental Graduate Committee.

**Master of Science in Mechanical Engineering**

The Master of Science degree in Mechanical Engineering requires 24 credit hours of courses and 6 credit hours of research, which culminates in a thesis, for a total of 30 credits. The University course distribution requirements, listed above, must be satisfied, as well as core course requirements. The core course requirement consists of: ME 452 and ME 453 or ME 413 (6 credits) and three additional core courses (9 credits). In addition, the student selects three electives (9 credits) and ME 490 thesis (6 credits), for the 30 credit total.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ME 452</td>
<td>Mathematical Methods In Engineering I</td>
<td>3</td>
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<tr>
<td>or ME 413</td>
<td>Numerical Methods In Mechanical Engineering</td>
<td>3</td>
</tr>
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</table>

Select three of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 423</td>
<td>Heat and Mass Transfer</td>
<td>3</td>
</tr>
<tr>
<td>ME 430</td>
<td>Advanced Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>MECH 406</td>
<td>Fundamentals of Solid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>MECH 425</td>
<td>Analytical Methods in Dynamics and Vibrations</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Credits: **30**

**Master of Science in Computational and Engineering Mechanics**

All students pursuing a master's degree in Computational and Engineering Mechanics must take a minimum of 30 credit hours of graduate level work, with not less than 24 of these hours being at the 400 level. The program must include the following courses and must satisfy the University's course distribution requirement for the Master's degree.

**Required Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 452</td>
<td>Mathematical Methods In Engineering I</td>
<td>3</td>
</tr>
<tr>
<td>ME 453</td>
<td>Mathematical Methods In Engineering II</td>
<td>3</td>
</tr>
<tr>
<td>ME 413</td>
<td>Numerical Methods In Mechanical Engineering</td>
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</tbody>
</table>

**Additional Requirements**

Select two of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 423</td>
<td>Heat and Mass Transfer</td>
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<tr>
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</tr>
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<td>Fundamentals of Solid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>MECH 425</td>
<td>Analytical Methods in Dynamics and Vibrations</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Credits: **30**

**Doctor of Philosophy in Mechanical Engineering**

The PhD program in Mechanical Engineering and Mechanics requires innovative research in collaboration with one or more faculty members, along with the completion of 72 credit hours beyond the bachelor’s degree (if graduate study is carried out entirely at Lehigh University), or 48 beyond the master’s degree (obtained at another university). The first stage of PhD candidacy in Mechanical Engineering and Mechanics is attained by achieving a minimum GPA of 3.35 in five core courses (see core course requirements for Master of Science in Mechanical Engineering). PhD students must also take ME 453, which can either be taken as part of the five core course requirement or taken as an additional course. The second stage of candidacy involves completion of a General Examination, which is based on assessment and presentation of a research topic. Formal University candidacy for the PhD is granted upon recommendation of the doctoral committee and approval by the engineering college. Course work for the PhD is determined in consultation with the student's advisor and doctoral committee. To
complete the PhD degree, the student must present and defend a dissertation before the doctoral committee.

**Doctor of Philosophy in Computational and Engineering Mechanics**
The PhD program in Computational and Engineering Mechanics requires innovative research in collaboration with one or more faculty members, along with the completion of 72 credit hours beyond the bachelor’s degree (if graduate study is carried out entirely at Lehigh University), or 48 beyond the master’s degree (obtained at another university). Students wishing to pursue a PhD in Computational and Engineering Mechanics must take the following courses as part of their total credit requirement:

**Required Core Courses**
- ME 452 Mathematical Methods In Engineering I: 3 credits
- ME 453 Mathematical Methods In Engineering II: 3 credits
- ME 413 Numerical Methods in Mechanical Engineering: 3 credits

**Additional Requirements**
Select two core courses from the following supplemental list: 6 credits
- MECH 419 Asymptotic Methods in the Engineering Sciences
- MECH 418 Finite Element Methods
- MECH 445 Nondeterministic Models in Engineering
- ME 446 Mechanical Reliability
- ME 423 Heat and Mass Transfer
- ME 430 Advanced Fluid Mechanics
- MECH 406 Fundamentals of Solid Mechanics
- MECH 425 Analytical Methods in Dynamics and Vibrations

**Total Credits** 15

1. In addition, before completion of the degree, a student must have received graduate credit for at least two of the four MEM core courses which are designated by a “1” in the above list. If desired, these noted courses may be used as part of the Computational and engineering mechanics core, and hence count towards the core GPA requirement.

A student who wishes to pursue a PhD in Computational and Engineering Mechanics must satisfy the GPA requirement and complete the PhD degree. In addition, the student must present and defend a dissertation before the doctoral committee.

**RESEARCH FACILITIES**
The department has a wide range of computational, computer graphics and experimental systems. The department’s CAD Lab has over 50 computers that include high-end engineering workstations. The university supports networks of hundreds of PCs as well as links to the Internet with thousands of online services.

Experimental facilities include 11 pulsed and continuous laser units for laser diagnostics in the areas of fluid and solid mechanics, four image processing systems, and a number of unique facilities for observing and controlling flow past surfaces and through machines, including two wind tunnels and three large-scale water channels. There are well-equipped laboratories for multidisciplinary studies of phenomena in the area of solid mechanics, including electron microscopy facilities. Other facilities include mechanical, electro-dynamic and servocontrolled hydraulic testing machines, photoelastic equipment, and Moire strain measuring instruments.

Extensively equipped, interdepartmental robotics, controls, and manufacturing laboratories are also available.

**RECENT RESEARCH ACTIVITIES**

**Continuum and Solid Mechanics**
Formulation of field equations and constitutive equations in nonlinear elasticity theories; mechanics of viscoelastic solids and fluids, plasticity theory; generalized continuum mechanics; thermo-mechanical and electromechanical interactions; analyses and modeling of manufacturing processes; free vibration and dynamic response of elastic shells, elastic-plastic deformation of shells upon cyclic thermal loading, and applications of shell analysis to nuclear power plant components; optical stress analysis; biomechanics of gait; wave propagation; finite amplitude wave propagation; composite materials and fabrication; tribology, surface friction and wear.

**Fracture Mechanics**
Stress analysis of materials containing defects, including viscoelastic, non-homogeneous, and anisotropic materials; analytical and experimental studies and modeling of crack growth under static, periodic, and random loadings and environmental effects; optimizations of fracture control; crack propagation theories for nonlinear material; influence of cracks on the strength of structural members and of interfaces; hydraulic fracture; applications to reliability and durability of composites, structural and microelectronic components, and to processes for resource recovery.

**Thermofluids**
Structure of turbulent boundary layers, wakes and jets; vortex solid boundary interactions; boundary layers in compressible flow, including hypersonic regimes; vortex breakdown in internal machinery and in flow past wings; drag reduction in turbulent flows; flow induced noise and vibration; flutter of blades in axial-flow turbomachinery and of tails and fins on aircraft; aero- and hydroelastic phenomena and noise generation of fliers and swimmers in nature; flow-structure interactions in rotating and oscillating systems for power generation; unsteady aerodynamic flows past three dimensional wings and bodies; flow structure and heat transfer at end-wall junctions in rotating machinery and on surfaces of aircraft flows in micro-hydro-electromechanical and nano-scale systems; convective heat transfer in systems of electronic components; flows through complex components of power generation systems; transport of coal particles; flow and heat transfer in fluidized beds; cycle analysis applied to coal gasifiers; [R]net optimization of heat pumps; laser-Doppler and particle image velocimetry; liquid crystal sensors for heat transfer; Raman spectral techniques applied to two-phase flow; laser diagnostics and image processing of complex flow and heat transfer systems.

**Theoretical Fluid Mechanics**
Vortex boundary layer interaction, modeling of turbulent boundary layers; geophysical flows such as frontal systems and mountain flows; statistical mechanics of plasmas, liquids and shock waves; [finite amplitude waves in stratified gases and liquids; shock wave propagation; non-Newtonian flows in flexible tubes with application to hemorheology; magneto-fluid mechanics; wing theory; thermally driven flows; noise generation due to flow past trailing edges of fliers in nature.

**Design**
Geometric modeling; tolerance analysis and synthesis; assembly modeling; geometric dimensioning and tolerancing; 3D digitizing; data and information structures; design for manufacturing; design methodology, tools and practices; expert systems in design; industry projects with Integrated Product Development (IPD) focus.

**Manufacturing**
Free-form surface machining; coordinate measuring machine applications to geometric dimensions and tolerances; Taguchi’s method; injection molding; sheet metal fabrication; FEA/FEM applications to plastic deformation of metals; rapid prototyping; intelligent manufacturing incorporating process modeling, sensor subsystems for in situ product quality monitoring, and knowledge-based control for real-time process adaptation; blow molding; composites processing; thermoforming; resin transfer molding; spin coating; electronic packaging.

**Systems Dynamics and Controls**
Modeling, simulation and control of dynamic systems including: control of unstable processes, programmed logic control experience, compensator design and construction, issues in digital implementation, state-of-the-industrial art experimental equipment, energy methods...
and bond graph modeling, methods of model identification from experimental data; application to various mechanisms, vehicles, chemical processes, aircraft systems, chemical processes, hydraulic systems, thermodynamic systems, microelectromechanical actuators; application to mechatronics for the integration of mechanical systems, computer control and programming for the design of smart consumer products and intelligent manufacturing machinery.

**Stochastic Processes**
Modeling of random behavior in mechanical systems; static and time-dependent stochastic fracture mechanics, with particular applications to assessments of reliability and service life prediction.

**Engineering Mathematics**

**Mechanical Engineering Courses**

**ME 010 Graphics for Engineering Design 3 Credits**
Graphical description of mechanical engineering design for visualization and communication by freehand sketching, production drawings, and 3D solid geometric representations. Introduction to creation, storage, and manipulation of such graphical descriptions through an integrated design project using state-of-the-art, commercially available computer-aided engineering software. Lectures and laboratory. (ES 1), (ED 2).

**ME 017 Numerical Methods in Mechanical Engineering 2 Credits**
Numerical methods applied to mechanical engineering problems. Techniques for interpolation, curve fitting, plotting of numerical data, etc. Numerical techniques for solving algebraic and differential equations. Computational platforms to be used include MATLAB.

**Prerequisites:** ENGR 010

**ME 021 Mechanical Engineering Laboratory I 1 Credit**

**Prerequisites:** MECH 012

**ME 050 Supplemental Topics in Mechanical Engineering 1-2 Credits**
Completion of material for Mechanical Engineering courses transferred from other institutions. Student will be scheduled for that part of Mechanical Engineering that is required for completion of missing material. Subject matter and credit hours to be determined by department chair for each student.

**ME 104 Thermodynamics I 3 Credits**
Basic concepts and principles of thermodynamics with emphasis on simple compressible substances. First and second law development, energy equations, reversibility, entropy and efficiency. Properties of pure substances and thermodynamic cycles.

**Prerequisites:** (MATH 033 or MATH 023) and (PHY 011)

**Can be taken Concurrently:** MATH 033, MATH 023, PHY 011

**ME 111 Professional Development 1 Credit**
Examination of ethical and professional choices facing mechanical engineers. Written and oral communications. Must have senior standing in Mechanical Engineering and Mechanics.

**ME 121 Mechanical Engineering Laboratory II 1 Credit**
A continuation of ME 21 including use of transducers, advanced instrumentation, and data acquisition. Emphasis on experimental exercises that illustrate, and/or introduce material from thermodynamics, and fluid mechanics. Includes proposal writing and interpretation of results.

**Prerequisites:** ME 021 and ME 104 and ME 231

**Can be taken Concurrently:** ME 231

**ME 141 General Aviation Technology and Operations 2 Credits**
A Federal Aviation Administration (FAA) certified course for students interested in understanding the engineering and operational aspects of the general aviation industry, including aerodynamics, aircraft systems and performance, weather, navigation, flight procedures, regulations, maneuvers, and the physiology of flight. Successful completion of the course will fulfill the FAA requirement for the ground school component of a private pilot certification.

**Prerequisites:** PHY 011

**ME 142 Instrument Ground Training 2 Credits**
A Federal Aviation Administration (FAA) certified course for students interested in pursuing an instrument rating from the FAA. Successful completion of the course will fulfill the FAA requirement for the ground school component of an instrument rating.

**Prerequisites:** ME 141

**ME 207 Mechanical Engineering Laboratory III 2 Credits**
Formulation of laboratory experiments through open-ended planning, including decision criteria for laboratory techniques and approaches. Execution of experiments based on individual plans, followed by assessment of experimental results.

**Prerequisites:** ME 121

**ME 215 Engineering Reliability 3 Credits**
Applications of reliability methods to engineering problems. Modeling and analysis of engineered components and systems subjected to environmental and loading conditions. Modeling content encompasses mechanistically based probability and experientially based statistical approaches. Concepts needed for design with uncertainty are developed. Principles are illustrated through case studies and projects. Engineering applications software will be extensively utilized for the projects.

**Prerequisites:** (MATH 023 or MATH 033) and MECH 012

**ME 231 Fluid Mechanics 3 Credits**

**Prerequisites:** MATH 205

**ME 240 Manufacturing 3 Credits**

**Prerequisites:** ME 010 and MECH 012

**ME 242 Mechanical Engineering Systems 3 Credits**
The modeling and analysis of mechanical, fluid, electrical and hybrid systems, with emphasis on lumped models and dynamic behavior, including vibrations. Load single and multiple degree of freedom systems. Computer simulation of nonlinear models, and computer implementation of the superposition property of linear models.

**Prerequisites:** MECH 102 and MATH 205

**ME 245 Mechanical Vibrations 3 Credits**

**Prerequisites:** MECH 102 and MATH 205 and ME 017

**ME 252 Mechanical Elements 3 Credits**
Methods for the analysis and design of machine elements such as springs, gears, clutches, brakes, and bearings. Motion analysis of cams and selected mechanisms. Projects requiring the design of simple mechanisms of mechanical sub-assemblies.

**Prerequisites:** MECH 012 and ME 010 and MECH 102
ME 255 Introduction to Aerospace Engineering 3 Credits
Properties of the atmosphere, aircraft design and performance basics including estimation of lift and drag of aerodynamic bodies. Concepts of stall and service ceiling of aircraft along with propulsive forces, stability and control.
Prerequisites: (PHY 011 and ME 104 and ME 231)
Can be taken Concurrently: ME 231
ME 299 Special Topics In Mechanical Engineering 1-4 Credits
Repeat Status: Course may be repeated.
ME 300 Apprentice Teaching 3 Credits
ME 304 Thermodynamics II 3 Credits
Prerequisites: ME 104
ME 309 (MAT 309) Composite Materials 3 Credits
Principles and technology of composite materials. Processing, properties, and structural applications of composites, with emphasis on fiber-reinforced polymers.
Prerequisites: (MECH 003 and MAT 033)
ME 310 Directed Study 1-3 Credits
Project work on any aspect of engineering, performed either individually or as a member of a team made up of students, possibly from other disciplines. Project progress is reported in the form of several planning and project reports. Direction of the projects may be provided by faculty from several departments and could include interaction with outside consultants and local communities and industries. Consent of department required.
Repeat Status: Course may be repeated.
ME 312 Analysis and Synthesis Of Mechanisms 3 Credits
Types of motion. Degrees of freedom of motion. Position, velocity and acceleration analysis of linkage mechanisms. Systematic approach to the design of linkage mechanisms. Motion generation, path synthesis and function synthesis. Structural synthesis of planar and spatial mechanisms. Static force analysis of mechanisms using virtual work.
Prerequisites: MATH 205 and MECH 102
ME 314 (MAT 314) Metal Forming Processes 3 Credits
Prerequisites: MATH 231
ME 315 (BIOE 315) Bioengineering Statistics 3 Credits
Probability and statistics applied to bioengineering problems focusing on modeling and data analysis. Types of data, types of distributions, parametric and nonparametric analyses, goodness-of-fit, regression, power analysis, and multivariate analysis, life models, simulation, cluster analysis, and Bayesian statistics. Projects and case studies.
Prerequisites: MATH 231
ME 321 Introduction to Heat Transfer 3 Credits
Analytical and numerical solutions to steady and transient one-and two-dimensional conduction problems. Forced and natural convection in internal and external flows. Thermal radiation. Thermal design of engineering processes and systems.
Prerequisites: ME 104 and ME 231
ME 322 Gas Dynamics 3 Credits
Prerequisites: ME 231 and ME 104
ME 323 Reciprocating and Centrifugal Engines 3 Credits
Thermal analysis and design of internal combustion engines (conventional and unconventional), gas turbine engines, air breathing jet engines, and rockets. Components such as jet nozzles, compressors, turbines, and combustion chambers are chosen to exemplify the theory and development of different types of components. Both ideal fluid and real fluid approaches are considered.
Prerequisites: ME 104
ME 331 Advanced Fluid Mechanics 3 Credits
Prerequisites: ME 231
ME 333 Propulsion Systems 3 Credits
Review of jet and rocket engine technologies. Jet and rocket engine thermodynamic and aerodynamic principles. Performance of turbojet, turbofan, and turboprop jet engines. Rocket engines include liquid, cryogenic, solid, and electric propulsion.
Prerequisites: ME 104 and (MECH 326 or ME 322)
ME 340 Advanced Mechanical Design 3 Credits
Probabilistic design of mechanical components and systems. Reliability functions, hazard models and product life prediction. Theoretical stress-strength-time models. Static and dynamic reliability models. Optimum design of mechanical systems for reliability objectives or constraints.
ME 341 Mechanical Systems 3 Credits
Prerequisites: ME 252
ME 342 Dynamics of Engineering Systems 3 Credits
Dynamic analysis of mechanical, electromechanical, fluid and hybrid engineering systems with emphasis on the modeling process. lumped and distributed-parameter models. Use of computer tools for modeling, design and simulation. Design projects.
Prerequisites: ME 242
ME 343 Control Systems 3 Credits
Linear analyses of mechanical, hydraulic and electrical feedback control systems by root locus and frequency response techniques. A design project provides experience with practical issues and tradeoffs.
Prerequisites: ME 242 or ECE 125 or ME 245
ME 344 (ISE 344, MAT 344) Metal Machining Analysis 3 Credits
Intensive study of metal cutting emphasizing forces, energy, temperature, tool materials, tool life, and surface integrity. Abrasive processes. Laboratory and project work.
Prerequisites: ME 240 or ISE 215 or IE 215 or MAT 206
ME 348 Computer-Aided Design 3 Credits
Impact of computer-aided engineering tools on mechanical design and analysis. Part geometry modeling and assembly modeling using solid representations. Analysis for mass properties, interference, kinematics, displacements, stresses and system dynamics by using state-of-the-art commercially available computer-aided-engineering software. Integrated design projects.
Prerequisites: ME 010 and MECH 012 and MECH 102 and MATH 205
ME 350 Special Topics 1-5 Credits
A study of some field of mechanical engineering not covered elsewhere. Consent of department chair required.
Repeat Status: Course may be repeated.
ME 355 Spacecraft Systems Engineering 3 Credits
Systems engineering approach to design, integration, testing, and operations of spacecraft for various missions. Technologies currently used in modern spacecraft bus and payload systems, astrodynamics, launch systems, life-cycle costs, and operational issues. Team works to design a spacecraft that meets a specific set of mission requirements.
Prerequisites: ME 255

ME 360 Nuclear Reactor Engineering 3 Credits
A consideration of the engineering problems related to nuclear reactor design and operation. Topics include fundamental properties of atomic and nuclear radiation, reactor fuels and materials, reactor design and operation, thermal aspects, safety and shielding, instrumentation and control. Course includes several design projects stressing the major topics in the course. Must have senior standing in engineering or physical science.

ME 362 Nuclear Fusion and Radiation Protection 3 Credits

ME 364 Renewable Energy 3 Credits
Fundamentals and design aspects of Renewable Energy (RE) technologies; biofuels, hydropower, solar photovoltaic, solar thermal, wind, geothermal energies. Details and difficulties in implementing RE. Senior standing in Engineering.
Prerequisites: ME 104 and ME 231

ME 366 Engineering Principles of Clean Coal Technology 3 Credits
Effect of coal properties on plant performance. Design and performance of coal-based electric power generation systems. Technologies to control emissions. Carbon capture and sequestration methods for coal-fired power plants and analysis of CCS options. Must have junior standing in engineering or physical science.

ME 368 Fundamentals of Energy Efficiency Practicum 3 Credits
Studies of the plant operation and energy usage. Students work with the Lehigh Industrial Assessment Center to do technical and economic feasibility studies of optimizing energy consumption. Industrial experience. Fundamentals of best practices to save energy, reduce waste, and increase productivity. Consent of instructor required.
Prerequisites: ME 104 and ME 231

ME 373 Mechatronics 3 Credits
Synergetic integration of mechanical engineering with electronics and intelligent computer control in designing and manufacturing machines, products and processes; semiconductor electronics, analog signal processing, with op amps, digital circuits, Boolean algebra, logic network designs, Karnaugh map, flip-flops and applications, data acquisition, A/ D and D/A, interfacing to personal computers, sensors and actuators, microcontroller programming and interfacing.

ME 374 Mechatronics Laboratory 3 Credits
Experiments and applications utilizing combinations of mechanical, electrical, and microprocessor components. Theory and application of electronic and electromechanical equipment, operation and control of mechatronic systems. Projects integrating mechanical, electronic and microcontrollers.

ME 376 (CHE 376) Energy: Issues & Technology 3 Credits
Energy usage and supply, fossil fuel technologies, renewable energy alternatives and environmental impacts. The scope will be broad to give some perspective of the problems, but in-depth technical analysis of many aspects will also be developed. Must have college-level introductory courses in chemistry, physics and mathematics. Consent of instructor required.

ME 385 Polymer Product Manufacturing 3 Credits
Polymer processes such as injection molding through a combination of theory development, practical analysis, and utilization of commercial software. Polymer chemistry and structure, material rheological behavior, processing kinetics, molecular orientation development, process simulation software development, manufacturing defects, manufacturing window establishment, manufacturing process design, manufacturing process optimization. Must have senior level standing in engineering or science. Credit not given for both ME 385 and ME 485.

ME 387 (CHE 387, ECE 387) Digital Control 3 Credits
Sampled-data systems; z-transforms; pulse transfer functions; stability in the z-plane; root locus and frequency response design methods; minimal prototype design; digital control hardware; discrete state variables; state transition matrix; Liapunov stability state feedback control (two lectures and one laboratory per week).
Prerequisites: CHE 386 or ECE 212 or ME 343

ME 388 Honors Project for Eckardt Scholar 1-4 Credits
Opportunity for Eckardt Scholars to pursue an extended project for senior honors. Transcript will identify department in which project was completed.
Repeat Status: Course may be repeated.

ME 389 (CHE 389, ECE 389) Control Systems Laboratory 2 Credits
Experiments on a variety of mechanical, electrical and chemical dynamic control systems. Exposure to state-of-the-art control instrumentation: sensors, transmitters, control valves, analog and digital controllers. Emphasis on design of feedback controllers and comparison of theoretical computer simulation predictions with actual experimental data. Lab teams will be interdisciplinary.
Prerequisites: CHE 386 or ECE 212 or ME 343

ME 401 (MSE 401) Integrated Product Development 3 Credits
An integrated and interdisciplinary approach to engineering design, concurrent engineering, design for manufacturing, industrial design and the business of new product development. Topics include design methods, philosophy and practice, the role of modeling and simulation, decision making, risk, cost, material and manufacturing process selection, platform and modular design, mass customization, quality, planning and scheduling, business issues, teamwork, group dynamics, creativity and innovation. The course uses case studies and team projects. ME 402.

ME 402 (MAT 402) Advanced Manufacturing Science 3 Credits
The course focuses on the fundamental science-base underlying manufacturing processes, and applying that science base to develop knowledge and tools suitable for industrial utilization. Selected manufacturing processes representing the general classes of material removal, material deformation, material phase change, material flow, and material joining are addressed. Students create computer-based process simulation tools independently as well as utilize leading commercial process simulation packages. Laboratory experiences are included throughout the course.

ME 411 Boundary-Layer Theory 3 Credits
The course is intended as a first graduate course in viscous flow. An introduction to boundary-layer theory, thermodynamics and heat transfer at the undergraduate level are assumed to have been completed. Topics include the fundamental equation of continuum fluid mechanics, the concept of asymptotic methods and low and high Reynolds number flows, laminar boundary layers, generalized similarity methods, two- and three-dimensional flows, steady and unsteady flows and an introduction to hydrodynamic stability. The material is covered in the context of providing a logical basis as an introduction to a further course in turbulent flows.

ME 413 Numerical Methods in Mechanical Engineering 3 Credits
ME 415 Flow-Induced Vibrations 3 Credits

ME 420 Advanced Thermodynamics 3 Credits

ME 421 Topics in Thermodynamics 3 Credits
Emphasis on theoretical and experimental treatment of combustion processes including dissociation, flame temperature calculations, diffusion flames, stability and propagation; related problems in compressible flow involving one-dimensional, oblique shock waves and detonation waves. Methods of measurement and instrumentation.

ME 423 Heat and Mass Transfer 3 Credits
This course is a first graduate course in the basic concepts of heat and mass transfer, providing a broad coverage of key areas in diffusion, conduction, convection, heat and mass transfer, and radiation. Topics covered include: the conservation equations, steady and transient diffusion and conduction, periodic diffusion, melting and solidification problems, numerical methods, turbulent convection, transpiration and film cooling, heat transfer with phase change, heat exchanges, radiation, mixed mode heat and mass transfer.

ME 424 Unsteady and Turbulent Flow 3 Credits
Stability of laminar flow; transition to turbulence. Navier-Stokes equations with turbulence. Bounded turbulent shear flows; free shear flows; statistical description of turbulence.

ME 426 Radiative and Conductive Heat Transfer 3 Credits
Principles of radiative transfer; thermal-radiative properties of diffuse and specular surfaces; radiative exchange between bodies; radiative transport through absorbing, emitting and scattering media. Advanced topics in steady-state and transient conduction; analytical and numerical solutions; problems of combined conductive and radiative heat transfer.

ME 428 Boundary Layers and Convective Heat Transfer 3 Credits
Navier-Stokes and energy equations, laminar boundary layer theory, analysis of friction drag, transfer and separation. Transition from laminar to turbulent flow. Turbulent boundary layer theory. Prandtl mixing length, turbulent friction drag, and heat transfer. Integral methods. Flow in ducts, wakes and jets. Natural convection heat transfer.

ME 430 Advanced Fluid Mechanics 3 Credits
This course is a first graduate course in incompressible fluid mechanics, providing a broad coverage of key areas of viscous and inviscid fluid mechanics. Topics covered include: Flow kinematics, differential equations of motion, viscous and inviscid solutions, vorticity dynamics and circulation, vorticity equation, circulation theorems, potential flow behavior, irrotational and rotational flows, simple boundary layer flows and solutions, and real fluid flows and consequences.

ME 431 Advanced Gas Dynamics 3 Credits

ME 433 (CHE 433, ECE 433) State Space Control 3 Credits
This course will cover the following topics in control theory: State-space representation of linear systems, linearity, time-variability and linearity properties of systems, review of some of the fundamental concepts in linear algebra, impulse response and transfer functions, solutions to LTV systems, solutions to LTI systems and Jordan form, Lyapunov stability, input-output stability, an introduction to optimal control theory, controllable and reachable subspaces, controllable systems, controllable decompositions, stabilizability, observability, output feedback, minimal realizations, Linear Quadratic Regulator (LQR), the Algebraic Riccati Equation (ARE), frequency domain properties of LQR controller. Several examples will be given from mechanical, electrical and chemical engineering applications.

ME 434 (CHE 434, ECE 434) Multivariable Process Control 3 Credits
A state-of-the-art review of multivariable methods of interest to process control applications. Design techniques examined include loop interaction analysis, frequency domain methods (Inverse Nyquist Array, Characteristic Loci and Singular Value Decomposition) feed forward control, internal model control and dynamic matrix control. Special attention is placed on the interaction of process design and process control. Most of the above methods are used to compare the relative performance of intensive and extensive variable control structures.

Prerequisites: CHE 433 or ME 433 or ECE 433

ME 436 (CHE 436, ECE 436) Systems Identification 3 Credits
The determination of model parameters from time-history and frequency response data by graphical, deterministic and stochastic methods. Examples and exercises taken from process industries, communications and aerospace testing. Regression, quasilinearization and invariant-imbedding techniques for nonlinear system parameter identification included.

ME 437 (CHE 437, ECE 437) Stochastic Control 3 Credits

Prerequisites: CHE 433 or ME 433 or ECE 433

ME 444 Experimental Stress Analysis in Design 3 Credits
Fundamental concepts of strain measurements and application of strain gages and strain gage circuits. Two-and three-dimensional photoelasticity, stress separation techniques, birefringent coatings, moiré methods, caustics. Use of image analysis in data acquisition and interpretation. Selected laboratory experiments.

ME 446 Mechanical Reliability 3 Credits

ME 450 Special Topics 3 Credits
An intensive study of some field of mechanical engineering not covered in more general courses.

ME 452 Mathematical Methods In Engineering I 3 Credits
Analytical techniques relevant to the engineering sciences are described. Vector spaces; eigenvalues; eigenvectors. Linear ordinary differential equations; diagonalizable and non-diagonalizable systems. Inhomogeneous linear systems; variation of parameters. Non-linear systems; stability; phase plane. Series solutions of linear ordinary differential equations; special functions. Laplace and Fourier transforms; application to partial differential equations and integral equations. Sturm-Liouville theory. Finite Fourier transforms; planar, cylindrical, and spherical geometries.

ME 453 Mathematical Methods In Engineering II 3 Credits

ME 458 Modeling of Dynamic Systems 3 Credits
Modeling of complex linear and nonlinear energetic dynamic engineering systems. Emphasis on subdivision into multiplex elements and representation by bondgraph language using direct, energetic, and experimental methods. Field lumping. Analytical and graphical reductions. Simulation and other numerical methods. Examples including mechanisms, electromechanical transducers, electric and fluid circuits, and thermal systems.
ME 460 Engineering Project 1-6 Credits
Project work on some aspect of mechanical engineering in an area of student and faculty interest. Selection and direction of the project could involve interaction with local communities or industries. Consent of department required.
Repeat Status: Course may be repeated.

ME 461 Integrated Product Development (IPD) Projects-1 2 Credits
Technical and economic feasibility study of new products. Selection and content of the project is determined by the faculty project advisor in consultation with the student, progress and final reports, oral and posters presentations. Consent of the program director and faculty project advisor required.
Prerequisites: TE 401 or ME 401

ME 462 IPD: Manufacturing 3 Credits
Industry sponsored Integrated Product Development Project (IPD) projects. The student works with an industry sponsor to create detailed design specifications, fabricate and test a prototype new product and plan for production. Selection and content of the project is determined by the faculty project advisor in consultation with the industry sponsor. Deliverables include progress and final reports, oral presentations, posters and a prototype. Consent of the department chair and faculty project advisor required.

ME 464 Computer-Aided Geometric Modeling 3 Credits
Representation schemes for geometric modeling, computational geometry for curve and surface design, finite-element meshing and NC tool path generation, interfacing different CAD/CAM databases, interactive computer graphics programming.

ME 466 Fundamentals of Acoustics 3 Credits

ME 468 Advanced Energy Efficiency Practicum 3 Credits
Critical assessments of energy management systems. Establishment of framework for industrial facilities to manage energy systems. Fundamentals of best practices for energy efficiencies associated with industrial energy savings. Progress and final reports required. Engineering graduate students only. Consent of instructor required.

ME 485 Polymer Product Manufacturing 3 Credits
An exploration of the science underlying polymer processes such as injection molding through a combination of theory development, practical analysis, and utilization of commercial software. Polymer chemistry and structure, material rheological behavior, processing kinetics, molecular orientation development, process simulation software development, manufacturing defects, manufacturing window establishment, manufacturing process design, manufacturing process optimization. This course is a version of ME 385 for graduate students, with research projects and advanced assignments. Closed to students who have taken ME 385. Must have graduate level standing in engineering or science.

ME 490 Thesis 1-6 Credits
Repeat Status: Course may be repeated.

ME 499 Dissertation 1-15 Credits
Repeat Status: Course may be repeated.

Mechanics Courses

MECH 002 Elementary Engineering Mechanics 3 Credits
Static equilibrium of particles and rigid bodies. Elementary analysis of simple truss and frame structures, internal forces, stress, and strain. Credit will not be given for both MECH 002 and MECH 003.
Prerequisites: (MATH 022 or MATH 052 or MATH 032) and (PHY 010 or PHY 011)
Can be taken Concurrently: MATH 022, MATH 052, MATH 032

MECH 003 Fundamentals of Engineering Mechanics 3 Credits
Static equilibrium of particles and rigid bodies. Analysis of simple truss and frame structures, internal forces, stress, strain, and Hooke’s Law, torsion of circular shafts; pure bending of beams. Is intended as a prerequisite for MECH 012. Credit not given for both MECH 002 and MECH 003.
Prerequisites: (MATH 022 or MATH 032) and PHY 011
Can be taken Concurrently: MATH 022, MATH 032

MECH 012 Strength of Materials 3 Credits
Prerequisites: MECH 003 and (MATH 023 or MATH 033)
Can be taken Concurrently: MATH 023, MATH 033

MECH 050 Supplemental Topics in Mechanics 1-2 Credits
Completion of material for MECH courses transferred from other institutions. Student will be scheduled for that part of MECH course that is required for completion of missing material. Subject matter and credit hours to be determined by department chair for each student.

MECH 102 Dynamics 3 Credits
Particle dynamics, work-energy, impulse-momentum, impact, systems of particles; kinematics of rigid bodies, kinetics of rigid bodies in plane motion, energy, momentum, eccentric impact.
Prerequisites: (MECH 002 or MECH 003) and (MATH 023 or MATH 033)
Can be taken Concurrently: MATH 023, MATH 033

MECH 103 Principles of Mechanics 4 Credits
Composition and resolution of forces; equivalent force systems; equilibrium of particles and rigid bodies; friction. Kinematics and kinetics of particles and rigid bodies; relative motion; work and energy; impulse and momentum.
Prerequisites: (MATH 023 or MATH 033) and (PHY 010 or PHY 011)

MECH 300 Apprentice Teaching 3 Credits

MECH 302 Advanced Dynamics 3 Credits
Fundamental dynamic theorems and their application to the study of the motion of particles and rigid bodies, with particular emphasis on three-dimensional motion. Use of generalized coordinates; Lagrange’s equations and their applications.
Prerequisites: MATH 205 and (MECH 102 or MECH 103)

MECH 305 Advanced Mechanics of Materials 3 Credits
Strength, stiffness, and stability of mechanical components and structures. Fundamental principles of stress analysis: three-dimensional stress and strain transformations, two-dimensional elasticity, contact stresses, stress concentrations, energy and variational methods. Stresses and deformations for rotating shafts, thermal stresses in thick-walled cylinders, curved beams, torsion of prismatic bars, and bending of plates. Projects relate analysis to engineering design.
Prerequisites: MECH 012 and MATH 205

MECH 307 Mechanics of Continua 3 Credits
Fundamental principles of the mechanics of deformable bodies. Study of stress, velocity and acceleration fields. Compatibility equations, conservation laws. Applications to two-dimensional problems in finite elasticity, plasticity, and viscous flows.
Prerequisites: MECH 305

MECH 312 Finite Element Analysis 3 Credits
Basic concepts of analyzing general media (solids, fluids, heat transfer, etc.) with complicated boundaries. Emphasis on mechanical elements and structures. Element stiffness matrices by minimum potential energy. Isoparametric elements. Commercial software packages (ABAQUS, NISA) are used. In addition, students develop and use their own finite element codes. Applications to design.
Prerequisites: MECH 012

MECH 313 Fracture Mechanics 3 Credits
Fracture mechanics as a foundation for design against or facilitation of fracture. Fracture behavior of solids; fracture criteria; stress analysis of cracks; subcritical crack growth, including chemical and thermal effects; fracture design and control, and life prediction methodologies.
Prerequisites: MECH 012 and MATH 205
MECH 326 Aerodynamics 3 Credits
Application of fluid dynamics to flows past lifting surfaces. Normal force calculations in inviscid flows. Use of conformal mappings in two dimensional airfoil theory. Kutta condition at a trailing edge; physical basis. Viscous boundary layers. Thin airfoil theory. Section design; pressure profiles and separation. Lifting line theory. Compressible subsonic flows; Prandtl-Glauert Rule. Airfoil performance at supersonic speeds.
Prerequisites: ME 231

MECH 328 Fundamentals of Aircraft Design 3 Credits
Review of aerodynamics; Weight and balance, stability, loads; Basics of propellers; Power and performance; International Standard Atmosphere; Introduction to aerospace composites; Introduction to FAA regulations.
Prerequisites: MECH 012

MECH 350 Special Topics 3 Credits
A study of some field of engineering mechanics not covered elsewhere. Consent of department required.

MECH 404 Mechanics & Behavior of Structural Members 3 Credits

MECH 406 Fundamentals of Solid Mechanics 3 Credits
An introductory graduate course in the mechanics of solids. Topics to be addressed include: curvi-linear tensor analysis, analysis of strain and nonlinear kinematics, stress, work conjugate stress-strain measures, conservation laws and energy theorems, variational calculus, isotropic and anisotropic linear elasticity, boundary value problems, beam and plate theories.

MECH 408 Introduction To Elasticity 3 Credits
This course is a first graduate course in solid mechanics. It addresses: kinematics and statics of deformable elastic solids; compatibility, equilibrium and constitutive equations; problems in plane elasticity and torsion; energy principles, approximate methods and applications.

MECH 410 Theory of Elasticity II 3 Credits
Advanced topics in the theory of elasticity. The subject matter may vary from year to year and may include, theory of potential functions, linear thermoelasticity, dynamics of deformable media, integral transforms and complex-variable methods in classical elasticity. Problems of boundary layer type in elasticity; current developments on the microstructure theory of elasticity.

MECH 411 Continuum Mechanics 3 Credits
An introduction to the continuum theories of the mechanics of solids and fluids. This includes a discussion of the mechanical and thermodynamical bases of the subject, as well as the use of invariance principles in formulating constitutive equations. Applications of the theories to specific problems are given.

MECH 413 Fracture Mechanics 3 Credits
Elementary and advanced fracture mechanics concepts; analytical modeling; fracture toughness concept; fracture toughness testing; calculation of stress intensity factors; elastic-plastic analysis; prediction of crack trajectory; fatigue crack growth and environmental effects; computational methods in fracture mechanics; nonlinear fracture mechanics; fracture of composite structures; application of fracture mechanics to design.

MECH 415 Stability of Elastic Structures 3 Credits

MECH 418 Finite Element Methods 3 Credits
Finite element approximations to the solution of differential equations of engineering interest. Linear and nonlinear examples from heat transfer, solid mechanics, and fluid mechanics are used to illustrate applications of the method. The course emphasizes the development of computer programs to carry out the required calculations. Must have knowledge of a high-level programming language.

MECH 419 (CHE 419) Asymptotic Methods in the Engineering Sciences 3 Credits

MECH 424 Unsteady Fluid Flows 3 Credits
Gas dynamics, finite amplitude disturbances in perfect and real gases; channel flows; three-dimensional acoustics; theories of the sonic boom. Motions in fluids with a free surface; basic hydrodynamics, small amplitude waves on deep water; ship waves; dispersive waves; shallow water gravity waves and atmospheric waves. Hemodynamics; pulsatile blood flow at high and low Reynolds number. Models of the interaction of flow with artery walls.

MECH 425 Analytical Methods in Dynamics and Vibrations 3 Credits
This course will mainly cover the following topics: coordinate systems, conservations laws, inertial frames, systems of particles, DAE sets, variable-mass systems, transport equation, review of some of the basic concepts from variational calculus, D’Alembert’s principle, Hamilton's principle, Lagrange multipliers, generalized momenta, 3D rigid-body motion, inertia matrices, Euler angles, inertial and elastic coupling, discrete eigenvalue problem, linearization of nonlinear systems, chaotic systems, Hamilton’s principle for continuous systems, Torsion, Sturm-Liouville equations, Rayleigh’s quotient, finite-element eigen-problems, interpolating functions, combined-effect vibrations, and some other related topics.

MECH 432 Inelastic Behavior Of Materials 3 Credits

MECH 445 Nondeterministic Models in Engineering 3 Credits
Application of probability and stochastic processes to engineering problems for a variety of applications. Modeling and analysis of common nondeterministic processes. Topics are selected from the following: linear and nonlinear models for random systems; random functions; simulation; random loads and vibrations; Kalman filtering, identification, estimation, and prediction; stochastic fracture and fatigue; probabilistic design of engineering systems; and spatial point processes. Must have advanced calculus and some exposure to probability and statistics.

MECH 450 Special Problems 3 Credits
An intensive study of some field of applied mechanics not covered in more general courses. Repeat Status: Course may be repeated.

MECH 454 Mechanics and Design of Composites 3 Credits

MECH 490 Thesis 1-6 Credits
MECH 499 Dissertation 1-15 Credits
Army ROTC program provides a means for students to qualify for a commission as an officer in the Active Army, Army Reserve, or Army National Guard.

**OVERVIEW**

The objectives of the military science program are to develop leadership and management ability in each student; to provide a basic understanding of the Army’s history, philosophy, organization, responsibilities, and role in American society; and to develop fundamental professional knowledge and skills associated with officership. These objectives are achieved through classroom instruction, leadership laboratories, realistic training scenarios, exposure to Army doctrine, professional development, leadership simulations, and individual assessment and counseling. Army ROTC offers a four-year program and a two-year program. The four-year program consists of a two-year basic course and a two-year advanced course. The two-year program consists of the two-year advanced course offered to students with previous military experience, and those who have successfully completed the four-week ROTC Cadet Initial Training. Basic course students incur no obligation for service in the Army as a result of taking these courses.

**Basic Course**

The basic course, normally taken in the freshman and sophomore years, provides training and instruction in leadership, public speaking, and basic military subjects, such as the Army’s role and organizational structure, history and philosophy of the Army, basic tactics, land navigation, first aid, group dynamics, and leadership traits and characteristics. Basic course students incur no military obligation and is only available to freshman and sophomore students.

**Advanced Course**

The advanced course is normally taken in the junior and senior years. The instruction includes management, military skills, advanced leadership and tactics, logistics, administration, military law, ethics, and professionalism, and includes attendance at the ROTC Cadet Leadership Course (CLC). Students receive $450 per month subsistence pay during the junior year and $500 per month in their senior year.

To enroll in the advanced course, an applicant must complete either the basic course or the four-week Cadet Initial Training (CIET); or have received basic course credit for previous military experience.

Note: The Advanced course (300 and 400 level) is a requirement for Scholarship and contracted cadets only and is not offered to participating students.

**Uniforms and Equipment**

Uniforms are provided to contracted and scholarship cadets only. In the event of lost equipment or uniforms, students will be charged for those items not returned upon leaving the program.

**Transfers**

Qualified students transferring from another institution may enter the ROTC program at the appropriate level and year, provided they have received the necessary credits, the recommendation of their former professor of military science (if applicable), and the approval of Cadet Command and the university. Please contact the ROTC office for details.

**Obligation after Graduation**

Upon graduation, a student will receive a commission as a Second Lieutenant in either the Active Army, Army Reserve, or National Guard. If offered active duty, scholarship students serve four years of active duty and four years of inactive ready reserve. If offered reserve duty, students normally serve eight years in a Reserve or National Guard unit.

**Graduate Studies**

ROTC graduates may request to delay their active service to pursue a full-time course of instruction leading to an advanced degree. The only four major areas of concentration are medical school, law school, veterinary school and seminary. Delay does not lengthen the active service obligation unless the degree is obtained at government expense.

**Course Credit**

Students in the College of Arts and Sciences and the College of Business and Economics may substitute military science advanced credits for six hours of electives. In the College of Engineering and Applied Science, six credits of advanced ROTC work are permissible within the normal program of each student, irrespective of curriculum. For curricula that include more than six hours of personal electives in the junior and senior years, inclusion of the more than six hours of ROTC credit with normal programs can be effected only with the approval of academic advisers. All military science credits, including those in the basic course, apply toward the student’s overall cumulative grade point average.

**CAREER OPPORTUNITIES**

Individuals are commissioned as officers in the United States Army after completion of the ROTC program including the Cadet Leadership Course (CLC), and the completion of their bachelor’s degree requirements. They then qualify in one of seventeen branches (specialties) such as the Corps of Engineers, Infantry, Armor, Aviation, Field Artillery, Air Defense Artillery, Signal Corps, Cyber Corps, Military Intelligence, Chemical Corps, Ordnance Corps, Finance, Transportation, Military Police, Adjutant General, Quartermaster, Medical Service Corps, or Nursing. Officers work as leaders/managers, specialists, or combinations of the two depending on the assignment.

**PROGRAMS AND OPPORTUNITIES**

**ROTC Scholarship Program**

This program is designed to offer financial assistance to outstanding young men and women entering the ROTC program who are interested in an Army career. Scholarships provide full annual tuition, a textbook allowance, and common fees; in addition to pay up to $500 per month for the period the scholarship is in effect. Three-year and two-year scholarships may be available to outstanding cadets who are currently enrolled in the ROTC program and are completing their freshman or sophomore year of college. This program is also open to all qualified students who are not currently enrolled in Army ROTC.

Four-year scholarships are open to all students entering ROTC as freshmen. Applications for scholarship must be made to Headquarters, U.S. Army Cadet Command, Fort Knox, KY by July 15th prior to the high school senior year for early selection, but no later than November 15th for normal application. You may apply on line at www.goarmy.com (http://www.goarmy.com) and follow the appropriate links. Application booklets are also available from most high school guidance offices, or may be obtained from the military science department.

**Two-Year Program**

Students who want to enroll in ROTC after their sophomore year may apply. Applicants must successfully complete a four-week Cadet Initial Training (CIET) and have two years of undergraduate or graduate studies remaining. The student is paid for the four-week encampment and receives transportation costs to and from the camp. Additional scholarships may be available at this camp.

**Physical Facilities**

Army ROTC uses areas on and adjacent to the university campus to conduct field training. These locations are excellent for most outdoor activities such as orienteering, patrolling, and survival training. Fort Indiantown Gap Military Reservation, located east of Harrisburg, Pa., and Fort Dix, NJ, located east of Philadelphia, Pa., are used for various weekend field exercises which allow cadets to apply the classroom leadership and Army doctrine in a training environment.

**Off-campus U.S. Army Training Schools**

Cadets may be selected to attend the following U.S. Army Schools: Airborne School (Fort Benning, Georgia), Air Assault School (Fort Campbell, Kentucky), Mountain Warfare School (Ethan Allen Training Center, Vermont), and Northern Warfare School (Fort Greely, Alaska) Combat Diver Qualification Course (Key West, Florida), Sapper Leader Course ( Ft. Leonardwood, MO). This off-campus program is fully funded by the U.S. Army. Many other installations throughout the world may be visited through the Cadet Troop Leader Training program. Nursing students may choose to attend the Nurse Summer Training Program at Army hospitals located throughout the United States.

**Minor in Military Science**

A minor in military science is available in the College of Arts and Sciences. A minor in military science consists of a minimum of 28 credit hours beyond the basic Military Science course and is designed to provide the student with an academic foundation necessary to support continued intellectual growth and stimulate future inquiry in the realm.
of civil military affairs and military science. Credit hours required are distributed as follows:

**Military Science**
- MIL 101 Adaptive Team Leadership I 3
- MIL 102 Adaptive Team Leadership II 3
- MIL 113 Developing Adaptive Leaders 3
- MIL 114 Leadership in a Complex World 3
- HIST 110 American Military History 4

**International Relations**
Select one course 3-4

**Written Communications**
Select one course from one of the following categories: 3
- Creative Writing
- Scientific Writing
- Writing for Mass Communications
- English Composition

**Human Behavior**
Select one course from one of the following categories: 3
- General Psychology
- Sociology
- Anthropology
- Ethics

**Computer Literacy**
Select one course 3

**Total Credits** 28-29

**COMMISSIONING REQUIREMENTS**
Individuals must complete either the two- or four-year programs, attend CLC, receive a college degree, have a cumulative GPA of 2.0, and complete all professional military education requirements to become commissioned officers in the United States Army.

**COURSE DESCRIPTIONS**
Leadership Laboratory is conducted for all students once a week for 60 to 90 minutes. The Leadership Laboratory provides a forum for cadets to exercise their leadership skills amongst their peers.

Instruction at several levels on a variety of subjects with military application provides the context within which students are furnished opportunities to both teach and lead in a group setting. Responsibility is expanded as the student progresses through the program. In the senior year, the students assume the responsibility for the planning, preparation and conduct of the laboratory. Leadership Laboratory is mandatory for all students enrolled in military science courses.

**CADET LEADERSHIP COURSE**
This is a four-week training program normally conducted at Fort Knox, KY. Prerequisites are:
1. The completion of the basic 100 and 200 level military science courses or the equivalent which is the completion of the Cadet Initial Entry Training (CIET).
2. Scholarship/contracted cadets must have completed all level courses up to and including the 300 level military science courses.

**Courses**
- MIL 015 Foundations Of Officership 0.1 Credits
  The American Army as an institution, its roots, history, customs and traditions and philosophy of leadership. Emphasis on development and role of a professional officer corps. Includes leadership laboratory.
- MIL 016 Basic Leadership 1 Credit
  Role of individual and leader within the group, leadership skills and characteristics. Emphasis on problem solving and application. Includes laboratory and FTX.
- MIL 023 Individual Leadership Studies 0-2 Credits
  Maps as tools in basic terrain analysis and as navigational aids and introduction to small unit tactics. Emphasis on application and field exercises at individual and small group levels. Includes leadership laboratory and FTX.
- MIL 024 Leadership and Teamwork 2 Credits
  Contemporary theories, traits and principles and small unit tactics development. Leadership philosophies, communications, leader-follower relationships, and leadership problem-solving. Leadership simulations. Includes leadership laboratory and FTX.
- MIL 101 Adaptive Team Leadership 10.3 Credits
  Essential junior officer skills: advanced land navigation, principles of war, small unit tactical planning, tactics and techniques of the soldier, team leading techniques, oral communications and trainer skills. Emphasizes application and field experience. Includes leadership laboratory and FTX. Consent of department chair required.
- MIL 102 Adaptive Team Leadership II 3 Credits
  Critical examination of leadership qualities, traits and principles with emphasis on military environment. Self, peer, and instructor leadership evaluation. Advanced military skills reinforced. Includes leadership laboratory and FTX. Consent of department chair required.
- MIL 113 Developing Adaptive Leaders 0.3 Credits
  Role, authority and responsibility of military commanders and staff in personnel, logistics and training management. Staff procedures, problem solving, training methods and oral and written communications skills used in military organizations. Includes leadership laboratory and FTX. Consent of department chair required.
- MIL 114 Leadership in a Complex World 3 Credits
  Development of the Profession of Arms, its fundamental values and institutions. Ethical responsibilities of military professionals in contemporary American society. Just war theory, international law of war, and American military law. Also covered are current topics to assist cadets in making the transition to the officer corps and service on active duty or in the reserve forces. Includes leadership laboratory and FTX. Consent of department chair required.
- MIL 118 Special Topics for Army Officer 1 Credit
- MIL 300 Apprentice Teaching 3 Credits

**Modern Languages and Literatures**
Knowledge of other languages opens the door to other cultures, traditions, and perspectives on the world, and promotes deeper insight into one’s own language and culture. Proficiency in modern languages is indispensable in a broad range of professions such as journalism, government, international affairs, law, the armed forces, and business. A bachelor of arts degree with a major in languages provides excellent preparation for professional careers in law, business, and the media. Language study is required for graduate study in many disciplines, as well as for research in science and technology. International experience is personally enriching and enhances career prospects.

**Languages offered**
Lehigh offers Arabic, Mandarin Chinese, French, German, Hebrew, Japanese, Russian, and Spanish. Courses include oral, reading, and writing skills, literature, film, culture, civilization, and professional areas such as business and health careers. A number of literature and culture courses are given in English, but most offerings stress classroom use of the target language.

**Language requirements**
The Global Studies major, the Joint IR/MLL major, as well as the honors major in international relations require language study. The college offers a program in the College of Arts and Sciences, the major in Asian Studies, the minors in Latin American Studies, and Asian Studies require language study. Students taking the B.A. in international relations are expected to study a language. Some doctoral programs also require competence in a language other than English, usually assessed by the Department of Modern Languages and Literatures.

**Advising**
Because of the sequential nature of language study and the variety of specializations available, the department pays special attention to student advising. Students whose experience, skills, and placement scores (Advanced Placement or College Board Achievement Test) do not give them a clear indication of their level of placement should consult with their instructor or the department chair.
Major Programs

The department offers major programs in Chinese, French and Francophone Studies, German, Spanish and Hispanic Studies, and Joint IR/MLL. The candidate for the major is expected to demonstrate adequate written and oral command of the language, as well as knowledge of its literature and culture. A period of study abroad is strongly recommended.

Double majors and Arts-Engineering majors including a language component are well-received by employers. Studies in the two areas are carefully coordinated by major advisers.

Major in Chinese

The major in Chinese will require 36 credits: a minimum of 24 credits in courses taught in Chinese, including 8 credits at the 200 or 300 level of Chinese language and literature (marked CHIN). Courses offered in English in MLL on Chinese literature and history may be included in the major and a maximum of two courses outside of MLL in the Asian Studies Program that are concerned specifically with China, such as those available in International Relations, Political Science, Religion, Sociology, etc., by approval of the major adviser. Majors in Chinese are strongly encouraged to study abroad in a Chinese speaking country.

Major in German

The major in German requires 32 credits in German language, literature, and culture beyond German 12. This includes all German courses that are 100 level and above, and emphasis should be on 200 and 300 level courses. One of these courses may be taken in English when the class is taught by a German faculty member and when the writing assignments are completed in German. For specific course requirements, see the language major adviser.

Majors in German are strongly encouraged to participate in a study abroad program in a German speaking country for the equivalent of one semester or more. A maximum of 16 credits of study abroad (24 for the honors major) may be transferred toward the major, with a maximum of 8 credits for summer, 12 credits for a semester, and 16 credits for a year of study abroad (24 for the honors major). In order to have credits from foreign institutions count toward their major, students must obtain approval from the German major adviser prior to their departure.

Requirements for the Honors Major in German (40 credits)

Requirements are the same as for the regular major in German, plus 8 additional hours of advanced literature (honors thesis of a comprehensive type) and maintenance of a 3.20 average in the major.

Major in French and Francophone Studies

Core Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>FREN 143</td>
<td>Advanced Written French</td>
<td>4</td>
</tr>
<tr>
<td>FREN 144</td>
<td>Advanced Oral French</td>
<td>4</td>
</tr>
<tr>
<td>One of the following</td>
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<td>3-4</td>
</tr>
</tbody>
</table>

Advanced course work

or four courses (200 or 300 level), with at least three courses at the 300 level. One of these courses may be taken in English when taught by a French faculty member.

Collateral requisites

from a list of approved courses taken in other programs and departments. These courses must be approved by the French major adviser.

Majors in French and Francophone Studies are strongly encouraged to participate in a study program in a French-speaking part of the world for the equivalent of one semester or more. Up to 12 credits for courses taken during one semester abroad (16 credits during one year) may count toward the major. In order to have credits from foreign institutions count toward their major, students must obtain approval from the French major adviser prior to their departure.

Requirements for the Departmental Honors Major (40 credits):

Requirements as for the major, plus 8 additional hours of advanced literature (honors thesis of a comprehensive type) and maintenance of a 3.20 average in the major.

Major in Spanish and Hispanic Studies

Core Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPAN 141</td>
<td>Advanced Spanish Grammar</td>
<td>4</td>
</tr>
<tr>
<td>SPAN 151</td>
<td>Cultural Evolution Spain</td>
<td>4</td>
</tr>
<tr>
<td>SPAN 152</td>
<td>Cultural Evolution of Latin America</td>
<td>4</td>
</tr>
</tbody>
</table>

Advanced course work

or three courses at the 300 level.

Electives

8

at the 100 or 200 level.

Collateral requisites

from a list of approved courses taken in other programs and departments. These courses must be approved by the Spanish major adviser.

Majors in Spanish and Hispanic Studies are strongly encouraged to participate in a study program in a Spanish-speaking country for the equivalent of one semester or more. Up to 12 credits for courses taken during one semester abroad (16 credits during one year) may count toward the major. In order to have credits from foreign institutions count toward their major, students must obtain approval from the Spanish major adviser prior to their departure.

Requirements for the Departmental Honors Major (40 credits):

Requirements as for the major, plus 8 additional hours of advanced literature (honors thesis of a comprehensive type) and maintenance of a 3.20 average in the major.

Joint International Relations/Modern Languages and Literatures Major

For more information please visit the joint IR/MLL Major. (p. 290)

Minor programs

The department offers minor programs in Chinese, French, German, International Film, Japanese, Russian, and Spanish, and coordinates these studies with a student’s major requirements in any college.

Requirements for the Minor

French, German, Spanish: Sixteen credit hours are required above Intermediate II; one or two courses at the 200 level, one or two courses at the 300 level.

Chinese, Japanese, Russian: A minimum of 16 credit hours.

See end of department section for International Film.

A maximum of 8 credits may be transferred for the minor.

Related programs

These are available in Asian Studies, Global Studies, Jewish Studies, Latin American Studies, and Women, Gender, and Sexuality Studies.
Students are urged to take elective courses on related subjects, either within or outside the department, as approved by their adviser.

**Preliminary Courses**

These may be replaced by other courses when a student qualifies for advanced standing.

- Elementary I (4) Intermediate I (4)
- Elementary II (4) Intermediate II (4)

**Advanced courses**

Except where otherwise noted, 200 or 300-level courses are open to students having completed eight credit hours beyond Intermediate II. Exceptions require the consent of the instructor.

**Language of instruction**

All courses are taught in the target language except MLL courses listed under "International Cultures and Literatures Taught in English." Students thereby become accustomed to considering the language as an active means of communication and not solely as an object of study.

**Language placement**

Students are normally placed in language courses on the basis of years of a language taken in high school, CEEB Achievement Test score, or the departmental equivalent (instructor's test, interview, or questionnaire). Students may change levels within a language during the first two weeks of class. Students who consider themselves capable of higher-level performance may apply to the instructor during the first two weeks of the semester for more advanced placement. They may also be allowed by the department chair to be admitted for credit to a lower-level language course after consultation with the instructor. Students who have had three years or more of a language in high school and drop to first-semester level will not receive credit for the course. No course under 100 level may be taken for credit once a higher course has been passed.

**Courses in English**

The department offers elective courses in English on literary, cultural, and social subjects listed under "International Culture and Literature Taught in English."

These courses may, in most cases, be taken to fulfill preliminary distribution requirements. One of these courses may be included in the major.

**Minor in International Film**

**Description**

The minor in International Film affords students the opportunity to examine a wide cross-section of world cinema. It is designed to provide a critical understanding of historical trends and current issues in film across various regions of the world. Covering national cinemas from Asia, Europe, and Latin America, course offerings will allow students to explore diverse approaches to film that are rooted in the history, culture, and society of different countries in each region.

The minor consists of 16 credits. All students must take a required core course (MLL 100), and the remaining courses are to be chosen from the list of electives below, in consultation with the minor advisor. (One course may be taken outside of the MLL department with the minor advisor's approval.)

**Core course**

- MLL 100 Introduction to International Film 4

**Elective courses**

- MLL/ASIA/WGSS/GCP 073 Film, Fiction, and Gender in Modern China 4
- FREN 322 Contemporary French Films 4
- GERM/GCP/MLL 231 New German Cinema 4
- SPAN 265 Spanish and Latin American Cinema 4

**Study Abroad and Travel Grants**

The department encourages students of languages to spend a summer, a semester, or a full year on an approved program of study abroad. Exchange agreements with partner institutions are continually being developed. The department offers a limited number of travel grants for study abroad to qualified students. Applications should be submitted by the first week of November for the spring and summer semesters and by the first week of April for summer and fall. Applications for Study Abroad in Asia are also reviewed by the Asian Studies faculty when funds are available. For credit, transfer students must consult in advance with their major adviser, language adviser, other appropriate departments, the Office of International Education, and when appropriate, the Office of Financial Aid.

Lehigh offers programs through the Lehigh in Shanghai Internship Program. The Lehigh Valley Association of Independent Colleges (LVAIC) offers programs in international locations for eight credits each. A faculty member acting as program director accompanies the students. Courses are taught at intermediate and advanced levels by qualified instructors from host institutions. Summer programs sponsored by the Lehigh-LVAIC Center for Jewish Studies include Hebrew in Israel. Credits are fully transferable under normal LVAIC cross-registration procedures. Interested students should consult with the Department of Modern Languages and Literatures, Williams Hall.

These courses are offered by Lehigh or under the Cooperation agreement with the Lehigh Valley Association of Independent Colleges. Summer or semester study abroad at approved programs may be incorporated into language majors and minors with the permission of the appropriate advisor to a maximum of 16 credits toward the major and eight credits toward the minor.

**INTERNATIONAL CULTURES AND LITERATURES TAUGHT IN ENGLISH**

These courses on international cultures and comparative topics carry no prerequisites; knowledge of the language is not required.

Language majors may count one MLL course taught in English for credit toward a major requirement. Interested students should consult their language major advisors. For course descriptions, see under each language area below.

**HEBREW**

The department offers courses both separately and in the context of the Jewish studies minor (p. 287).

Modern Hebrew is taught in the Department of Modern Languages and Literature. Biblical Hebrew is taught in the Department of Religion Studies.

**Arabic Courses**

**ARAB 001 Elementary Arabic I 4 Credits**

The general objective of this course is to familiarize students with the sounds and the letters of Arabic, along with basic communication skills. Students are required to use Arabic in class discussion. Attendance and class participation are necessary to achieve the above-stated goals. Upon completion of this course, students will be able to read, write, speak, and understand Arabic at the elementary level.

**Attribute/Distribution: HU**

**ARAB 002 Elementary Arabic II 4 Credits**

Continuation of ARAB 001. Emphasis on communicative ability in oral and writing skills and use of the language. Students develop ability to communicate with native speakers on a variety of everyday topics; introductions, descriptions of people and things, disseminating information, stating preferences, describing locations, etc. Students will be able to read, write, speak, and understand authentic materials on familiar topics, as well as recognize and understand various grammatical rules and their application in context, and expand their cultural awareness.

**Attribute/Distribution: HU**

**ARAB 011 Intermediate Arabic I 4 Credits**

Development of communication skills and cultural awareness through reading materials and viewing films. Grammar is presented in context. Emphasis on communicative ability in oral and writing skills, and on the use and cultural aspects of the language through authentic materials. Students learn how to communicate effectively and appropriately while satisfying their intellectual curiosity to learn about the civilization and culture, current as well as historical dimensions.

**Prerequisites: ARAB 002**

**Attribute/Distribution: HU**
ARAB 012 Intermediate Arabic II 4 Credits
Enhancement of communication skills, proficiency, competence, and use of the language. Students will enhance and develop their ability to understand the spoken word and to converse on a variety of topics; discuss, narrate, and read authentic materials that cover a variety of issues and topics; e.g., educational, cultural, and factual; write short paragraphs; recognize and use grammatical rules in context; and expand cultural awareness through class discussion and reading materials. Frequently taught in the target language to emphasize and reinforce classroom use. Students will be able to read, write, speak, and understand Arabic at the upper intermediate level.
Attribute/Distribution: HU

ARAB 099 Special Topics 1-4 Credits
Repeat Status: Course may be repeated.

ARAB 190 Special Topics I 1-4 Credits
Develop communication skills, emphasize and reinforce classroom use. Translate articles from newspapers, write short stories, and converse on a variety of topics. Directed study, reading, and writing. Periodic consultations and reports.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

ARAB 191 Special Topics II 1-4 Credits
Continuation of ARAB 190. Literary and linguistic topics not covered in regular classes.
Attribute/Distribution: HU

ARAB 231 Third Year Arabic I 4 Credits
Enhance fluency, particularly conversational Arabic. Emphasis on comprehension of written and spoken language. Dialogue, reading, and analysis of texts to enhance critical thinking, as well as promote mastery of the language. Immersion in overall increase in fluency. Advanced level geared towards command and comprehension of conversation and written texts, textbooks, and media (i.e., newspaper, magazine).
Attribute/Distribution: HU

ARAB 232 Third Year Arabic II 4 Credits
Continuation of Third Year Arabic I. Emphasis on comprehension of written and spoken language. Dialogue, reading, and analysis of texts to enhance critical thinking, as well as promote mastery of the language. Immersion in overall increase in fluency. Advanced level geared towards command and comprehension of conversation and written texts, textbooks, and media (i.e., newspaper, magazine).
Attribute/Distribution: HU

ARAB 300 Apprentice Teaching 1-4 Credits
Repeat Status: Course may be repeated.

ARAB 341 Fourth Year Arabic I 4 Credits
Enhance fluency, particularly conversational and written Arabic. Reading and analysis of texts to enhance critical thinking, and promote mastery of the language. Immersion and overall increase in fluency. Students will be expected to communicate with classmates and the instructor in Arabic and to make presentations in Arabic pertaining to current events. Increased use of Arabic during classroom instruction. Students expected to come prepared to present something that utilizes the language: poems, personal stories or experiences, current event articles etc.
Attribute/Distribution: HU

ARAB 342 Fourth Year Arabic II 4 Credits
Continuation of Fourth Year Arabic I. Enhance fluency, particularly conversational and written Arabic. Emphasis on reading and analysis of texts to enhance critical thinking, promote mastery of the language. Immersion and overall increase in fluency. Students will be expected to communicate with classmates and the instructor in Arabic and to make presentations in Arabic pertaining to current events. Increased use of Arabic during classroom instruction. Students expected to come prepared to present something that utilizes the language: poems, personal stories or experiences, current event articles etc.
Attribute/Distribution: HU

Chinese Courses
CHIN 001 Beginning Chinese Reading and Writing I 2 Credits
Introduction to the Chinese writing system and beginning character acquisition; reading practice with pinyin transcription system. (Fall) Non-heritage speakers are strongly encouraged to take the Spoken of the same level during the same semester as this Reading and Writing course.
Attribute/Distribution: HU

CHIN 002 Beginning Chinese Reading and Writing II 2 Credits
Continuation of CHIN 001: continued character acquisition, reading practice in pinyin and simple character texts. Non-heritage speakers are strongly encouraged to take the Spoken course of the same level during the same semester as this Reading and Writing course.
Attribute/Distribution: HU

CHIN 003 Beginning Spoken Chinese I 2 Credits
Introduction to Mandarin Chinese pronunciation, the pinyin transcription system, and modern colloquial Chinese; emphasis on oral proficiency. Not open to native speakers. Students are strongly encouraged to take Reading and Writing course of the same level during the same semester as this Spoken course.
Attribute/Distribution: HU

CHIN 004 Beginning Spoken Chinese II 2 Credits
Continuation of CHIN 003: further practice with text based dialogues in modern colloquial Chinese; emphasis on oral proficiency. Not open to native speakers. Students are strongly encouraged to take Reading and Writing course of the same level during the same semester as this Spoken course.
Attribute/Distribution: HU

CHIN 011 Intermediate Chinese Reading and Writing I 2 Credits
Continued focus on vocabulary/character acquisition and text-based reading and writing exercises using Chinese characters. Non-heritage speakers are strongly encouraged to take the Spoken course of the same level during the same semester as this Reading and Writing course.
Attribute/Distribution: HU

CHIN 012 Intermediate Chinese Reading and Writing II 2 Credits
Continuation of CHIN 011: vocabulary/character acquisition and text-based reading and writing exercises using Chinese characters. Non-heritage speakers are strongly encouraged to take the Spoken course of the same level during the same semester as this Reading and Writing course.
Attribute/Distribution: HU

CHIN 013 Intermediate Spoken Chinese I 2 Credits
Further development of communicative skills in Chinese using situational dialogues and class discussion; emphasis on oral proficiency. Not open to native speakers. Students are strongly encouraged to take Reading and Writing course of the same level during the same semester as this Spoken course.
Attribute/Distribution: HU

CHIN 014 Intermed Spoken Chinese II 2 Credits
Continuation of CHIN 013: further development of communicative skills in Chinese using situational dialogues and class discussion; emphasis on oral proficiency. Not open to native speakers. Students are strongly encouraged to take Reading and Writing course of the same level during the same semester as this Spoken course.
Attribute/Distribution: HU

CHIN 021 Survival Chinese 2 Credits
A brief introduction to the language and culture. Focus on speaking and listening skills. Lessons based on practical situations for living or traveling in China.
Attribute/Distribution: HU

CHIN 091 Chinese Language & Culture Abroad I 1-8 Credits
Introductory intensive study of conversation in the language of the country; reading, development of writing skills and selected aspects of the culture.
Attribute/Distribution: HU
CHIN 092 Chinese Language and Culture Abroad I (Part TWO) 3 Credits
Intensive study of conversation in Chinese, rapid review of the basic grammar, reading and analysis of basic interactive dialogues, development of writing skills, familiarity with select aspects of the culture.
Prerequisites: CHIN 021
Can be taken Concurrently: CHIN 021

CHIN 111 Advanced Chinese Reading & Writing I 2 Credits
Reading, translation, and writing practice using text-based exercises, short stories, essays, and other selected materials. Non-heritage speakers are strongly encouraged to take the Spoken course of the same level during the same semester as this Reading and Writing course.
Attribute/Distribution: HU

CHIN 112 Advanced Chinese Reading & Writing II 2 Credits
Continuation of CHIN 111: reading, translation, writing exercises using text-based exercises, short stories, essays, and other selected materials. Non-heritage speakers are strongly encouraged to take the Spoken course of the same level during the same semester as this Reading and Writing course.
Attribute/Distribution: HU

CHIN 113 Advanced Spoken Chinese I 2 Credits
Topical discussions and oral presentations in Chinese. Students are strongly encouraged to take Reading and Writing course of the same level during the same semester as this Spoken course.
Attribute/Distribution: HU

CHIN 114 Advanced Spoken Chinese II 2 Credits
Continuation of CHIN 113: topical discussions and oral presentations in Chinese. Students are strongly encouraged to take Reading and Writing course of the same level during the same semester as this Spoken course.
Attribute/Distribution: HU

CHIN 119 Writing Skills in Chinese 2 Credits
Students above the intermediate level of spoken and written Chinese work individually with the instructor on topics of their own choice.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

CHIN 122 Intermediate Business Chinese 2 Credits
Introduction to Chinese business environment and business terminology. Emphasis on reading comprehension and translation.
Attribute/Distribution: HU

CHIN 134 Chinese Short Stories 2 Credits
Supplementary reading designed for students at the intermediate level of Chinese. Focus on improved reading and speaking proficiency. Reading materials will strengthen understanding of both contemporary and historical Chinese culture.
Attribute/Distribution: HU

CHIN 191 Chinese Language & Culture Abroad II 1-8 Credits
Intensive study of conversation in the language of the country; rapid review of basic grammar, the reading and analysis of moderately difficult texts, development of rudimentary writing skills, supplemented study of selected aspects of contemporary civilization. Consent of department required. Must have proficiency examination in the target country.
Attribute/Distribution: HU

CHIN 251 Chinese Special Topics 1-4 Credits
Materials not covered in regular courses. Students help design the course.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

CHIN 252 Advanced Business Chinese 2 Credits
Prerequisites: CHIN 112 or CHIN 114
Attribute/Distribution: HU

CHIN 253 Chinese Fiction 2 Credits
Students read modern Chinese short stories or a novel. Emphasis on reading comprehension and translation.
Repeat Status: Course may be repeated.
Prerequisites: CHIN 112 or CHIN 114
Attribute/Distribution: HU

CHIN 254 Intensive Chinese Conversation 2 Credits
Conversational practice based on topical readings. For advanced speakers only.
Prerequisites: CHIN 112 or CHIN 114
Attribute/Distribution: HU

CHIN 255 Newspaper Readings In Chinese 2 Credits
Prerequisites: CHIN 112 or CHIN 114
Attribute/Distribution: HU

CHIN 291 Chinese Language & Culture Abroad III 1-8 Credits
Intensive practice of speaking and writing in the language of the country aimed at providing the student with extensive proficiency of expression and the ability to discriminate linguistic usage, idiomatic expressions and an introduction to stylistics. Reading and analysis of more difficult texts, supplemented by in-depth study of selected aspects of contemporary civilization. Consent of department required. Must have proficiency examination in the target country.
Attribute/Distribution: HU

CHIN 300 Apprentice Teaching 1-4 Credits
Repeat Status: Course may be repeated.

CHIN 371 Advanced Readings in Chinese 1-4 Credits
Directed study of an author, genre, or period not covered in regular courses. Can be combined with select Asian Studies courses to include relevant readings in English. Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

CHIN 384 Research in Chinese Language and Culture Abroad 1-8 Credits
For students with advanced language skills to do research or work abroad in Chinese (above the third year level). Independent Study.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

French Courses

FREN 001 Elementary French I 4 Credits
Multimedia approach to the study of French. Introduction to French conversation, grammar, and culture.
Attribute/Distribution: HU

FREN 002 Elementary French II 4 Credits
Continuation of FREN 001.
Attribute/Distribution: HU

FREN 011 Intermediate French I 4 Credits
Further acquisition of the fundamentals of French conversation, writing, and culture. Multimedia approach.
Attribute/Distribution: HU

FREN 012 Intermediate French II 0,4 Credits
Continuation of FREN 011.
Attribute/Distribution: HU

FREN 099 French Special Topics 1-6 Credits

FREN 133 (AAS 133, HIST 133, LAS 133, MLL 133, POLS 133) Lehigh in Martinique: Globalization and Local Identity 3-4 Credits
History, culture, and politics of the French Caribbean island of Martinique, from its position as a key site of the 18th century Atlantic World economy to becoming an official French department and outpost of the European Union. Interdisciplinary perspectives on the complex nature of social identity, historical memory and impact of globalization. No French is required. Offered during winter inter-term through Lehigh Study Abroad.

FREN 143 Advanced Written French 4 Credits
Intensive practice in written French and introduction to literary criticism.
Attribute/Distribution: HU
FREN 144 Advanced Oral French 4 Credits
Emphasis on comprehension and oral performance of the French language. Student acquires confidence in speaking French through discussions of current issues, articles, novels, movies, and other topics. Required for French majors.
Attribute/Distribution: HU

FREN 152 Introduction to Literary Analysis 4 Credits
Exposure to representative French and Francophone works from the Middle Ages to the Twenty-First Century offering various critical strategies needed to read and interpret a literary text.
Attribute/Distribution: HU

FREN 199 French Special Topics 1-6 Credits

FREN 237 Introduction to the Francophone World 4 Credits
Introduction to the Francophone world through a series of texts, films, articles, etc. from Francophone Europe, North Africa, sub-Saharan Africa, Canada, Vietnam, and the Caribbean. Students will become acquainted with Francophone cultures and literatures while developing their interpretative and writing skills. In French.

FREN 242 The Harem in French and Francophone Literature and Film 4 Credits
Explore representations of this forbidden and secret feminine space, the harem, starting with French theater from the 17th century all the way to 20th-21st century Francophone North African novels and film. We will attempt a comparative study between the French and Francophone traditions and will be looking at the harem as a visual as well as textual feminine space from which narratives emerge and the extent to which they constitute a counter-discourse that questions dominant power structures.
Attribute/Distribution: HU

FREN 251 Postcolonizing France: North African Immigration 4 Credits
Depictions of North African immigrants (legal or illegal) and French citizens of North African descent in postcolonial France in novels, film, and Rap music. Explore key concepts such as hospitality, minority ethnic settlement, multiculturalism, nationality and citizenship, racism, extreme-right politics, and anti-discrimination policy, and attempt to see how North African postcolonial identities are articulated in relation to perceptions of French national identity, republican values, universalism, etc.
Attribute/Distribution: HU

FREN 255 Introduction to the Francophone World 4 Credits
Introduction to the Francophone world through a series of texts, films, articles, etc. from Francophone Europe, North Africa, Sub-Saharan Africa, Canada, Vietnam, and the Caribbean. Students will become acquainted with Francophone cultures and literatures while developing their interpretative and writing skills. In French.

FREN 259 French Special Topics 1-6 Credits

FREN 272 French Culture of Business 4 Credits
A course on the fundamentals of business in France. We will learn about banking, marketing, advertising, the stock market, and many other aspects of business in France. We will learn about foreign ventures in France, such as Disney and McDonald's. We will learn how to open a bank account, apply for a job, and what life is like in a French company. Ideal for someone who wants to intern or work for an international company or a company with a French connection. Taught in French.

FREN 281 French Cultural Program 1-6 Credits
A program in a French-speaking country offering formal language courses and cultural opportunities.
Attribute/Distribution: HU

FREN 299 French Special Topics 1-6 Credits

FREN 300 Apprentice Teaching 1-4 Credits

FREN 311 French Classicism 4 Credits
French classical theater, novel, and criticism, with emphasis on Corneille, Racine, Molière, Pascal, Lafayette, Malherbe, and Boileau.
Attribute/Distribution: HU

FREN 312 (AAS 312) Modernity in the Maghreb 4 Credits
Emergence of the modern self through a comparative study of textual as well as visual representations of postcolonial subjects by male and female writers and film makers. Study of the way the sociopolitical context of countries such as Morocco, Algeria, and Tunisia informs the constitution of subjectivity within a multicultural and multilingual community. Issues such as patriarchy, nationalism, colonialism, postcolonialism, identity, gender, and Islam in North African literature and film from Franco-Arab traditions.
Attribute/Distribution: HU

FREN 313 The Age Of Enlightenment 4 Credits
The Philosophes and Encyclopédistes of the eighteenth century, with emphasis on Voltaire, Rousseau, Montesquieu, and Diderot.
Attribute/Distribution: HU

FREN 316 Nineteenth Century French Literature 4 Credits
Study of major nineteenth century novelists and poets.
Attribute/Distribution: HU

FREN 318 French Drama in the Twentieth Century 3 Credits
Contemporary French drama with an analysis of its origins and movements.
Attribute/Distribution: HU

FREN 320 Contemporary French Fiction 4 Credits
Reading and discussion of contemporary works of fiction (post1980). Study of how these works fit into the context of French literature and relate more specifically to major literary currents of the twentieth century.
Attribute/Distribution: HU

FREN 321 Twentieth-Century French Short Fiction 4 Credits
Examination, within the framework of short fiction, of the major literary currents that have made up twentieth-century literature. Works by Sartre, Camus, Robbe-Grillet, Le Clézio, Echenoz, Sallanave, Toussaint, Diebar, Ben Jelloun, and others.
Attribute/Distribution: HU

FREN 322 Contemporary French Films 4 Credits
French Films from the late 1950s to the present. Introduction to cinematographic language and exploration of the issues of gender, power, and madness. Films by Truffaut, J-L. Godard, C. Denis, A. Varda, J-J Beineix, E. Rohmer, and others.
Attribute/Distribution: HU

FREN 324 The Outsider In French Fiction 4 Credits
Focus on otherness/difference in French fiction from the eighteenth to the twentieth century. Reading and discussion of short stories and novels by Graffigny, Diderot, Maupassant, Gide, Camus, Duras, Beauvoir, Le Clézio and others.
Attribute/Distribution: HU

FREN 325 Illegal immigration in Francophone Literature and Film 4 Credits
This course examines representations of illegal immigrants in postcolonial francophone literature and film. We will be looking at visual and textual narratives from and about those who decided to leave their African homeland to seek a better future in Europe despite the very restrictive policies adopted by most of the European Union on illegal immigration. The course will explore issues of postcolonial identity, the notions of borders, displacement, exile, trauma and how they relate to the act of writing.
Attribute/Distribution: HU

FREN 327 (WGSS 327) Women Writing In French 4 Credits
Reading and discussion of works written by women in French. The emphasis is on 19thand 20thcentury writers, such as G. Sand, Colette S. de Beauvoir, M. Duras, and Andrée Chédid.
Attribute/Distribution: HU
GERM 001 Elementary German I 4 Credits
Fundamentals of German; reading and simple texts; simple conversation and composition; vocabulary building. Three class hours plus one laboratory or drill hour each week. No previous German required.
Attribute/Distribution: HU

GERM 002 Elementary German II 4 Credits
Continuation of GERM 1, including reading of more advanced texts. Three class hours plus one laboratory or drill hour each week.
Attribute/Distribution: HU

GERM 011 Intermediate German I 4 Credits
Review of grammar, composition, reading of intermediate texts, vocabulary building.
Attribute/Distribution: HU

GERM 012 Intermediate German II 4 Credits
Continuation of GERM 011.
Attribute/Distribution: HU

GERM 091 German Language & Culture I Abroad 1-8 Credits
Intensive study of conversation in the language of the country; reading, development of writing skills and selected aspects of the culture.
Attribute/Distribution: HU

GERM 163 German Civilization and Culture 4 Credits
Cultural, historical, and political evolution of Germany and German-speaking countries in Europe.
Attribute/Distribution: HU

GERM 167 German Conversation and Composition 4 Credits
Intensive practice in spoken and written German.
Attribute/Distribution: HU

GERM 169 Business German 4 Credits
German in business, the professions, international, and social relations. Letter writing, comprehension of technical texts, specialized vocabulary, and grammar review.
Attribute/Distribution: HU

GERM 181 German Cultural Program 1-8 Credits
Summer program abroad. Formal instruction in the language and the culture of a German-speaking country.
Attribute/Distribution: HU

GERM 191 German Language & Culture II Abroad 1-8 Credits
Intensive study of conversation in the language of the country; rapid review of basic grammar, the reading and analysis of moderately difficult texts, development of rudimentary writing skills, supplemented study of selected aspects of contemporary civilization. Consent of chair and proficiency examination in the target country is required.

GERM 211 German Drama 4 Credits
Drama as a literary genre; plays from various periods of German literature.
Attribute/Distribution: HU

GERM 218 (MLL 218) Goethe's "Faust" 4 Credits
Study of Goethe's play with an introduction to the Faust tradition and Faustian themes in modern literature.
Attribute/Distribution: HU

GERM 231 (MLL 231) New German Cinema 4 Credits
Viewing, discussion, and written analysis of selected German films.
Attribute/Distribution: HU

GERM 240 Contemporary Germany 4 Credits
Readings and conversations in German about topics including the social and natural sciences, technology, the environment, politics, daily life, and sports. Practice in spoken and written German.
Attribute/Distribution: HU

GERM 250 German Special Topics 1-4 Credits
Literary and linguistic topics not covered in regular courses.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

GERM 260 (MLL 260) Multicultural Germany 4 Credits
A look at Germany from the perspective of its “others”—the immigrants. Literary and cultural texts, and films on ethnic diversity and integration.
Attribute/Distribution: HU

GERM 267 Advanced German Conversation and Composition 4 Credits
A continuation of Germ 167. Practice of speaking and writing skills in German through readings of more complex texts.
Attribute/Distribution: HU

GERM 269 Advanced Professional German 4 Credits
A continuation of Business German with an emphasis on specific economic issues affecting contemporary Germany, Switzerland, and Austria. Preparation for the national exam "Certificate for the Professions" and the "International Business German Examination".
Attribute/Distribution: HU

GERM 281 German Cultural Program 1-8 Credits
Study abroad. Formal instruction in German and direct contact with the people and the culture during at least one month in a German-speaking country. Consent of German study abroad adviser required.
Attribute/Distribution: HU

GERM 291 German Language Culture II Abroad 1-8 Credits
Intensive practice of speaking and writing in the language of the country aimed at providing the student with extensive proficiency of expression and the ability to discriminate linguistic usage. Idiomatic expressions, an introduction to stylistics. Reading and analysis of more difficult texts, supplemented by in-depth study of selected aspects of contemporary civilization. Consent of chair and proficiency examination in the target country is required.

GERM 300 Apprentice Teaching 1-4 Credits

GERM 301 Survey Of German Literature 4 Credits
An overview of German literary traditions through the nineteenth century, focusing on the Middle Ages, Renaissance, Reformation, Baroque, Enlightenment, Classicism, Romanticism, Realism, and Naturalism.
Attribute/Distribution: HU

GERM 303 (MLL 303, WGSS 303) Grimm’s Fairy Tales: Folklore, Feminism, Film 4 Credits
This intercultural history of the Grimm’s fairy tales investigates how folktale types and gender stereotypes developed and became models for children and adults. The course covers the literary fairy tale in Germany, Europe and America. “Little Red Riding Hood”, “Cinderella”, or “Sleeping Beauty” exist not only in the Grimm’s collection but in many forms of world literature/film. Modern authors have rewritten fairy tales in feminist ways, promoting social change. Taught in English. German language students may receive a German component.
Attribute/Distribution: HU

GERM 305 Modern German Literature 4 Credits
Topics in German literature of the twentieth and twenty-first century.
Attribute/Distribution: HU
GERM 320 Berlin: Transformations of a Metropolis 4 Credits  
A literary and cultural history of Berlin from its foundation to the present. 
After a historical overview, we will focus on the modern period that 
covers the Weimar Republic, the Third Reich, the divided city of the 
postwar era, the fall of the wall, and the continuing process of redefining 
Berlin’s identity as Germany’s old and new capital. 
Attribute/Distribution: HU

GERM 345 German Short Stories 4 Credits 
Readings of short prose texts in German. 
Attribute/Distribution: HU

GERM 350 German Special Topics 1-4 Credits 
Literary or linguistic topics not covered in regular courses. Consent of 
instructor required. 
Repeat Status: Course may be repeated. 
Attribute/Distribution: HU

GERM 370 German Internships 1-8 Credits 
Designed to give advanced qualified students the chance to acquire field 
experience and training with selected firms and governmental agencies 
in German-speaking countries. Assigned readings, written reports, and 
employer performance evaluations are required. Consent of instructor 
required. 
Repeat Status: Course may be repeated. 
Attribute/Distribution: HU

Hebrew Courses 
HEBR 001 Elementary Modern Hebrew I 4 Credits 
Class instruction will focus on the introduction of the Hebrew alphabet 
and basic vocabulary. Instruction will also emphasize the basics of 
Hebrew listening comprehension, vocabulary, reading, writing, grammar 
and speaking. Class activities are planned for an inclusive approach to 
different styles of learning. No previous study of Hebrew required. 
Attribute/Distribution: HU

HEBR 002 Elementary Modern Hebrew II 4 Credits 
Continuation of Hebrew 1. Instruction will focus on expanding Hebrew 
vocabulary and grammar; introduction of the past tense. Class activities 
are planned for an inclusive approach to different styles of learning. Hebrew 1 or previous background in Hebrew required. 
Attribute/Distribution: HU

HEBR 011 Intermediate Modern Hebrew I 4 Credits 
Class instruction will focus on developing fundamental patterns of 
conversation and expanding grammar. Hebrew 1 and Hebrew 2, or 
previous background in Hebrew required. 
Attribute/Distribution: HU

HEBR 012 Intermediate Modern Hebrew II 4 Credits 
Continuation of Hebrew 011. Class instruction will focus on developing 
fundamental patterns of conversation and expanding grammar. Hebrew 1 and Hebrew 2, or previous background in Hebrew required. 
Attribute/Distribution: HU

HEBR 151 Hebrew Special Topics 1-4 Credits 
Class instruction will focus on cultural, ethnic, and religious dimensions 
of Israeli society through film. Class discussion and writing in Hebrew 
will be based on related topics. Consent of instructor required. Taught in 
Hebrew. 
Repeat Status: Course may be repeated. 

HEBR 152 Hebrew Special Topics II 4 Credits 
Continuation of HEBR 151. Class instruction will focus on cultural, 
ethnic, and religious dimensions of Israeli society through film. Class 
discussion and writing in Hebrew will be based on related topics. 
Consent of instructor required. Taught in Hebrew. 
Repeat Status: Course may be repeated. 

Japanese Courses  
JPNS 001 Elementary Japanese I 4 Credits 
This course introduces the basic grammatical structures commonly 
found in daily situations in Japan. All four aspects of language skills 
are introduced. Hiragana, Katakana, and approximately 50 Kanji are 
introduced. 
Attribute/Distribution: HU

JPNS 002 Elementary Japanese II 4 Credits 
Continuation of JPNS 001. Approximately 100 Kanji are introduced. 
Prerequisites: JPNS 001

JPNS 011 Intermediate Japanese I 4 Credits 
Continuation of JPNS 002. This course introduces more complex 
grammatical structures and develops all four aspects of language skills. 
Slightly more emphasis on reading and writing. Approximately 100 Kanji 
are introduced. 
Prerequisites: JPNS 002

JPNS 012 Intermediate Japanese II 4 Credits 
Continuation of JPNS 011. 
Prerequisites: JPNS 011

JPNS 099 Japanese Special Topics 1-4 Credits 
Course may be repeated. 

JPNS 131 Advanced Japanese Reading and Writing I 3 Credits 
Reading, translation, and writing practice using authentic Japanese 
materials. 
Prerequisites: JPNS 012

JPNS 132 Advanced Japanese Reading and Writing II 3 Credits 
Continuation of Advanced Japanese Reading and Writing I. 
Prerequisites: JPNS 141 or JPNS 131

JPNS 140 Advanced Japanese I 4 Credits 
This course emphasizes advanced reading comprehension on topics 
related to Japan. Approximately 100 Kanji are introduced. 
Prerequisites: JPNS 012

JPNS 141 Advanced Japanese II 4 Credits 
Continuation of JPNS 140. 
Prerequisites: JPNS 141

JPNS 151 Advanced Spoken Japanese 1 Credit 
Emphasis on comprehension and oral performance of the Japanese 
language through discussion of current issues and other topics. 
Repeat Status: Course may be repeated. 
Prerequisites: JPNS 012

JPNS 152 Advanced Spoken Japanese II 1 Credit 
Continuation of JPNS 151. Emphasis on comprehension and oral 
performance of Japanese language through discussion of current issues 
and other topics. Variable content. 
Repeat Status: Course may be repeated. 
Prerequisites: JPNS 151

JPNS 199 Japanese Special Topics 1-4 Credits 
Course may be repeated. 

JPNS 231 Advanced Japanese Reading and Writing I 2 Credits 
Reading, translation, and writing practice using authentic Japanese 
materials. 
Prerequisites: JPNS 1% 

JPNS 232 Advanced Japanese Reading and Writing II 2 Credits 
Continuation of Advanced Japanese Reading and Writing I. 
Prerequisites: JPNS 142 or JPNS 231

JPNS 290 Japanese Special Topics 1-4 Credits 
Literary or linguistics topics not covered in regular courses. Consent of 
instructor required. 
Repeat Status: Course may be repeated. 
Attribute/Distribution: HU, SS
JPNS 291 Advanced Japanese and Culture Abroad 1-8 Credits
Intensive practice of speaking and writing in the language of the country aimed at providing the student with extensive proficiency of expression and the ability to discriminate linguistic usage. Idiomatic expressions and an introduction to stylistics. Reading and analysis of more difficult texts, supplemented by in-depth study of selected aspects of contemporary civilization. Consent of chair and proficiency examination in the target country required.
Attribute/Distribution: HU

JPNS 299 Japanese Special Topics 1-4 Credits
Repeat Status: Course may be repeated.

JPNS 300 Apprentice Teaching 1-4 Credits
Repeat Status: Course may be repeated.

JPNS 390 Japanese Special Topics 1-4 Credits
Literary or linguistics topics not covered in regular courses. Consent of instructor required.
Repeat Status: Course may be repeated.

Attribute/Distribution: HU, SS

Modern Languages Literatures Courses

MLL 006 (GS 006) Globalization and Cultures 4 Credits
This course is a reflection on the processes of globalization and their consequences, both good and bad, on the world’s societies and on our concepts of culture and identity. It provides a multidisciplinary examination of what cultures gain and lose from their interaction with the rest of the world and what it means to be a citizen of a globalized yet diverse world.
Attribute/Distribution: HU

MLL 027 Russian Classics 4 Credits
Russian classics in translation.
Attribute/Distribution: HU

MLL 051 Contemporary Hispanic-American Literature 4 Credits
Reading and discussion of distinguished Latin American writers: Borges, García Márquez, Cortázar, and Vargas Llosa.
Attribute/Distribution: HU

MLL 053 This Hispanic World and its Culture 4 Credits
Characteristics and values of the people of Spain and Latin America in literary works and other material. Hispanic cultural contributions to Western civilization.
Attribute/Distribution: HU

MLL 068 (ASIA 068) Japanese Language: Past and Present 4 Credits
Historical and contemporary aspects of the Japanese language, including the origins of Japanese in relation to Korean, the influence of Chinese, syntactic features which reflect the hierarchical character of Japanese society, differences in female and male speech, and use of foreign loan words.
Prerequisites: JPNS 001
Attribute/Distribution: HU

MLL 073 (ASIA 073, WGCC 073) Film, Fiction, and Gender in Modern China 4 Credits
Study of the struggle for an individual “modern” identity out of traditionally defined roles for men and women as depicted by Chinese writers and filmmakers. Class, texts, and films in English. Students interested in setting up a corollary Chinese language component for credit as CHIN 371 or CHIN 251, may discuss this possibility with the professor.
Attribute/Distribution: HU

MLL 074 (ASIA 074) Chinese Cultural Program 1-8 Credits
A summer program in China, taught in English.
Attribute/Distribution: HU

MLL 075 (ASIA 075, HIST 075) Chinese Civilization 4 Credits
The development of traditional Chinese thought, beliefs, technology, and institutions from a historical perspective.
Attribute/Distribution: HU, SS

MLL 076 (ASIA 076, HIST 076) Understanding Contemporary China 4 Credits
An overview of recent history, politics, economy, religion, problems of modernization, popular culture. Contemporary Chinese society viewed against the backdrop of tradition and the tumultuous history of twentieth-century China.
Attribute/Distribution: SS

MLL 078 (ASIA 078) Asian-American Studies 4 Credits
A survey of issues concerning Asians living in the United States from the perspectives of history, language, literature, and film.
Attribute/Distribution: HU

MLL 099 Modern Languages & Literature Special Topics 1-6 Credits

MLL 100 Introduction to International Film 4 Credits
An introduction to international film traditions and theory. We look at the importance of cinema as both art and entertainment and consider the social, political, and economic role of film in national and global contexts.
Attribute/Distribution: HU

MLL 125 (ASIA 125) Immortal Images: Traditional Chinese Literature in Translation 4 Credits
Explore age-old themes in literature as diverse as pre-modern novels, ghost stories, poetry, divination manuals, and medical texts. Students interested in setting up a corollary Chinese language component for credit as CHIN 371 or 251, may discuss this with the professor.
Attribute/Distribution: HU

MLL 127 (ASIA 127) OrienTations: Approaches to Modern Asia 4 Credits
An introduction to East, Southeast, and South Asia at the beginning of the 21st century. How is globalization transforming Asian societies? How are Asians represented (or misrepresented) in the West? How do Asian peoples view Western influences on them? What distinguishes our perspectives on politics, individual liberty, civic responsibility, religious faith and practice, work, etc? How is the trend toward globalization in the coming “Asian Century” likely to be affected by the growing assertiveness of nations like China and India? (H/S).

MLL 128 (GS 128) Literature and Globalization 4 Credits
An introduction to fiction as it reflects and discusses major issues related to globalization. The readings will include a selection of fiction from a diversity of world regions and will introduce the students to a theoretical reflection on the role of literary writing in a globalizing world. Students will be able to gain appreciation for the written fictional text as it takes on a diversity of issues related to globalization in a variety of world regions and cultural perspectives.

MLL 133 (AAS 133, FREN 133, HIST 133, LAS 133, POLS 133) Lehigh in Martinique: Globalization and Local Identity 3-4 Credits
History, culture, and politics of the French Caribbean island of Martinique, from its position as a key site of the 18th century Atlantic world economy to becoming an official French department and outpost of the European Union. Interdisciplinary perspectives on the complex nature of social identity, historical memory, and impact of globalization. No French is required. Offered during winter inter-term through Lehigh Study Abroad.

MLL 140 (ANTH 140, COGS 140) Introduction to Linguistics 4 Credits
Relationship between language and mind; formal properties of language; language and society; how languages change over time. May not be taken pass/fail.
Attribute/Distribution: SS

MLL 165 (ASIA 165) Love and Revolution in Shanghai 4 Credits
Project-based course examines human relationships and political-economic changes in Shanghai through the lens of literature, film, and a selection of other readings. Discussion of conflicts between and influences of pre-communist, communist, and capitalist systems as played out in the Shanghai urban arena.
Attribute/Distribution: HU
MLL 177 (ASIA 177) China Enters the Modern Age 4 Credits
The collapse of the imperial order and China's agonizing transformation into a modern nation-state over the past 150 years. The impact of imperialism, war, radical social change, and protracted revolution on Chinese traditions, values, and institutions.
Attribute/Distribution: HU, SS

MLL 199 Modern Languages & Literature Special Topics 1-4 Credits

MLL 202 (ENGL 202, GS 202, LAS 202) Latin American In Fact, In Fiction 4 Credits
This class couples a survey of Latin American literature in translation with an interdisciplinary approach to the study of Latin America. Departing initially from readings of literary and cinematographic works, our analyses will engage methodologies from multiple disciplines including history, sociology, and cultural studies. Accordingly, this course will examine critical developments in Latin American aesthetics along with the cultural climates in which they matured. This course assumes no prior study of Spanish, Portuguese, or Latin American culture.
Attribute/Distribution: HU

MLL 211 German Drama 4 Credits
Drama as a literary genre; plays from various periods of German literature.
Attribute/Distribution: HU

MLL 218 (GERM 218) Goethe's "Faust" 4 Credits
Study of Goethe's play with an introduction to the Faust tradition and Faustian themes in modern literature.
Attribute/Distribution: HU

MLL 231 (GERM 231) New German Cinema 4 Credits
Viewing, discussion, and written analysis of selected German films.
Attribute/Distribution: HU

MLL 260 (GERM 260) Multicultural Germany 4 Credits
A look at Germany from the perspective of its "others"--the immigrants. Literary and cultural texts, and films on ethnic diversity and integration.
Attribute/Distribution: HU

MLL 299 Modern Languages & Literature Special Topics 1-6 Credits

MLL 300 Apprentice Teaching 1-4 Credits

MLL 302 (ENGL 302, GS 302, LAS 302) Travel and Adventure in Latin American Fiction 4 Credits
Centering on a corpus of works presenting tales of travel and adventure, this class offers an overview of Latin American narrative genres (including "fantastic" narrative, magical realism, and postmodern fiction) from the mid 20th century to present day. Through close readings of works by Adolfo Bioy Casares and Roberto Bolaño, among others, and the analysis of filmic representations of travel in Latin America, we will examine differing modes of perceiving the region defined as Latin America.
Attribute/Distribution: HU

MLL 303 (GERM 303, WGSU 303) Grimms' Fairy Tales: Folklore, Feminism, Film 4 Credits
This intercultural history of the Grimms' fairy tales investigates how folktales types and gender stereotypes developed and became models for children and adults. The course covers the literary fairy tale in Germany, Europe and America. "Little Red Riding Hood", "Cinderella", or "Sleeping Beauty" exist not only in the Grimms' collection but in films and many forms of world literature. Modern authors have rewritten fairy tales in feminist ways, promoting social change. Taught in English. German language students may receive a German component.
Attribute/Distribution: HU

MLL 321 (GS 321) Intercultural Communication 4 Credits
Language is ambiguous by nature and discourse is interpreted in cultural and linguistic contexts. This course covers different cultural and linguistic strategies individuals use to communicate with each other, essential concepts for interacting with individuals from other cultural and linguistic backgrounds, and different strategies of communication as defined by specific cultures. Covering the theory and practice of intercultural interaction, this course examines assumptions about language and culture, and includes practical advice to help students develop the cultural sensitivity essential for communication today.
Attribute/Distribution: HU

MLL 326 Modernity in the Maghreb 4 Credits
The emergence of the modern self through a comparative study of textual as well as visual representations of post colonial subjects by male and female writers and film makers. How the sociopolitical context of countries such as Morocco, Algeria and Tunisia informs the constitution of subjectivity within a multicultural and multilingual community. Issues of patriarchy, nationalism, colonialism, post colonialism, identity, gender and religion in North African literature and film from Franco-Arab Traditions Taught in French.
Attribute/Distribution: HU

MLL 389 (IR 389) IR/MLL Capstone Project 4 Credits
A research project on international politics that will include original research in at least one foreign language under the joint supervision of an adviser in IR and one in the relevant language in MLL. Consent of department required.
Attribute/Distribution: SS

MLL 399 Modern Languages & Literature Special Topics 1-6 Credits

MLL 403 (WGSS 403) Grimms' Fairy Tales: Folklore, Feminism, Film 3 Credits
This intercultural history of the Grimms' fairy tales investigates how folktales types and gender stereotypes developed and became models for children and adults. The course covers the literary fairy tale in Germany as well as Europe and America. Versions of "Little Red Riding Hood", "Cinderella", or "Sleeping Beauty" exist not only in the Grimms' collection but in films and many forms of world literature. Modern authors have rewritten fairy tales in feminist ways, promoting social change. Taught in English. German language students may receive a German component.

Russian Courses
RUSS 001 Elementary Russian I 4 Credits
Classroom and laboratory, audio, and video introduction to the fundamentals of conversational and grammatical patterns; practice in pronunciation, simple conversation, reading, and writing.
Attribute/Distribution: HU

RUSS 002 Elementary Russian II 4 Credits
Continuation of RUSS 001.
Attribute/Distribution: HU

RUSS 011 Intermediate Russian I 4 Credits
Classroom and laboratory practice in conversation. Development of reading and writing skills.
Attribute/Distribution: HU

RUSS 012 Intermediate Russian II 4 Credits
Continuation of RUSS 011.
Attribute/Distribution: HU

RUSS 141 Russian Conversation and Composition I 4 Credits
Intensive practice in oral and written Russian and oral comprehension. Readings and discussions on Russian literature and culture.
Attribute/Distribution: HU

RUSS 142 Russian Conversation and Composition II 4 Credits
Continuation of RUSS 141.
Attribute/Distribution: HU

RUSS 199 Russian Special Topics 1-6 Credits

RUSS 215 Russian Classics: Russian Literature with Variable Topic and Credit 1-4 Credits
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

RUSS 231 Russians In Real World I 4 Credits
Readings and conversations about selected nonliterary topics including the social and natural sciences, business, economics, the environment, current political events in Russia and throughout the former Soviet republics.
Attribute/Distribution: HU

RUSS 232 Russians In Real World II 4 Credits
A continuation of RUSS 231.
Attribute/Distribution: HU
SPAN 141 Advanced Spanish Grammar 4 Credits
Intensive study of Spanish grammar with stress on finer points. Analysis of syntax and style. Improvement of grammar through composition. Heritage speakers should substitute with another 100-level class.
Attribute/Distribution: HU

SPAN 142 Advanced Conversational Spanish 4 Credits
Conversational practice stressing the building of vocabulary based on literary texts and topics of general interest. Designed to stimulate fluent and spontaneous use of spoken Spanish. does not count toward completion of major.
Attribute/Distribution: HU

SPAN 151 Cultural Evolution Spain 4 Credits
The historical and cultural evolution of Spain. Discussion of representative literary works in their cultural and historical contexts.
Attribute/Distribution: HU

SPAN 263 (LAS 263) The Spanish American Short Story 4 Credits
Comparative study of representative works by major writers such as Quiroga, Borges, and Cortazar, among others.
Attribute/Distribution: HU

SPAN 265 (LAS 265) Spanish and Latin American Cinema 4 Credits
Prerequisites: SPAN 141

SPAN 270 Communicating in Spanish for Medical Personnel 4 Credits
For prospective medical personnel communicating with Spanish-speaking patients. Dialogues, healthcare vocabulary. Review of grammar.
Prerequisites: SPAN 141

SPAN 275 (LAS 275, WGSS 275) Introduction to Hispanic Women Writers 4 Credits
The objective of this class is to introduce students to Hispanic contemporary female authors from Latin America, Spain, and the United States through the analysis of all literary genres (novel, short story, poetry, essay, and drama). This class provides students with a solid introduction to Hispanic women’s writing from the last years of the Nineteenth Century to the present, as well as to feminist literary theory.
Attribute/Distribution: HU

SPAN 276 Latin America's Changing Economy 3 Credits
An introduction to political and economic changes in Latin America. Emphasis will be placed on key figures and events in the history of Latin America, and their impact on its current economic situation.
Attribute/Distribution: HU

SPAN 330 (LAS 330) Latin American Women Writers 4 Credits
Comparative study of works by Latin American women writers, including novel, short story, poetry, and drama. Focus on issues of identity, gender, and colonialism.
Prerequisites: Consent of instructor

SPAN 342 Advanced Conversation 4 Credits
Conversational practice stressing the building of vocabulary based on literary texts and topics of general interest. Designed to stimulate fluent and spontaneous use of spoken Spanish. does not count toward completion of major.
Attribute/Distribution: HU

SPAN 350 Latin American Literature Before 1950 4 Credits
A survey of Latin American literature before 1950, focusing on the changes in literary style and form.
Prerequisites: Consent of instructor

SPAN 351 Latin American Literature After 1950 4 Credits
A survey of Latin American literature after 1950, focusing on the changes in literary style and form.
Prerequisites: Consent of instructor

SPAN 352 (LAS 352) Latin American Women's Studies 4 Credits
Comparative study of works by Latin American women writers, including novel, short story, poetry, and drama. Focus on issues of identity, gender, and colonialism.
Prerequisites: Consent of instructor

SPAN 353 (LAS 353) International Interactions in Mexico 4 Credits
A study of the development of Mexico as a country through the analysis of all literary genres (novel, short story, poetry, essay, and drama). This class provides students with a solid introduction to Mexican women’s writing from the last years of the Nineteenth Century to the present, as well as to feminist literary theory.
Attribute/Distribution: HU

SPAN 354 (LAS 354) Women's Studies in the World 4 Credits
Comparative study of women's lives and experiences in various countries and cultures. Includes works by women from the United States, Latin America, and Europe.
Prerequisites: Consent of instructor

SPAN 355 (LAS 355) Women's Studies in the World II 4 Credits
Continued study of women's lives and experiences in various countries and cultures. Includes works by women from the United States, Latin America, and Europe.
Prerequisites: Consent of instructor

SPAN 356 (LAS 356) Women's Studies in the World III 4 Credits
Continued study of women's lives and experiences in various countries and cultures. Includes works by women from the United States, Latin America, and Europe.
Prerequisites: Consent of instructor
SPAN 276 (LAS 276) Contemporary Literature Of The Southern Cone 4 Credits
This course focuses on the literature of Argentina, Chile, and Uruguay from the beginning of the 20th Century to the present. It analyzes the works of major authors through different genres studying how they represent history and culture, particularly during periods of political instability and state violence. Texts by Jorge Luis Borges, Pablo Neruda, Manuel Puig, Griselda Gambaro, Cristina Peri Rossi, and Antonio Skarmeta, among others, are studied.
Attribute/Distribution: HU

SPAN 290 Spanish Special Topics 2-4 Credits
Study of an author or theme, or completion of a special project. Topics may vary; for credit.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

SPAN 291 (ALLN 291) Spanish Language & Culture Abroad III 1-8 Credits
Intensive practice of speaking and writing in the language of the country aimed at providing the student with extensive proficiency of expression and the ability to discriminate linguistic usage. Idiomatic expressions and an introduction to stylistics. Reading and analysis of more difficult texts, supplemented by in-depth study of selected aspects of contemporary civilization. Consent of chair and proficiency examination in the target country.

SPAN 300 Apprentice Teaching 1-4 Credits
Repeat Status: Course may be repeated.

SPAN 308 Spanish Novel Since 1939 4 Credits
The evolution of the novel from post civil war to the present. Reading of Cela, Laforet, Delibes, Rodoreda, and Marsé, among others.
Attribute/Distribution: HU

SPAN 320 (LAS 320) Literature of the Spanish Caribbean 4 Credits
Study of representative works with emphasis on Cuba and Puerto Rico. Writers include Barret, Carpenter, Sánchez, and Rodríguez Juliá.
Prerequisites: LAS 152 or SPAN 152
Attribute/Distribution: HU

SPAN 321 (LAS 321) Children and Adolescents in Contemporary Spanish American Literature 4 Credits
Discussion of narrative techniques and the category of the self as they relate to the images of adolescence and childhood in works by such authors as Vargas Llosa, Reinaldo Arenas, José Blanco, Silvina Ocampo.
Prerequisites: LAS 152 or SPAN 152
Attribute/Distribution: HU

SPAN 322 (LAS 322) The Short Novel in Contemporary Spanish American Literature 4 Credits
Reading and discussion of representative works by García Márquez, Céline, Rulfo, and Bloy Casares, among others.
Prerequisites: LAS 152 or SPAN 152
Attribute/Distribution: HU

SPAN 323 (LAS 323) Literature and Revolution in Contemporary Cuba 4 Credits
Study of works written after 1959 by dissident, nondissident, and exiled authors (Desnoes, Norberto Fuentes, Benítez Rojo, and Pedro Juan Gutiérrez, among others).
Attribute/Distribution: HU

SPAN 325 (LAS 325) Hispanic Literature Of The United States 4 Credits
Discussion of fiction, poetry, drama, and film from the main groups in the U.S. Hispanic population. Discussion of Hispanic ethnic identity, bilingualism, and minority issues.
Prerequisites: LAS 152 or SPAN 152
Attribute/Distribution: HU

SPAN 326 (LAS 326, WGSS 326) Tradition and Resistance: Women Writers of Latin America 4 Credits
Study of poetry and narrative works by Latin American women writers. Authors include Rosario Ferré, Rosario Castellanos, Elena Poniatowska, and Cristina Peri Rossi, among others.
Prerequisites: SPAN 152
Attribute/Distribution: HU

SPAN 342 (LAS 342) The New Narrative in Spanish American Literature 4 Credits
Critical evaluation of distinguished works of Spanish American prose fiction of the 1960's and 70's. Readings by Donoso, Fuentes, García Márquez, and Vargas Llosa, among others.
Attribute/Distribution: HU

SPAN 345 (LAS 345) Testimonial Writing of the Hispanic World 4 Credits
This course explores the genre testimonio, which confronts the official history of the Latin American and Spanish dictatorships and portrays the experiences and struggles of those who suffered political repression. The course focuses on the analysis of both literary and visual testimonios from the Hispanic world, as well as on theoretical issues concerning discourses of truth.
Attribute/Distribution: HU

SPAN 346 (LAS 346, WGSS 346) Contemporary Hispanic Women Writers: The Novelists 4 Credits
This course explores the works of Hispanic women writers who have been oppositional to hegemonic cultural politics during the Twentieth Century in Latin America and Spain. Within their particular contexts, we examine issues these writers define as important in their work, their literary and political impact, use of literature to empower minority positions, and their narratives' effects on the changing literary canon. Selected topics include: historical interpretations, exile, forms of violence and repression, expressions of desire, and sexuality.
Attribute/Distribution: HU

SPAN 379 Spanish Internship 2-4 Credits
Designed to give advanced qualified students the chance to acquire field experience and training with selected firms and governmental agencies in Spanish-speaking countries or U.S. agencies serving the Hispanic community. Assigned readings, written reports, and employer performance evaluations are required. Students must be registered through an educational institution to receive credit. Consent of instructor required.
Prerequisites: SPAN 141
Attribute/Distribution: HU

SPAN 389 Honors Project 1-8 Credits
Course may be repeated.

SPAN 390 Spanish Special Topics 2-4 Credits
Study of an author, theme or period. Topics vary; for credit. Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

SPAN 391 (LAS 391) Melodrama in Contemporary Spanish American Narrative 4 Credits
From the earliest works of Latin American narrative onward, melodrama has served as a fundamental tool for the structuring of dramatic conflict. Ranging from the programmatic social novel to the most parodic contemporary works, we will carefully examine the aims of melodramatic narration in works by Roberto Arlt and Mario Vargas Llosa, among others, as well as in various films and telenovelas.
Attribute/Distribution: HU

SPAN 392 (LAS 392) The City and the Country in Spanish American Narrative 4 Credits
Across the history of the region defined as Latin America, urbanization, on the one hand, and the isolation of national interiors, on the other, have contributed to a problematic relationship between the city and the country. In examining works by the likes of Roberto Arlt, José Donoso, and Mario Bellatin, among others, this course examines the dialogue between the ostensibly separate environs of city and country, and questions they ways in which they influence one another.
Attribute/Distribution: HU

SPAN 393 (LAS 393) The Boom and Beyond 4 Credits
This class will examine works from the so-called Boom of Spanish American literature in the 1960s alongside texts produced following this crucial moment of artistic and social change throughout Latin America. Moving from the Boom toward the postmodern, we will consider works by Gabriel García Márquez, Manuel Puig, and Mario Levrero, among others.
Attribute/Distribution: HU
Music

The study of music develops skills which will serve the student well in any career: self-discipline, teamwork, problem solving and leadership. A student graduating with the B.A. degree in music will have a strong foundation in music theory and substantial exposure to western music from the Middle Ages to the present. This curriculum will prepare a student for graduate studies in musicology, music theory, composition, jazz, conducting, or performance. A music major or minor taken in conjunction with a business major may lead to a variety of careers in arts management or in the recording and music publishing industries. For some a double major or a minor in music will not lead to a career but to a lifelong involvement with an art form that gives lasting satisfaction.

The music department (http://music.cas2.lehigh.edu) also offers significant performance experiences in instrumental and vocal ensembles, large and small, and in private instruction. The Zoellner Arts Center (http://zoellner.cas2.lehigh.edu) facilities include a Listening Library, practice rooms, a composition and digital class piano studio, a fine recording studio, classrooms and rehearsal rooms. Most importantly, the center boasts its concert facility, Baker Hall. With its 1000-seat capacity and excellent acoustics, it is flexible both on the stage (concert or theater mode) and in seating arrangements. The fully adjustable pit can serve opera or musical theatre, can provide additional seating, or can become an extension of the stage.

Professors. Paul F. Salerni, PhD (Harvard University); Steven P. Sametz, DMUS (University of Wisconsin); Nadine J. Sine, PhD (New York University)

Associate Professors. Eugene O. Albulescu, AD (Indiana University Bloomington); William Warfield, MMus (Manhattan School of Music)

Lecturer. David B. Diggs, MMus (Stony Brook University)

Professors Of Practice. Michael Jorgensen, DMUS (Florida State University); Sun Min Lee, MMus (Westminster Choir College)

Emeritus. Jerry T. Bidlack, MMus (Boston University)

MAJOR PROGRAM

The Bachelor of Arts in Music (36-credit minimum) is for those students who wish to have double majors, who might choose a related field (e.g., arts management, part-time performance careers in orchestras) or who simply want a concentrated exposure to music study. Students choose between five different concentrations: performance; history and literature; theory and composition; jazz; conducting. For those who intend to pursue graduate study in music or a performing career, the major program should be viewed as the minimum requirement. Such students should regularly seek the advice of department faculty in expanding their program to suit their particular needs and goals.

Performance Concentration

Theory and Musicianship Skills

MUS 011 Basic Musicianship 2
MUS 002 Keyboard Harmony I 1
MUS 082 Harmony I 3
MUS 003 Keyboard Harmony II 1
MUS 007 Aural Skills 1
MUS 083 Harmony II 3
MUS 004 Keyboard Harmony III 1
MUS 008 Aural Skills II 1

Music History

Select two of the following: 6

MUS 233 Medieval and Renaissance Music
MUS 234 Baroque and Classical Music
MUS 235 Romantic Music
MUS 236 Music Since 1900
MUS 336 Seminar in the History of Musical Style 3

Additional Requirements

Lessons, ensembles and recitals 11

Total Credits 36

The student must perform a half recital in the junior year, a full recital in the senior year, and juries during the sophomore and junior years. Jury Requirement: see website at http://www.lehigh.edu/music Students must also complete three semesters of MUS 100 (0 credit P/F) or its equivalent.

History Concentration

Theory and Musicianship Skills

MUS 011 Basic Musicianship 2
MUS 002 Keyboard Harmony I 1
MUS 082 Harmony I 3
MUS 003 Keyboard Harmony II 1
MUS 007 Aural Skills 1
MUS 083 Harmony II 3
MUS 004 Keyboard Harmony III 1
MUS 008 Aural Skills II 1

Music History

MUS 233 Medieval and Renaissance Music 3
MUS 234 Baroque and Classical Music 3
MUS 235 Romantic Music 3
MUS 236 Music Since 1900 3
MUS 336 Seminar in the History of Musical Style 3

Additional Requirements

Electives, lessons, and ensembles 1

MUS 350 Senior Project 2 1-6

Total Credits 37-42

1 At least three must be in performance.
2 The students must produce a major research project during the senior year.

Students must also complete three semesters of MUS 100 (0 credit P/F) or its equivalent.

Composition and Theory Concentration

Theory

MUS 082 Harmony I 3
MUS 003 Keyboard Harmony II 1
MUS 007 Aural Skills 1
MUS 083 Harmony II 3
MUS 004 Keyboard Harmony III 1
MUS 008 Aural Skills II 1
MUS 243 Counterpoint 4
MUS 137 Musicianship I 1
MUS 245 Classical and Romantic Forms 4
MUS 138 Musicianship II 1

Music History

MUS 336 Seminar in the History of Musical Style 3

Select one of the following: 3

MUS 233 Medieval and Renaissance Music
MUS 234 Baroque and Classical Music
MUS 235 Romantic Music
MUS 236 Music Since 1900

Composition

MUS 253 Composition I 4
MUS 254 Composition II 4

Additional Requirements

Lessons or ensembles 2

Total Credits 36

Students must produce a substantial composition or theoretical analysis under the direction of department faculty during the senior year. A keyboard test is required to enter composition class. Students must also complete three semesters of MUS 100 (0 credit P/F) or its equivalent.

Jazz Concentration

Music Theory and Musicianship Skills

MUS 011 Basic Musicianship 2
MUS 002  Keyboard Harmony I 1
MUS 082  Harmony I 3
MUS 003  Keyboard Harmony II 1
MUS 007  Aural Skills 1
MUS 083  Harmony II 3
MUS 004  Keyboard Harmony III 1
MUS 008  Aural Skills II 1

Jazz Theory
MUS 139  Jazz Theory 3

Jazz History
MUS 128  Jazz History I 3
MUS 129  Jazz History II 3
MUS 236  Music Since 1900 3

Small Jazz groups
Select a minimum of 4 credits: 4
MUS 049  Small Jazz Ensembles

Jazz Performance
Select six credits: 6
MUS 024  Jazz Ensemble
MUS 027  Jazz Orchestra

Additional Requirement
MUS 350  Senior Project (for variable credit) 1

Total Credits 36-41

Students must also complete three semesters of MUS 100 (0 credit P/F) or its equivalent.

1 Under faculty direction.

Conducting Concentration

Music Theory and Musicianship Skills
MUS 011  Basic Musicianship 2
MUS 002  Keyboard Harmony I 1
MUS 082  Harmony I 3
MUS 003  Keyboard Harmony II 1
MUS 007  Aural Skills 1
MUS 083  Harmony II 3
MUS 004  Keyboard Harmony III 1
MUS 008  Aural Skills II 1

Music History
MUS 336  Seminar in the History of Musical Style 3
Select two of the following: 6
MUS 233  Medieval and Renaissance Music
MUS 234  Baroque and Classical Music
MUS 235  Romantic Music
MUS 236  Music Since 1900

Conducting
MUS 321  Conducting I 2
MUS 322  Conducting II 2
Select at least two of the following: 4
MUS 311  Conducting Internship (one must be in orchestra)

Additional Requirement
Performance Electives (lessons and ensembles) 6

Total Credits 36

A piano proficiency exam must be completed before the end of the sophomore year. The student must undertake a senior project under faculty direction. Students must also complete three semesters of MUS 100 (0 credit P/F) or its equivalent.

BACHELOR OF ARTS IN MUSIC COMPOSITION

The Bachelor of Arts in Music Composition is designed for students committed to pursuing music composition beyond the undergraduate level. It is an intensive composition program with a 54-credit minimum.

Music Theory
MUS 082  Harmony I 3
MUS 003  Keyboard Harmony II 1
MUS 007  Aural Skills 1
MUS 083  Harmony II 3
MUS 004  Keyboard Harmony III 1
MUS 008  Aural Skills II 1
MUS 139  Jazz Theory 3
MUS 243  Counterpoint 4
MUS 137  Musicianship I 1
MUS 245  Classical and Romantic Forms 4
MUS 138  Musicianship II 1

Music History
MUS 236  Music Since 1900 3
MUS 336  Seminar in the History of Musical Style 3
Select one of the following: 3
MUS 129  Jazz History II
MUS 233  Medieval and Renaissance Music
MUS 234  Baroque and Classical Music
MUS 235  Romantic Music

Composition
MUS 253  Composition I 4
MUS 254  Composition II 4
Select two semesters of the following: 6
MUS 353  Composition Seminar
MUS 321  Conducting I (one semester) 2

Electives
Select six credits of music electives. 6

Total Credits 54

Students will have to pass a piano proficiency exam by the end of the sophomore year. Students will compile a composition portfolio by the end of the senior year. Students must also complete three semesters of MUS 100 (0 credit P/F) or its equivalent.

MINOR PROGRAMS

Minor in Music
The minor requires a minimum of 17 credits and may include MUS 090. The program is designed to be flexible but must include:

MUS 011  Basic Musicianship 2
MUS 002  Keyboard Harmony I 1
MUS 082  Harmony I 3
MUS 003  Keyboard Harmony II 1
MUS 007  Aural Skills 1
MUS 083  Harmony II 3
MUS 004  Keyboard Harmony III 1
MUS 008  Aural Skills II 1

Music History
MUS 336  Seminar in the History of Musical Style 3
Select two of the following: 6
MUS 233  Medieval and Renaissance Music
MUS 234  Baroque and Classical Music
MUS 235  Romantic Music
MUS 236  Music Since 1900

Conducting
MUS 321  Conducting I 2
MUS 322  Conducting II 2
Select at least two of the following: 4
MUS 311  Conducting Internship (one must be in orchestra)

Additional Requirement
Performance Electives (lessons and ensembles) 6

Total Credits 36

Students who test out of any courses (such as Keyboard I) may take any course as electives to make a total of 17 credits. Students must also complete three semesters of MUS 100 (0 credit P/F) or its equivalent.

MINOR IN MUSIC INDUSTRY

The music industry minor is intended to provide exposure to basic information, issues and skills useful for students who may want to pursue entry level positions in the music business or to promote their own work. The Music Industry Minor is currently in Review and therefore on Hiatus for the 2016-17 academic year.

There are six required courses:

MUS 161  Production and Marketing of Sound Recordings 3
MUS 164  Management Of Careers in Performing Arts 3
MUS 261  Recording Techniques I  3
MUS 010  Basic Skills in Music  2
or MUS 011  Basic Musicianship  2
MUS 361  Music Internship  3
ACCT 108  Fundamentals of Accounting  3
or ACCT 151  Introduction to Financial Accounting  3

Total Credits  17

MUSIC OPTION

Although Music and Engineering/Science is not a major in itself, Lehigh attracts many engineering and science students who wish to continue their active involvement in music and the music department. For those students who are interested in pursuing this option, music can be taken as a dual degree (B.S. or B.A.), minor or elective.

CONCERT REQUIREMENT

Majors and minors must enroll in MUS 100 and attend concerts approved by the music department for a minimum of three semesters.

DEPARTMENTAL HONORS

A student must have a 3.75 average in courses in the major to pursue honors. Candidates for departmental honors should submit to the department chair a written proposal, prepared in consultation with a faculty project adviser by the end of the junior year. The project which must go beyond required course work could result in a research paper, a composition or a performance. Upon acceptance of the proposal by the department faculty, the student should register for MUS 350 for one to six credits, which may be taken all at once or over the senior year. The awarding of departmental honors will be contingent on the quality of the completed project. Students who complete two concentrations in the major may also petition for consideration.

PRIVATE LESSONS

Lessons in most instruments and voice may be taken for one credit per semester; students may also enroll for no credit to avoid overloading. Lessons must be arranged through the department at set fees that are not included in tuition. Please note that registering for lessons cannot guarantee availability due to difficulties in scheduling.

PERFORMING GROUPS

Admission to performing ensembles is by audition (except Choral Union, Symphonic Band and Marching 97). Students receive one credit per semester by registering for the appropriate course number. Students may also register for zero credit as indicated in the catalog. Although there is no limit to the number of these courses that may be taken, students should check with their adviser to determine the number that may be applied toward graduation.

COURSE OFFERINGS

Please note that many upper level courses have no prerequisites beyond MUS 010 or MUS 011 and are open to anyone with basic knowledge of musical terminology.

Courses

MUS 002 Keyboard Harmony I 1 Credit
For intended majors and minors only. Beginning piano skills designed to enable the student to use the piano as a tool. Major and minor scales in both hands, forming chords, elementary sight reading. Students may test out upon examination.
Prerequisites: MUS 011
Attribute/Distribution: HU

MUS 003 Keyboard Harmony II 1 Credit
Continuation of MUS 2. Diatonic progressions in major and minor and more advanced sight reading. Students may test out upon examination.
Prerequisites: MUS 011
Corequisites: MUS 082
Attribute/Distribution: HU

MUS 004 Keyboard Harmony III 1 Credit
Additional keyboard skills, including progressions with secondary chords, modulations, and sight reading. Students may test out upon examination.
Prerequisites: MUS 082
Corequisites: MUS 083
Attribute/Distribution: HU

MUS 007 Aural Skills II 1 Credit
Sight singing, rhythm exercises, and ear training through dictation exercises.
Prerequisites: MUS 011
Corequisites: MUS 082
Attribute/Distribution: HU

MUS 008 Aural Skills II 1 Credit
Continuation of MUS 007.
Prerequisites: MUS 082
Corequisites: MUS 083
Attribute/Distribution: HU

MUS 010 Basic Skills in Music 2 Credits
Rudimentary skills in listening, and in reading and writing musical notation provide a vocabulary for describing music. By applying these skills in a brief survey of classical music, students develop an ability to think critically about music and to write intelligently about a wide range of musical experience. Intended for those not planning to major in or minor in music.
Attribute/Distribution: HU

MUS 011 Basic Musicianship 2 Credits
For intended majors and minors. Development of basic skills in using notation, sight singing and ear training.
Corequisites: MUS 002
Attribute/Distribution: HU

MUS 012 Surveys In Music 3 Credits
Varied topics in music for the non-major such as Italian opera, Keyboard Music, and the Symphony. Emphasis on developing listening skills and acquaintance with important works in the genre.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 021 Marching Band 0,1 Credits
No audition required for admission.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

MUS 022 Wind Ensemble 0,1 Credits
Admission by audition.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 023 Symphonic Band 0,1 Credits
No audition required for admission.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 024 Jazz Ensemble 0,1 Credits
Up to six credits may be used for graduation credit in CEAS and CBE. Admission by audition.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 025 Jazz Orchestra 0,1 Credits
Student/community/professional musicians performing classic, contemporary and original big band literature.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 031 University Choir 0,1 Credits
Admission by audition.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 032 Choral Union 0,1 Credits
No audition required for admission.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 033 Glee Club 0,1 Credits
Admission by audition.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 034 Freshman Lab Choir 0 Credits
Admission by audition.
Attribute/Distribution: HU
MUS 035 Dolce Women’s Choir 0,1 Credits
Women from university choir sing treble music.
Repeat Status: Course may be repeated.
Corequisites: MUS 031
Attribute/Distribution: HU

MUS 037 Scenes from Opera 0,1 Credits
Work on stage movement, characterization, etc. Leading to a performance at the end of the semester. By audition only.
Repeat Status: Course may be repeated.

MUS 048 Chamber Music Collegium 0,1 Credits
Admission by audition.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 049 Small Jazz Ensembles 0,1 Credits
Admission by audition.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 061 Philharmonic Orchestra 0,1 Credits
Admission by audition.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 065 Class Guitar for Beginners 0,1 Credits
Beginning techniques and skills for guitar, either acoustic or electric. For students with less than a year of guitar instruction. Students supply their own instruments. Fees associated with course.
Attribute/Distribution: HU

MUS 066 Class Voice for Beginners 0,1 Credits
Group instruction for beginning students of voice, including breathing and vocal production techniques; diction; beginning solo pieces. Fees associated with course.
Attribute/Distribution: HU

MUS 067 Class Drum Set for Beginners 0,1 Credits
Rudiments of drum set playing for students with less than a year of drum instruction. Fees associated with course.
Attribute/Distribution: HU

MUS 068 Class Piano for Beginners I 0,1 Credits
Instruction for beginning piano students, including rudiments of musical notation in relation to the keyboard; beginning pieces for solo piano and the group. Fees associated with course.
Attribute/Distribution: HU

MUS 071 Private Piano Study 0,1 Credits
Up to six credits may be used for graduation credit in CEAS and CBE. Fees associated with course.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 072 Private Vocal Study 0,1 Credits
Private instruction. Fees associated with course.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 073 Private String Study 0,1 Credits
Private instruction. Fees associated with course.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 074 Private Woodwind Study 0,1 Credits
Private instruction. Fees associated with course.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 075 Private Brass Study 0,1 Credits
Private instruction. Fees associated with course.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 076 Private Percussion Study 0,1 Credits
Private instruction. Fees associated with course.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 077 Private Organ Study 0,1 Credits
Private instruction. Fees associated with course.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 078 0,1 Credits
Private instruction. Fees associated with course.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 079 Private Electric Guitar Study 0,1 Credits
Private instruction. Fees associated with course.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 082 Harmony I 3 Credits
Exercises in writing in four-part chorale style. This includes all diatonic chords and non-harmonic tones.
Prerequisites: MUS 011
Corequisites: MUS 003 and MUS 007
Attribute/Distribution: HU

MUS 083 Harmony II 3 Credits
Continuation of MUS 82 including modulation, chromatic chords, analysis.
Prerequisites: MUS 082 and MUS 007
Corequisites: MUS 004 and MUS 008
Attribute/Distribution: HU

MUS 084 Private Drumset Study 0,1 Credits
Private Instruction. Fees associated with the course.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 087 Class Drum Set for Intermediate Players 0,1 Credits
Continuation of MUS 067: Class Drum Set for Beginners.
Prerequisites: MUS 067
Attribute/Distribution: HU

MUS 088 LehighArts LIVE (1) 1 Credit
Offered in the second half of the semester, this course is run entirely through Course Site. It requires students to attend seven arts events and write reaction papers on each along with a final essay.

MUS 100 Concert Requirement 0 Credits
Three concerts approved by the department (for majors and minors).
Repeat Status: Course may be repeated.

MUS 128 (AAS 128) Jazz History I 3 Credits
A study of the roots of jazz. Starting in West Africa, the course traces the synthesis of African and European elements to 1945. Musicians covered are Gottshalk, Bolden, Morton, Armstrong, Hawkins, Basie, Ellington and others.
Attribute/Distribution: HU

MUS 129 (AAS 129) Jazz History II 3 Credits
A survey of modern jazz from 1945 to the present. Musicians covered include Parker, Gillespie, Monk, Davis, Coltrane, Hancock, and Coleman. Can be taken independently of Jazz History I, but the first course would be helpful.
Attribute/Distribution: HU

MUS 130 Jazz Masters 3 Credits
An in-depth study of the music of a single major figure in jazz history, such as Miles Davis, Ornette Coleman, Duke Ellington. May be repeated for credits as title varies.
Attribute/Distribution: HU

MUS 137 Musicianship I 1 Credit
Continuation of keyboard and aural skills.
Corequisites: MUS 243

MUS 138 Musicianship II 1 Credit
Continuation of keyboard and aural skills.
Corequisites: MUS 245
MUS 139 Jazz Theory 3 Credits
Study of the music theory that is the foundation of a good jazz solo, composition or arrangement. Study of the modes of the major and melodic minor scale, chord/scale theory using major, melodic minor, diminished, and whole-tone scales. Basic chord progressions, functional analysis of jazz tunes, and ear training are also included.
Prerequisites: MUS 082
Attribute/Distribution: HU

MUS 151 Vocal Diction 1 Credit
Introduction to the use of the International Phonetic Alphabet. Application to French, Italian, German and English diction using art song repertoire. Preparation of a song in each language.
Attribute/Distribution: HU

MUS 161 Production and Marketing of Sound Recordings 3 Credits
Foundations for organizing a recording project to be carried out by the class, which works in teams. This course will focus especially on artist negotiations, recording techniques, music publishing and manufacturing.
Attribute/Distribution: ND

MUS 164 Management Of Careers in Performing Arts 3 Credits
An overview of what performing artists and managers experience during cycles of career development. Topics include recognition of talent, positioning in the marketplace, creating support structures and attainment of personal goals. Students will be required to apply practical techniques in furthering the career of a chosen artist.
Attribute/Distribution: ND

MUS 167 Intermediate Drum Set Class 0,1 Credits
For students who have taken MUS 067: Beginner drum set class. Fees associated with the course.
Prerequisites: MUS 067
Attribute/Distribution: HU

MUS 170 Private Instruction for Performance Concentrators 2 Credits
Lesson fees apply. Repeatable for credit. Restricted to music majors concentrating in performance.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 233 Medieval and Renaissance Music 3 Credits
Development of musical style from early Christian chant to the sacred and secular forms of the late 16th century, viewed in cultural contexts.
Prerequisites: MUS 011
Attribute/Distribution: HU

MUS 234 Baroque and Classical Music 3 Credits
The major genres and composers of the 17th and 18th centuries studied in their cultural context.
Prerequisites: MUS 011
Attribute/Distribution: HU

MUS 235 Romantic Music 3 Credits
Study of the major composers and their works from late Beethoven to Mahler and Strauss.
Prerequisites: MUS 011
Attribute/Distribution: HU

MUS 236 Music Since 1900 3 Credits
Beginning with the major trends at the turn of the century, a study of the important composers and works of the last century to the present.
Prerequisites: MUS 011
Attribute/Distribution: HU

MUS 243 Counterpoint 4 Credits
Writing and analyzing pieces in Renaissance and Baroque contrapuntal styles.
Prerequisites: MUS 083
Corequisites: MUS 137
Attribute/Distribution: ND

MUS 245 Classical and Romantic Forms 4 Credits
Analyzing and writing pieces in classical and romantic forms. Exercises in chromatic harmony.
Prerequisites: MUS 243
Corequisites: MUS 138
Attribute/Distribution: ND

MUS 247 Advanced Musicianship 1 Credit
To teach students advanced exercises in sight singing and ear training.
Prerequisites: MUS 008

MUS 251 Special Topics 1-3 Credits
Study of musical topics in history or composition not covered in regular courses. Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 253 Composition I 4 Credits
Writing for acoustic and electronic instruments based on 20th century models. Acoustic orchestration, digital synthesis, effects processing. Use of the computer for score preparation and as a compositional tool.
Prerequisites: MUS 083 and MUS 008
Attribute/Distribution: ND

MUS 254 Composition II 4 Credits
Continuation of MUS 253.
Prerequisites: (MUS 253)
Attribute/Distribution: ND

MUS 261 Recording Techniques I 3 Credits
Recording music in various popular and classical styles using state of the art studio equipment. Topics include microphone choice, placement, mixing, effects processing, digital editing and post production.
Attribute/Distribution: ND

MUS 262 Recording Techniques II 3 Credits
Continuation of Recording Techniques I.
Prerequisites: (MUS 261)
Attribute/Distribution: ND

MUS 291 Independent Study 1-3 Credits
Individually supervised work in history or composition, or continuation of projects begun in regular courses. Consent of department chair required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 300 Apprentice Teaching 1-3 Credits
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

MUS 311 Conducting Internship 2 Credits
Work under the direction of one of the faculty directors to learn the organization and musical tasks required of directors as they prepare ensembles for performance.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 312 Advanced Choral Composition 2 Credits
Intensive, weeklong seminar/workshop for individual study with international faculty. Joint seminars and lab choir rehearsals on choral literature; rehearsals and premieres of student works. New works and repertoire presented in final concert conducted by faculty and participants.

MUS 321 Conducting I 2 Credits
Beginning study of conducting techniques, including score reading and preparation, analysis, conducting patterns and gestures.
Prerequisites: (MUS 083)
Attribute/Distribution: HU

MUS 322 Conducting II 2 Credits
Continuation of MUS 321.
Prerequisites: (MUS 321)
Attribute/Distribution: HU

MUS 336 Seminar in the History of Musical Style 3 Credits
Study and analysis of the development of musical language and genre from the middle ages to the present.
Prerequisites: MUS 083
Can be taken Concurrently: MUS 083
Attribute/Distribution: ND

MUS 350 Senior Project 1-6 Credits
Repeat Status: Course may be repeated.
Attribute/Distribution: ND
MUS 353 Composition Seminar 3 Credits
Seminar review of original compositions alternating with private lessons in composition. The seminar is intended for students doing either independent work in composition or senior projects.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 361 Music Internship 3 Credits

MUS 370 Recital 1-2 Credits
Department permission.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

MUS 389 Honors Project 1-8 Credits
Repeat Status: Course may be repeated.

MUS 412 Advanced Choral Composition 2 Credits
Intensive, weeklong seminar/workshop for individual study with international faculty. Joint seminars and lab choir rehearsals on choral literature; rehearsals and premieres of student works. New works and repertoire presented in final concert conducted by faculty and participants.

Philosophy

Philosophy Home Page (https://philosophy.cas2.lehigh.edu)

Originally encompassing all fields of study, philosophy remains the foundational discipline of all the disciplines at the university and the core of a liberal arts education. At once both highly theoretical and profoundly practical, philosophical thinking is reflective and critical conceptual activity concerned with some of the most enduring and challenging of fundamental questions about the nature, meaning, and possibilities of human existence, the world, and the ways we think about them. What makes humans human? What is the best way to live? What can we know? What really exists? How can we think well? What are goodness, truth, beauty, space, time, causation, language, consciousness, happiness, freedom, rationality, justice? Questions like these occur to most people, especially when we are young; cherished beliefs and assumptions about them structure our lives, often without our being aware of them. Philosophers are gripped by such questions and seek to address them through creatively critical thinking, reasoned analysis and argumentation, and thoughtful discussion, instead of making assumptions or accepting answers to them based on opinion or prejudice. The study of philosophy develops skills in careful and flexible thinking, critical analysis, sound reasoning and argumentation, objective evaluation, clear and persuasive writing, and the toleration of uncertainty.

Professors. Gordon C. F. Bean, PhD (Yale University); Mark H. Bickhard, PhD (University of Chicago); Robin S. Dillon, PhD (University of Pittsburgh); John Gillroy, AM (University of Chicago); Roslyn E. Weiss, PhD (Columbia University); Aladdin M. Yaqub, PhD (University of Wisconsin)

Associate Professors. Chad Kautzer, PhD (Stony Brook University); Michael Mendelson, PhD (University of California San Diego)

Assistant Professor. Ricki L. Bliss, PhD (University of Melbourne)

Emeriti. Robert F. Barnes, Jr., PhD (University of California Berkeley); Steven L. Goldman, PhD (Boston University); J. Ralph Linggren, PhD (Marquette University); Norman P. Melchert, PhD (University of Pennsylvania)

THE MAJOR PROGRAM
The major program in philosophy is designed to provide a broad exposure to the major areas of philosophy as well as a strong grounding in the history of the western philosophical tradition. The program emphasizes the close reading and critical evaluation of classic texts from ancient times to the present, and students can expect to develop sophisticated analytic and expository skills that will enable them to engage in original, critical reflection on their own. The major program provides excellent preparation for graduate study in philosophy as well as a solid foundation for any career that places a premium upon clear, careful thinking, rigorous conceptual and analytical skills, and effective written and oral communication.

The major consists of a minimum of 40 credits in philosophy. These must include PHIL 292 Philosophical Methods (2 credits) for junior majors, the senior thesis sequence PHIL 390 (2 credits) and PHIL 391 (4 credits), and 16 credits of Disciplinary Area courses. At least 12 credits in addition to PHIL 292, PHIL 390, and PHIL 391 must be at the 200-level or above. Independent studies may be taken to satisfy major requirements. No more than 2 Philosophy courses at the 0-level can count toward the major.

Major Requirements

Thesis and Methods

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<tr>
<td>PHIL 292</td>
<td>Philosophical Methods</td>
<td>2</td>
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<tr>
<td>PHIL 390</td>
<td>Senior Thesis</td>
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<tr>
<td>PHIL 391</td>
<td>Senior Thesis</td>
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Disciplinary Areas

Logic
Select one of the following:
- PHIL 114 Symbolic Logic (4 credits)
- PHIL 214 Topics in Philosophical Logic
- PHIL 303 Mathematical Logic

Ethics
Select one of the following:
- PHIL 105 Ethics
- PHIL 116 Bioethics
- PHIL 205 Contemporary Ethics
- PHIL 206 Figures/Themes in Ethics

History of Philosophy
Select two of the following:
- PHIL 131 Ancient Philosophy (8 credits)
- PHIL 132 Hellenistic Philosophy
- PHIL 133 Medieval Philosophy
- PHIL 135 Modern Philosophy
- PHIL 137 Nineteenth Century Philosophy
- PHIL 139 Contemporary Philosophy
- PHIL 231 Figures and Themes in Ancient Philosophy
- PHIL 232 Figures and Themes in Hellenistic Philosophy
- PHIL 233 Figures and Themes in Medieval Philosophy
- PHIL 235 Figures and Themes in Modern Philosophy
- PHIL 237 Figures and Themes in Nineteenth Century Philosophy
- PHIL 239 Figures and Themes in Contemporary Philosophy

Advanced Courses
Select 12 credits of courses at the 200-level or above

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<tr>
<td>PHIL 232</td>
<td>Figures and Themes in Hellenistic Philosophy</td>
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<td>PHIL 233</td>
<td>Figures and Themes in Medieval Philosophy</td>
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<td>PHIL 235</td>
<td>Figures and Themes in Modern Philosophy</td>
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<td>PHIL 237</td>
<td>Figures and Themes in Nineteenth Century Philosophy</td>
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<tr>
<td>PHIL 239</td>
<td>Figures and Themes in Contemporary Philosophy</td>
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Independent Studies
Independent studies may be taken to satisfy major requirements.

Total Credits 38

1 Disciplinary area courses can satisfy this requirement.

Writing-Intensive Requirement
Majors are strongly encouraged to fulfill their junior writing-intensive requirement by taking a WI-designated philosophy course.

SENIOR THESIS
The senior thesis is a year-long independent project during which philosophy majors, with the consent and under the guidance of a philosophy faculty advisor, investigate a topic of special interest to them. The topic may be historical or non-historical, pure or applied, disciplinary or interdisciplinary; the only constraint is that the topic must be approved by the thesis advisor. Seniors take PHIL 390 in the fall, devoting their energies to refining the topic, working through the bulk of the essential literature, and producing a paper roughly 20 pages in length on the thesis topic. PHIL 391 is taken in the spring semester of the senior year and is focused on investigating the topic more intensively, expanding,
PHIL 004 Intro: Belief, Knowledge, and Action 4 Credits
Through reading selected texts in philosophy, from the ancient period to the modern Enlightenment and Romantic reaction, we shall introduce ourselves to some of the central epistemological, ontological, ethical, and socio-political positions developed in relation to their historical and material contexts. A unifying theme thus will be the emergence and evolution of rational thought and its relation to belief, knowledge, and action.
Attribute/Distribution: HU

PHIL 005 Intro: Contemporary Moral Problems 4 Credits
An examination of contemporary issues that raise questions about right and wrong, good and bad, both for individuals and for social policy, using the methods, theories, and concepts of moral philosophy.
Attribute/Distribution: HU

PHIL 006 Intro: Conduct and Character 4 Credits
How should we live our lives? How should we act? What kinds of persons should we be? What should we care about? These are among the central questions of philosophy because they are among the most central questions of human existence. This explores answers that have been proposed by thinkers throughout history and across cultures.
Attribute/Distribution: HU

PHIL 007 Intro: Emerson, Thoreau, and Beyond 4 Credits
Emerson and Thoreau write to revitalize our dumb words and numb lives. Emerson tells us that what matters is not having lived, but living, not having read somebody’s book, but thinking. And somehow all this wonderful excitement comes from creation, from becoming, and all becoming is becoming new. There is no unhappy creation. The literary power of Emerson and Thoreau, of Frederick Douglass, Margaret Fuller and Walt Whitman, is widely recognized, but their philosophical vocation is still repressed. This introduction to philosophy will be through the doors offered by these American authors and their impact on other prominent thinkers.
Attribute/Distribution: HU

PHIL 008 Intro: Ethics In Global Perspectives 4 Credits
Examination of the moral perspectives of a variety of different ethical outlooks, including Euro-American, Hindu, Buddhist, Confucian, African, and Islamic traditions, and of serious moral problems arising from globalization, including the increasing gap between the rich so-called First World nations and the poor so-called Third World nations, global environmental degradation, war and terrorism.
Attribute/Distribution: HU

PHIL 010 (ASIA 010, REL 010) Intro to Buddhism: Love Death and Freedom 4 Credits
This course will introduce students to Buddhist practices, philosophical systems, and cultural forms, from Buddhism’s Indian origins to its spread in East Asia and Tibet. Students will explore how Buddhists have approached the problem of death, the possibility of freedom, and the forms of social and individual love and concern. Course materials include poetry, biographies, philosophical writings, art and film.
Attribute/Distribution: HU

PHIL 014 Reasoning and Critical Thinking 4 Credits
Most intellectual endeavors involve reasoning. Whether in everyday discussion about right and wrong, friendly political disagreements, ordinary explanations of natural phenomena, and short letters to editors, or in sophisticated legal debates, national political campaigns, complex treatises, and intricate scientific theories, reasons are constantly invoked to support or criticize points of view. This course develops skills needed to reason well, to analyze and critique others’ reasoning, to distinguish reasoning from mere rhetoric, and to become a savvy consumer of information.
Attribute/Distribution: HU
PHIL 015 Intro: Friendship 4 Credits
Because of the importance of friendship to be happy and fulfilled human life, philosophers, from ancient times to the present have devoted considerable attention to it. In this , we shall read and discuss a variety of philosophical conceptions of friendship and its value.
Among the philosophical classics to be considered are works by Plato, Aristotle, Cicero, Augustine, Aquinas, Montaigne, Kant, Thoreau, and Kierkegaard. We shall also consider several contemporary treatments of the subject.
Attribute/Distribution: HU

PHIL 016 Intro: Free Will and Responsibility 4 Credits
Do we choose who we become as we mature, or is who we become foreordained? Are we born with a unique self, or is the self produced by our interaction with external forces? Are we free agents who can be held responsible for our actions, or is free will an illusion? This course explores these questions and the implications of answers for moral, political, and social values.
Attribute/Distribution: HU

PHIL 020 Intro: The Examined Life in Film and Literature 4 Credits
Socrates claimed the "the unexamined life is not worth living" and Western philosophers have for 2400 years taken that challenge to heart. But there are other ways of examining the human condition philosophically than in the writings of philosophers. This course uses works of literature (novels, plays, and poems) and film that address the same issues that Western philosophers have addressed, and continue to address: the natures of truth, justice, the good, reality, the self, happiness, the meaningfulness of life.
Attribute/Distribution: HU

PHIL 023 Intro: Artists on Art and Life 4 Credits
One of the peculiarities of the philosophical study or art, Aesthetics, is that philosophers ignore the writings of artists on art. This introduction to philosophy does not. Aestheticians spend much of their time writing about what art is. Artists are more interested in what art does and how art does it, and those questions will be the focus of this . We will be reading the words of and looking at the artwork of artists who might include: van Gogh, Cezanne, Madeline Gins, Picasso, Alberti, Hogarth, Mondrain, Kandinsky, Klee, Debussey, Leonardo, Le Corbusier, Anne Truit, Schoenberg, Tarkovsky, Boccioni, Alison Knowles, Alan Kaprow, Laurie Anderson, Robert Venturi and Denis Scott Brown, Francis Bacon, and more.
Attribute/Distribution: HU

PHIL 024 Intro: Good, God, and Evil 4 Credits
The problem traditionally known as "theodicy" asks how God (theos) is related to justice (dike). If the world isn't perfectly good, very good, or even pretty good, how can it be that God is both good and powerful, all-good (omnibenevolent) and all-powerful (omnipotent)? We can solve the problem of God and evil by saying that God is not all that good or not all that powerful-and indeed theologians and others have gone that route. But what if we don't want to relinquish God's goodness or His power? What then can we say? What have the great philosophers and religious thinkers said?
Attribute/Distribution: HU

PHIL 027 Intro: Beyond The Edge of Darkness 4 Credits
One of the on-going concerns of philosophical reflection, both East and West, has been to provide an account of the existential landscape within which we find ourselves that offers an alternative to the circumstantial frustrations and tragedies with which our experience seems to confront us. We will examine texts from a variety of trajectories, and traditions, some of which seem designed to highlight our predicament, some of which seem designed to resolve it.
Attribute/Distribution: HU

PHIL 100 (GS 100, POLS 100) Introduction to Political Thought 4 Credits
A critical examination of political ideologies: Liberalism, Marxism, Fascism, and Islamism.
Attribute/Distribution: ND

PHIL 101 Ancient Political Heritage 4 Credits
Important Political thinkers from the pre-Socratics to early, modern political theorists like Machiavelli.
Attribute/Distribution: SS

PHIL 105 Ethics 4 Credits
Examination of right and wrong, good and bad, from classic sources such as Plato, Aristotle, Hume, Kant, Mill and Nietzsche.
Attribute/Distribution: HU

PHIL 114 (MATH 114) Symbolic Logic 4 Credits
A first course in logical theory, introducing the notions of logical consequence and proof, as well as related concepts such as consistency and contingency. Formal systems taught may include: term logic, sentence logic, and predicate logic.
Attribute/Distribution: MA

PHIL 116 (HMS 116, REL 116) Bioethics 4 Credits
Moral issues that arise in the context of health care and related biomedical fields in the United States today, examined in the light of the nature and foundation of moral rights and obligations. Topics include: confidentiality, informed consent, euthanasia, medical research and experimentation, genetics, and the distribution of health care.
Attribute/Distribution: HU

PHIL 117 (AAS 117) Race, Racism, and Philosophy 4 Credits
An introduction to the philosophy born of struggle against racism and white supremacy. We will read the work of philosophers, mostly European, who quietly made modern racism possible by inventing the category of race, but we will concentrate on the work of philosophers, mostly of African descent, who for 200 years have struggled to force a philosophical critique of the category of race and the practice of white supremacy.
Attribute/Distribution: HU

PHIL 120 Philosophy and Film 4 Credits
This seminar course will explore a variety of themes, genres, and movements within cinema from a philosophical perspective. Regular screenings of films from silent era to present. Content may vary depending upon instructor.
Attribute/Distribution: HU

PHIL 121 Philosophy and Literature 4 Credits
Exploration of philosophical themes through the study of literature and film. Authors may include: Homer, Euripides, Dante, Rimbaud, Sterne, George Eliot, Valery, Joyce, Melville, T.S. Eliot, Rilke, Proust, Musil, Stevens, Cummings, Camus, Sartre, Beckett, Morrison, Bartheime.
Attribute/Distribution: HU

PHIL 122 Philosophy Of Law 4 Credits
Analysis of the conceptual foundations of our legal system. Special attention devoted to the nature of law and legal obligation, liberty and privacy in constitutional litigation, justice and contractual obligation, theories of punishment in criminal law, and the nature and scope of responsibility in criminal law.
Attribute/Distribution: HU

PHIL 123 Art, Beauty, and Aesthetic Experience 4 Credits
Theories, classical and modern, of the nature of beauty and the aesthetic experience. Practical criticism of some works of art, and examination of analogies between arts, and between art and nature.
Attribute/Distribution: HU

PHIL 124 (REL 124) Philosophy Of Religion 4 Credits
Critical examination, from a philosophical perspective, of some fundamental problems of religion, the nature of religious experience and belief, reason and revelation, the existence and nature of God, the problem of evil, and religious truth.
Attribute/Distribution: HU

PHIL 125 Social & Political Philosophy 4 Credits
Examination of visions of good social life and values that should shape society so that people are able to live good lives together. Issues covered may include the nature of freedom, how the facts of gender, race, class, ethnic, and cultural differences should be taken into account in social and political relations, the limits of religious tolerance, war, world hunger.
Attribute/Distribution: HU
PHIL 127 Existentialism 4 Credits
Investigation of the historical development of existentialism from its origins in the 19th century (Kierkegaard, Nietzsche) through its marriage to phenomenology in the early 20th (Heidegger, Sartre, Merleau-Ponty), and out the other side as a vigorous dimension of much literary, psychological, and artistic work produced in the last 50 years.

Attribute/Distribution: HU

PHIL 128 Philosophy Of Science 4 Credits
Science obviously works, and newer theories surely are better than the theories they replace, but why does science work, how does it work, and in what sense is it progressive? Is science a revelation of reality or an account of evolving human experience? Are scientists rational? Is scientific reasoning logical? This course surveys the wide range of 20th century responses to these surprisingly elusive, and surprisingly still open, questions.

Attribute/Distribution: HU

PHIL 129 (JST 129, REL 129) Jewish Philosophy 4 Credits
Consideration of how major Jewish thinkers from the first to 21st centuries confronted questions at the intersection of religion and philosophy: the existence and nature of God, free will, evil, divine providence, miracles, creation, revelation, and religious obligation.

Attribute/Distribution: HU

PHIL 131 (CLSS 131) Ancient Philosophy 4 Credits
Historical survey of selected texts and issues in the classical world, from the pre-Socratics through Aristotle, with emphasis on the origins of the western philosophical traditions in ethics, metaphysics, and epistemology.

Attribute/Distribution: HU

PHIL 132 (CLSS 132) Hellenistic Philosophy 4 Credits
Historical survey of selected texts and issues in post-Aristotelian Greek and Roman philosophy from the fourth century B.C. to the third century A.D. Areas of focus may include epicureanism, stoicism, academic and pyrrhonian scepticism, and neoplatonism.

Attribute/Distribution: HU

PHIL 135 Modern Philosophy 4 Credits
Historical survey of selected texts and issues in western philosophy from the fourth to 14th centuries. Attention will be given to the relation between developments in medieval philosophy and major currents in ancient and modern thought. Figures may include Augusteine, Eriugena, Anselm, Aquinas, Ockham, and Nicholas of Autrecourt.

Attribute/Distribution: HU

PHIL 135 Medieval Philosophy 4 Credits
Historical survey of selected texts and issues in medieval philosophy from the fourth to 14th centuries. Attention will be given to the relation between developments in medieval philosophy and major currents in ancient and modern thought. Figures may include Descartes, Leibniz, Locke, Hume, and Kant.

Attribute/Distribution: HU

PHIL 137 Nineteenth Century Philosophy 4 Credits
Historical survey of selected texts and issues in 19th century philosophy. Areas of focus may include post-Kantian idealism; period-specific critiques of religion, politics, and morality; theories of history; the origins of utilitarianism, pragmatism, existentialism, and mathematical logic; etc. Figures may include Hegel, Marx, Kierkegaard, Mill, Peirce, Frege, Nietzsche, James, etc.

Attribute/Distribution: HU

PHIL 139 Contemporary Philosophy 4 Credits
Philosophical thought from the late 19th century to the present; pragmatism, linguistic analysis, existentialism, and Marxism. Truth and knowledge, values and moral judgment, meaning, the place of the individual in the physical world and society, and the impact of the scientific method upon all of these.

Attribute/Distribution: HU

PHIL 140 (ASIA 140) Eastern Philosophy 4 Credits
Survey of selected texts and issues in the eastern philosophical traditions. Attention will be given to the development and interrelations of these traditions as well as a comparison of western and eastern treatments of selected issues. Areas of focus may include Confucianism, Taoism, and Zen Buddhism.

Attribute/Distribution: HU

PHIL 141 (REL 141) Islamic Philosophy 4 Credits
An introduction to medieval Islamic philosophy. The medieval era was the golden age of Islamic civilization, when science, mathematics, philosophical theories, logic, jurisprudence, etc., flourished. Islamic scientific and philosophical thoughts were greatly influenced by the Greek intellectual tradition, and the Islamic intellectual tradition influenced European thoughts during the Middle Ages and beyond. Thinkers to be studied include al-Kindi, al-Rizi, al-Farabi, Ibn Sina (Avicenna), al-Ghazali, Ibn Tufayl, and Ibn Rush (Averroes).

Attribute/Distribution: HU

PHIL 142 (ASIA 142) Zen and Art of the Everyday 4 Credits
The Japanese conception of beauty is strikingly different to our own: it is associated with impermanence, imperfection, and austerity. Moreover, attention to beauty pervades even everyday activities in Japan, such as wrapping purchases at the dollar store or putting out garbage. This course explores principles that guide the Japanese aesthetic sensibility with an eye to its expression in Japanese literature, film, and traditional arts, such as the tea ceremony and gardening.

Attribute/Distribution: HU

PHIL 145 Philosophy and Technology 4 Credits
This course is an exploration of questions of metaphysics and morality in the digital age. Are new technologies changing our views of metaphysics (what’s real) and morality (what’s right)? Can classical and contemporary philosophical theories help us think more clearly and make better choices when faced with new technologies? To help answer these questions, students will read a variety of philosophical works that invite critical reflection on a broad array of topics at the intersection of philosophy and technology.

Attribute/Distribution: HU

PHIL 146 (WGSS 146) Philosophy of Sex and Gender 4 Credits
An examination of concepts, values, and assumptions relevant to gender and sex(uality) in our diverse society, investigating how they affect our lives in both concrete and symbolic ways. Intersections among gender, sex(uality), race, class, religion, ethnicity, etc., will be explored. Special attention will be paid to how gendered assumptions color our understandings of experiences of embodiment and emotion, reasoning and decision-making, knowledge production, and public and private relationships and activities.

Attribute/Distribution: HU

PHIL 150 Philosophy of Education 4 Credits
A historical survey of major views on the meaning and function of education, this course will address questions such as, What is the role of education in individual human development? What are the goals of education? What are the ideal approaches to meet these goals? What is the relationship between one's view of learning and one's view of teaching? What is the relationship between educational institutions and the state? Does everyone need the same type of education?

Attribute/Distribution: HU

PHIL 150 Philosophy of Education 4 Credits
A historical survey of major views on the meaning and function of education, this course will address questions such as, What is the role of education in individual human development? What are the goals of education? What are the ideal approaches to meet these goals? What is the relationship between one's view of learning and one's view of teaching? What is the relationship between educational institutions and the state? Does everyone need the same type of education?

Attribute/Distribution: HU

PHIL 180 Special Topics 1-4 Credits
Selected topics of philosophy not included in other courses.

Repeat Status: Course may be repeated.

Attribute/Distribution: HU

PHIL 192 (ASIA 192, REL 192) Lehigh in Japan: Kyoto I 3 Credits
This is one of 2 courses that will be part of an intensive international summer school course to take start Summer 2016 in Kyoto University. Students will study aspects of Western and Japanese philosophical thought in a small group led by local and international speakers. Participants in the class will also be local and international. Students will be expected to attend all classes for a number of hours over a period of two weeks.

Attribute/Distribution: HU
PHIL 193 (ASIA 193, REL 193) Lehigh in Japan: Kyoto II 3 Credits
A second component of the Philosophy summer school in Kyoto will involve a series of excursions to galleries, museums, temples, shrines, stores, and restaurants. Students can expect to develop their understanding of both Japanese aesthetics and the way in which the philosophical systems present in Japan have influenced the Japanese aesthetic sensibility. Students will be required to submit a series of shorter pieces of writing and a final project.
Attribute/Distribution: HU

PHIL 205 Contemporary Ethics 4 Credits
Examination of significant questions addressed by contemporary moral philosophers. Topics vary, but might include: What is a good person? What kind of life is worth living? What moral issues are raised by gender, race, and class? Is morality relative or absolute? Is morality all that important? Must have completed one HU-designated course in Philosophy at 100-level or higher, or consent of the instructor.
Repeat Status: Course may be repeated.
Prerequisites: PHIL 105
Attribute/Distribution: HU

PHIL 206 Figures/Themes in Ethics 4 Credits
This semester course will involve in-depth focus on a major figure in ethics (e.g., Plato, Aristotle, Hume, Kant, Mill, etc.) or on a theme such as relativism, free will, the intersection of religion and ethics, or war. Must have completed one HU-designated course in Philosophy at 100-level or higher.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

PHIL 214 (MATH 214) Topics in Philosophical Logic 4 Credits
Topics may include the many systems of non-classical logic, truth theory, the impact of incompleteness and undecidability results on philosophy, the foundational projects of various philosophers/mathematicians, or the work of an important figure in the history of philosophical logic. Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: MA

PHIL 217 Figures/Themes in Race, Racism, and Philosophy 4 Credits
An investigation of a significant figure in the philosophy of race (e.g., Plato, Aristotle, Hume, Kant, Mill, etc.) or on a theme such as relativism, free will, the intersection of religion and ethics, or war. Must have completed one HU-designated course in Philosophy at 100-level or higher.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

PHIL 220 Ways of Knowing 4 Credits
Recent work in theories of knowledge. Questions addressed include: What is knowledge? How does it differ from mere opinion and belief? If you can’t know whether you are dreaming, how can you know you have two hands? Can we know anything at all? Does knowledge require answers to all possible doubts or only reasonable doubts? How should we determine the horizon of the reasonable—psychologically or philosophically? Must have completed one HU-designated course in Philosophy at 100-level or higher.
Attribute/Distribution: HU

PHIL 221 Reflecting on Reality 4 Credits
Metaphysics, the study of the basic structure of reality, seeks both to determine at a fundamental level what exists and what it means for something to be real, and to understand the nature of what exists, for example, whether what exists is mind-independent or depends on human thought, and whether different concepts, categories, or perspectives used to describe reality generate different realities. Topics might include social constructionism, universals and properties, identity and individuation, causation, necessity and possibility, realism and antirealism.
Attribute/Distribution: HU

PHIL 223 Figures/Themes In Aesthetics 4 Credits
An investigation of a significant figure in aesthetics (e.g., Burke, Kant, Hegel, Benjamin, Adorno, Goodman, Kivy, Derrida, Deleuze) and/or an investigation of a significant theme in aesthetics (e.g., sensuality, representation, politics, expressionism, cinematic gore, minimalism, architecture, postmodernism). Consent varies. Must have completed one HU-designated course in Philosophy at 100-level or higher.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

PHIL 224 (REL 224) Topics in the Philosophy of Religion 4 Credits
Selected problems and issues in the philosophy of religion. Must have completed one HU-designated course in Philosophy.
Attribute/Distribution: HU

PHIL 226 (WGSS 226) Feminism and Philosophy 4 Credits
Analysis of the nature, sources, and consequences of the oppression and exploitation of women and justification of strategies for liberation. Topics include women’s nature and human nature, sexism, femininity, sexuality, reproduction, mothering. Must have completed one HU-designated course in Philosophy, or one course in Women, Gender, and Sexuality Studies.
Attribute/Distribution: HU

PHIL 228 Topics in the Philosophy of Science 4 Credits
Themes in the natural, life and social sciences. Must have completed one 100-level HU-designated course or have consent of instructor.
Repeat Status: Course may be repeated.
Prerequisites: (PHIL 128)
Attribute/Distribution: HU

PHIL 231 (CLSS 231) Figures and Themes in Ancient Philosophy 4 Credits
This seminar course will involve in-depth focus upon a major ancient thinker (e.g., Plato, Aristotle, Sextus Empiricus, Plotinus, etc.) or the classical treatment of a particular theme (e.g., “human nature,” “the good life,” ethical or political theory, etc.). Content varies. May be repeated for credit if content differs from previous. Must have completed one HU-designated course in Philosophy.
Repeat Status: Course may be repeated.
Prerequisites: PHIL 105 or PHIL 116 or PHIL 121 or PHIL 122 or PHIL 123 or PHIL 124 or PHIL 125 or PHIL 127 or PHIL 128 or PHIL 129 or PHIL 131 or PHIL 132 or PHIL 133 or PHIL 135 or PHIL 137 or PHIL 139 or PHIL 140 or PHIL 141 or PHIL 142 or PHIL 145 or PHIL 146 or PHIL 150
Attribute/Distribution: HU

PHIL 232 (CLSS 232) Figures/Themes in Hellenistic Philosophy 4 Credits
This seminar course will involve in-depth focus upon a major movement in Hellenistic Philosophy (roughly 4th century B.C.E. to the 2nd Century C.E.) such as Epicureanism, Stoicism, Ancient Scepticism, or Neoplatonism, or the Hellenistic treatment of a particular theme (e.g. freedom from anxiety, the nature of the Cosmos and our place within it, or human nature). Content varies. Must have completed one HU-designated course in Philosophy at 100-level or higher.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

PHIL 233 Figures/Themes in Medieval Philosophy 4 Credits
This seminar course will involve in-depth focus upon a major medieval thinker (e.g. Augustine, Boethius, Maimonides, Bonaventure, Dante, etc.) or the medieval treatment of a particular theme (e.g. the relation of “will” and “intellect,” the “problem of universals,” ethical or political theory, etc.). Content varies. Must have completed one HU-designated course in Philosophy at 100-level or higher.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU
PHIL 235 Figures/Themes in Modern Philosophy 4 Credits
This seminar course will involve in-depth focus upon a major 17th or 18th century thinker (e.g. Descartes, Leibniz, Berkeley, Kant, etc.) or the modern treatment of a particular theme (e.g. the nature of “idees,” the roles of experience, reason, and revelation, ethical or political theory, etc.). Content varies. Must have completed one HU-designated course in Philosophy at 100-level or higher.
Repeat Status: Course may be repeated.
Prerequisites: PHIL 105 or PHIL 116 or PHIL 117 or PHIL 121 or PHIL 122 or PHIL 123 or PHIL 124 or PHIL 125 or PHIL 127 or PHIL 128 or PHIL 129 or PHIL 131 or PHIL 132 or PHIL 133 or PHIL 134 or PHIL 135 or PHIL 139 or PHIL 140 or PHIL 141
Attribute/Distribution: HU

PHIL 237 Figures/Themes in Nineteenth Century Philosophy 4 Credits
This seminar course will involve in-depth focus upon a major 19th century thinker (e.g. Hegel, Marx, Kierkegaard, Mill, Peirce, Frege, Nietzsche, James, etc.) or the 19th century treatment of a particular theme (e.g. the end of history, revolution, nihilism, authenticity, origins of mathematical logic, infinity, etc.). Content varies. Must have completed one HU-designated course in Philosophy at 100-level or higher.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

PHIL 239 Figures/Themes in Contemporary Philosophy 4 Credits
This seminar course will involve in-depth focus upon a major contemporary thinker (e.g. Russell, Whitehead, Husserl, Heidegger, Wittgenstein, Quine, Habermas, Rawls, Rorty, Derrida, Davidson, Foucault, Deleuze, Irigaray, etc.) or the contemporary treatment of a particular theme (e.g. logical positivism, naturalism, non-foundationism, existential phenomenology, return to virtue, neopragmatism, hermeneutics, post-structuralism, postmodernism, neokantian political theory, the politics of identity, etc.). Content varies. Must have completed one HU-designated course in Philosophy at 100-level or higher.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

PHIL 240 (ASIA 240) Figures/Themes in Eastern Philosophy 4 Credits
This seminar course will involve in-depth focus upon a major figure in Eastern thought or upon the Eastern treatment of a particular theme or set of themes. Content varies. Must have completed one HU-designated course in Philosophy at 100-level or higher.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

PHIL 241 (REL 241) Critics Of Religion 4 Credits
In recent years, with the resurgence of religion as a significant political force globally, the claims of religion have been subjected to renewed scrutiny and critique. A wide array of scientists, philosophers, and social critics (e.g., Richard Dawkins, Daniel Dennet, Sam Harris, Christopher Hitchens) have challenged religion’s basic claims and provide alternative rational, scientifically grounded explanations. However, in many instances, these books fall short of the powerful critiques, previously formulated by philosophers such as Baruch Spinoza and Friedrich Nietzsche, or those of contemporary French philosophers Michel Foucault and Gilles Deleuze. In this seminar, we shall explore in-depth the critiques of religion contained in the writings of Spinoza, Nietzsche, Sigmund Freud, Foucault and Deleuze. Students will have an opportunity to examine one or more of the recent critiques of religion in light of the arguments of these philosophers.
Attribute/Distribution: HU

PHIL 250 (COGS 250) Philosophy of Mind 4 Credits
An exploration of the mind-body problem. Are the body and mind distinct substances (dualism); or is there only body (materialism); or only mind (idealism)? Other views to be considered include behaviorism (the view that behavior can be explained without recourse to mental states), and the view that the mind is a complex computer. Must have completed one HU-designated course in Philosophy at 100-level or higher.
Attribute/Distribution: HU

PHIL 260 Making Sense of Words 4 Credits
Issues in the philosophy of language, including analysis of the nature of the relation between the words we use and the world in which we live. We will aim to understand how words make sense and how we make sense of ourselves and the world through words. We will examine such central notions as truth, meaning, and reference, as understood in historically influential philosophical theories of language. Must have completed one HU-designated course in Philosophy at 100-level or higher.
Prerequisites: PHIL 105 or PHIL 116 or PHIL 117 or PHIL 121 or PHIL 122 or PHIL 123 or PHIL 124 or PHIL 125 or PHIL 127 or PHIL 128 or PHIL 129 or PHIL 131 or PHIL 132 or PHIL 133 or PHIL 134 or PHIL 135 or PHIL 139 or PHIL 140 or PHIL 141
Attribute/Distribution: HU

PHIL 265 Philosophy of Mathematics 4 Credits
A survey of the main philosophical views on the nature of mathematics and mathematical knowledge, including the classical debate between the logicist, formalist, and intuitionist schools, and the recent debate between realism and antirealism. Some of the material makes use of logical theory. Must have completed one HU-designated course in Philosophy at 100-level or higher.
Attribute/Distribution: HU

PHIL 271 Independent Study 1-4 Credits
Individual philosophical investigation of an author, book, or topic designed in collaboration with a philosophy professor. Tutorial meetings; substantial written work. Must have completed one HU-designated course in philosophy. Consent of faculty instructor required.
Repeat Status: Course may be repeated.

PHIL 292 Philosophical Methods 2 Credits
Methods of and approaches to philosophical research, reasoning, and writing, as preparation for senior thesis. Open only to junior philosophy majors. Department permission required.
Attribute/Distribution: HU

PHIL 300 Apprentice Teaching 1-4 Credits

PHIL 303 (MATH 303) Mathematical Logic 3,4 Credits
Detailed proofs for the basic mathematical results relating the syntax and semantics of first-order logic (predicate logic): the Soundness and Completeness (and Compactness) Theorems, followed by a brief exposition of the celebrated limitative results of Gödel, Turing, and Church on incompleteness and undecidability. The material is conceptually rigorous and mathematically mature; the necessary background is a certain degree of mathematical sophistication or a basic knowledge of symbolic logic. Consent of instructor required.
Prerequisites: (PHIL 114)
Attribute/Distribution: MA

PHIL 347 (AMST 347, REL 347) American Religious Thinkers 4 Credits
An examination of the writings of key figures in the history of American religious thought (such as Edwards, Emerson, Bushnell, Peirce, James, Royce, Dewey and the Niebuhrs). Attention will be directed both to the historical reception of these writings and to their contemporary significance. Must have completed one HU-designated course in Philosophy at 100-level or higher.
Attribute/Distribution: HU

PHIL 364 (POLS 364) Issues In Contemporary Political Philosophy 3-4 Credits
Selected topics in contemporary political philosophy, such as the Frankfurt school, existentialism, legitimation, authenticity, participatory democracy, and the alleged decline of political philosophy.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS

PHIL 367 (POLS 367) American Political Thought 3-4 Credits
Critical examination of American political thought from the founding of the Republic to the present. Writings from Madison, Hamilton, and Jefferson to Emma Goldman, Mary Daly, Malcolm X, Henry Kariel, and others will be discussed.
Attribute/Distribution: SS
PHIL 371 Advanced Independent Study 1-4 Credits
Individual philosophical investigation of an author, book, or topic designed in collaboration with a philosophy professor. Tutorial meetings; substantial written work. Must have completed one HU designated philosophy course at 200-level or higher, and have consent of instructor. Repeat Status: Course may be repeated. Attribute/Distribution: ND

PHIL 390 Senior Thesis 2 Credits
The first part of two semesters of intensive research and writing supervised by the philosophy faculty thesis advisor in anticipation of completing a senior thesis in philosophy. Individual tutorials; substantial written work. Senior standing as a philosophy major and permission of the philosophy faculty thesis advisor required. Repeat Status: Course may be repeated. Attribute/Distribution: ND

PHIL 391 Senior Thesis 4 Credits
Continuation and completion of PHIL 390 under the guidance of the thesis advisor. Consent of thesis advisor required. Repeat Status: Course may be repeated. Prerequisites: (PHIL 390) Attribute/Distribution: ND

Photronics

PHOTONICS
The Master of Science Degree in Photonics is an interdisciplinary program designed to provide students with a broad training in the various aspects of photonics, including topics in electrical engineering, materials science, and physics. Admission to the program requires a B.S. or M.S. in either the engineering or physical sciences.

Applications should be directed to one of the three sponsoring departments (Electrical and Computer Engineering, Materials Science and Engineering, or Physics). Procedures and admission criteria are the same as those followed by the home department. International students must satisfy minimum university language requirements. The admissions process is under the supervision of the individual department to which you apply.

Physics

Physics students study the basic laws of mechanics, heat and thermodynamics, electricity and magnetism, optics, relativity, quantum mechanics, and elementary particles. Students also study applications of the basic theories to the description of bulk matter, including the mechanical, electric, magnetic, and thermal properties of solids, liquids, gases, and plasmas, and to the description of the structure of atoms and nuclei. In addition, students develop the laboratory skills and techniques of the experimental physicist, skills that can be applied in the experimental search for new knowledge or in applications relating to known theories.

A majority of physics graduates go to graduate school in physics, often earning the Ph.D. degree. These graduates take university or college faculty positions, or work on research in a variety of university, government, or industrial laboratories. Some students choose employment immediately after the bachelor’s degree. They use their many approved and free electives to supplement their science background with applied courses, such as engineering, to develop the skills needed for a position in a particular area.

Because of the fundamental role of physics in all natural sciences, students also use the physics major as an excellent preparation for graduate study in many other scientific areas, such as optical engineering, applied mathematics, computer science, biophysics, molecular biology, astrophysics, geology and geophysics, materials science and engineering, meteorology, or physical oceanography. Attractive engineering areas with a high science content include optical communications, aeronautical engineering, nuclear engineering, including both fission and fusion devices; electrical engineering, including instrumentation; electronics and solid-state devices, electrical discharges and other plasma-related areas; and mechanical engineering and mechanics, including fluids and continuum mechanics. The broad scientific background developed in the physics curriculum is also an excellent background for professional schools, such as law (particularly patent law), medicine, and optometry.

Lehigh offers three undergraduate degrees in physics and two undergraduate degrees in astronomy or astrophysics. The three physics degrees are the bachelor of arts with a major in physics and the bachelor of science in physics in the College of Arts and Sciences, and the bachelor of engineering physics in the College of Engineering and Applied Science. The B.A. with a major in astronomy and the B.S. in astrophysics are in the College of Arts and Sciences and are described in the Astronomy and Astrophysics section of this catalog.

In addition, there are several five-year, dual-degree programs involving physics: The Arts-Engineering program (see the Arts-Engineering section of this catalog), the combination of the bachelor of science program in the College of Arts and Sciences with electrical engineering (described below), and the combination of electrical engineering and engineering physics (see the Electrical Engineering and Engineering Physics section of this catalog).

The bachelor of science curriculum in the College of Arts and Sciences requires somewhat more physics and mathematics than the bachelor of arts major, while the latter provides more free electives and fewer hours for graduation. By making good use of the electives in these programs, students can pursue graduate work in physics or physical aspects of other science or engineering disciplines, or technical careers requiring a basic knowledge of physics. The bachelor of arts curriculum is particularly useful for those planning careers in areas where some knowledge of physics is needed or useful, but is not the main subject, such as science writing, secondary school teaching, patent law, or medicine. The bachelor of science in engineering physics curriculum in the College of Engineering and Applied Science requires an engineering concentration in either solid state electronics or optical sciences, in addition to regular physics and mathematics courses. This four-year program prepares students to do engineering work in an overlap area between physics and engineering. This may involve engineering in a forefront area in which it is desirable to have more physics knowledge than that typically provided in an engineering program. It may be a field of experimental physics which either relies heavily on forefront engineering or in which the nature of the problem dictates that scientists and engineers will accomplish more working together rather than separately.

Requirements and recommended course sequences are described below for programs in the College of Arts and Sciences and in the P. C. Rossin College of Engineering and Applied Science. Note that no more than 6 credits of military science may be applied toward any degree program.

Professors. Ivan Biaggio, PhD (ETH Zurich); Gary G. DeLeo, PhD (University of Connecticut); Volkmar R. Dierolf, PhD (University of Utah); James D. Gunton, PhD (Stanford University); John P. Huenekeens, PhD (University of Colorado Boulder); Alvin S. Kanofsky, PhD (University of Pennsylvania); Yong W. Kim, PhD (University of Michigan Ann Arbor); George Eadon McCluskey, Jr., PhD (University of Pennsylvania); H. Daniel Ou-Yang, PhD (University of California Los Angeles); Jeffrey M. Rickman, PhD (Carnegie Mellon University); Vyacheslav Rotkin, PhD (Ioffe Institute); Michael J. Stavola, PhD (University of Rochester); Jean Toulohuise, PhD (Columbia University); Dimitrios Vavylonis, PhD (Columbia University)

Associate Professors. Jerome C. Licini, PhD (Massachusetts Institute of Technology); Mary Virginia McSwain, PhD (Georgia State University)

Assistant Professors. Sera Cremonini, PhD (Brown University); Aurelia Honerkamp Smith, PhD (University of Washington); Joshua A. Pepper, PhD (Ohio State University); Rosi Jan Reed, PhD (University of California Davis)

Professor Of Practice. Paola M Cereghetti Biaggio, PhD (Swiss Federal Institute of Technology)

Emeriti. Garold J Borse, PhD (University of Virginia); W. Beall Fowler, PhD (University of Rochester); Albert Peet Hickman, PhD (Rice University); Arnold H. Kritz, PhD (Yale University); Shelden H. Radin, PhD (Yale University); Russell A. Shaffer, PhD (Johns Hopkins University)
### Intermediate and Advanced Courses

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<td>PHY 215</td>
<td>Classical Mechanics I</td>
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<td>Thermal Physics</td>
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<td>PHY 342</td>
<td>Atomic and Molecular Structure</td>
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<td>PHY 364</td>
<td>Nuclear and Elementary Particle Physics</td>
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### Approved Elective Courses

Select two courses from among...

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<tr>
<td>PHY 380</td>
<td>Introduction to Computational Physics</td>
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... plus three additional courses in appropriate technical areas in consultation with the adviser. Students planning graduate work in Physics are advised to include PHY 273 (Research) among their electives.

### Total Credits

90-92

A total of 123 credits are required for the BS in Physics.

### RECOMMENDED SEQUENCE OF COURSES

The recommended sequence of courses for physics degree programs are indicated below. General electives are not indicated, but they should be selected in consultation with the advisor so that educational goals and total credit hour requirements are satisfied.

#### B.A. with a Major in Physics, College of Arts & Sciences

**First Year**

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Total Credits: 62-65

#### Second Year

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Total Credits: 62-65

### B.S. in Physics, College of Arts & Sciences

**First Year**

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Total Credits: 62-65

#### Second Year

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<td>CSE 002 2</td>
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Total Credits: 62-65

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*Or an equivalent course in scientific computing.
Bachelor of Engineering Physics
with a concentration in Solid State Electronics

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Total Credits: 131

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P.C. ROSSIN COLLEGE OF ENGINEERING & APPLIED SCIENCES

Both concentrations require 131 credit hours. The tables below indicate both course requirements and recommended enrollment sequences.

COMBINED B.S.(PHYSICS)/B.S.(ELECTRICAL ENGINEERING)
The combined arts/engineering programs resulting in bachelors degrees in both physics and electrical engineering may be arranged so that either of the two degrees is completed within the first four years. The suggested curricula are:

Physics-Elec. Engr (Physics first)

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Total Credits: 131

(1) The 11 credit hours of SSE (Solid State Engineering) electives must include ECE 257 or ECE 258 or PHY 273. Other advanced physics or engineering courses may be included among the SSE electives with the approval of the student’s advisor.

Other advanced physics or engineering courses may be included among the OE electives with the approval of the student’s advisor.
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**Physics approved electives**

Select three of the following: 9

- PHY 363 Physics of Solids
- PHY 369 Quantum Mechanics I
- PHY 352 Modern Optics
- or PHY 355 Nonlinear Optics
- PHY 348 Plasma Physics
- or PHY 365 Physics Of Fluids
- PHY 380 Introduction to Computational Physics

**Total Credits**: 9

Students must satisfy both the HSS requirements of the College of Engineering and Applied Science and the distribution requirements, including the junior writing intensive requirement, of the College of Arts and Sciences. Courses appropriate for both may be counted in both categories.

Approved electives are subject to the approval of the student’s advisor. Students planning graduate work in physics are advised to include PHY 273 and PHY 369 among their electives.

**ASTRONOMY/ASTROPHYSICS DEGREE PROGRAMS**

(See the Astronomy (p. 87) section in this catalog.)

**RESEARCH OPPORTUNITIES**

A majority of physics, astronomy, and engineering physics majors take advantage of opportunities to participate in research under the direction of a faculty member. Research areas available to undergraduates are the same as those available to graduate students; they are described below under the heading For Graduate Students. Undergraduate student research is arranged informally as early as the sophomore (or, occasionally, freshman) year at the initiation of the student or formally as a senior research project. In addition, a number of students receive financial support to do research during the summer between their junior and senior years, either as Physics Department Summer Research Participants or as Sherman Fairchild Scholars.

**The use of electives**

The electives available in each of the physics and astronomy curricula provide the student with an opportunity to develop special interests and to prepare for graduate work in various affiliated areas. In particular, the many available upper-level physics, mathematics, and engineering courses can be used by students in consultation with their faculty advisors to structure programs with special emphases in a variety of areas such as optical communications, solid-state electronics, or biophysics.
DEPARTMENTAL HONORS
Students may earn departmental honors by satisfying the following requirements:

• Grade point average of at least 3.50 in physics courses.
• Complete 6 credits of PHY 273 (research), or summer REU project, submit a written report, and give an oral presentation open to faculty and students.
• Complete three courses from the list:
  • Select one of the following: 3
    - PHY 332 High-Energy Astrophysics
    - PHY 342 Relativity and Cosmology
    - PHY 348 Plasma Physics  3
    - PHY 363 Physics of Solids  3
    - PHY 352 Modern Optics  3
    - or PHY 355 Nonlinear Optics
    - PHY 369 Quantum Mechanics I  3
    - PHY 380 Introduction to Computational Physics  3

Any 400 level Physics course

For students majoring in astronomy or astrophysics, see the Astronomy and Astrophysics section of this catalog.

FIVE-YEAR COMBINED BACHELOR/MASTER’S PROGRAMS
Five-Year programs that lead to successive bachelor and master’s degrees are available. These programs satisfy all of the requirements of one of the five bachelor’s degrees in physics (B.A., B.S., B.S.E.P.) and astronomy/astrophysics (B.A., B.S.), plus the requirements of the M.S. in physics in the final year. Depending upon the undergraduate degree received, one summer in residence may be required. Interested students should contact the associate chair of physics no later than the spring semester of their junior year for further detail.

THE MINOR PROGRAM
The minor in physics consists of 15 credits of physics courses, excluding PHY 005 and ASTR 007. No more than one physics course required in a student’s major program may be included in the minor program. The minor program must be designed in consultation with the physics department chair.

FOR GRADUATE STUDENTS
The department of physics has concentrated its research activities within several fields of physics, with the result that a number of projects are available in each area. Current departmental research activities include the following:

Condensed matter physics. Areas of interest include the optical and electronic properties of defects in semiconductors and insulators, quantum phenomena in semiconductor devices, collective dynamics of disordered solids, structural phase transitions in ferroelectrics and superconducting crystals, theory of quantum charge transport in nanotubes and single molecule systems, physics of nano devices.

Atomic and molecular physics. Research topics include atomic and molecular spectroscopy and collision processes. Recent work has addressed velocity-changing collisions, diffusion, energy-pooling collisions, charge exchange, fine structure mixing, light-induced drift and radiation trapping.

Cosmology and string theory: This research area examines the fundamental structure of spacetime and the quantum nature of gravity. Research directions include a wide range of topics in quantum field theory and string theory, with applications to strongly coupled gauge theories, gravity and theoretical cosmology.

High-energy physics: The department provides both theoretical and experimental research opportunities in the field of high-energy physics. Experimental work involves the examination of the quark gluon plasma (QGP) created in heavy-ion collisions by using particle jets and heavy flavor quarks as probes of the medium. These studies make use of the Solenoidal Tracker (STAR) detector at the Relativistic Heavy Ion Collider (RHIC), and other accelerator experiments. Theoretical studies address fundamental aspects and phenomenological applications of string theory, gravitational descriptions of quantum field theory, and gauge/string dualities.

Nonlinear optics and photonics. Research topics include nonlinear light-matter interaction that enable the control of light with light, four-wave mixing, phase conjugation, resonant Brillouin scattering, ferroelectric domain patterning for quasi phase matching, waveguides, photonic crystals, holey and other specialty fibers, and the application of photonics to biological systems.

Plasma physics. Computational studies of magnetically confined toroidal plasmas address anomalous thermal and particle transport, large scale instabilities, and radiofrequency heating. Laboratory studies address collisional and collisionless phenomena of supercritical laser-produced plasmas.

Statistical physics. Investigation is underway of nonequilibrium fluctuations in gases, chaotic transitions and 1/f dynamics, light-scattering spectroscopy, colloidal suspensions, the nonlinear dynamics of granular particles, and pattern formation in nonequilibrium dissipative systems, including the kinetics of phase transitions and spatiotemporal chaos.

Soft condensed matter and biological physics. Current research topics include both the experimental and theoretical studies of complex fluids including biological polymers, colloids, and biological cells and tissues. Laser tweezers, Raman scattering, photoluminescence and advanced 3-D optical imaging techniques are integrated for investigating the structures and dynamical properties of these systems. Theoretical studies focus on the kinetics of phase transitions, including the crystallization of globular and membrane proteins and also the modeling of interactions of proteins and nanotubes.

Complex fluids. Polymers in aqueous solutions, colloidal suspensions, and surfactant solutions are investigated using techniques such as “laser tweezers,” video-enhanced microscopy, and laser light scattering. Areas of interest include the structures of polymers at liquid-solid interfaces and microstructure of confined macromolecules. Recent work addresses systems of biological significance.

Computational physics. Several of the above areas involve the use of state-of-the-art computers to address large-scale computational problems. Areas of interest include atom-atom collisions, simulations of tokamak plasmas, the statistical behavior of ensembles of many particles, the calculation of electronic wave functions for molecules and solids, and the multi-scale modeling of nano-bio systems.

Candidates for advanced degrees normally will have completed, before beginning their graduate studies, the requirements for a bachelor’s degree with a major in physics, including advanced mathematics beyond differential and integral calculus. Students lacking the equivalent of this preparation will make up deficiencies in addition to taking the specified work for the degree sought.

At least eight semester hours of general college physics using calculus are required for admission to all 200- and 300-level courses. Additional prerequisites for individual courses are noted in the course descriptions. Admission to 400-level courses generally is predicated on satisfactory completion of corresponding courses in the 200- and 300-level groups or their equivalent.

FACILITIES FOR RESEARCH
Research facilities are housed in the Sherman Fairchild Center for the Physical Sciences, containing Lewis Laboratory, the Sherman Fairchild Laboratory for Solid State Studies, and a large connecting research wing. Well-equipped laboratory facilities are available for experimental investigations in research areas at the frontiers of physics. Instruments used for experimental studies include a wide variety of laser systems ranging from femtosecond and picosecond pulsed lasers to stabilized single-mode cw Ti-sapphire and dye lasers. There is also a Fourier-transform spectrometer, cryogenic equipment that achieves temperatures as low as 0.05K and magnetic fields up to 9 Tesla, a facility for luminescence microscopy, and a laser-tweezers system for studies of complex fluids. The Fairchild Laboratory contains a processing laboratory where advanced Si devices can be fabricated and studied. All laboratories are well furnished with electronic instrumentation for data acquisition and analysis.
Several professors are members of the interdisciplinary Center for Optical Technologies that offers a wide range of state-of-the-art facilities including a fiber drawing tower, waveguide and fiber characterization labs, and a new epitaxy facility for the growth of III-V semiconductor structures and devices. Extensive up-to-date computer facilities are available on campus and in the department. All computing resources can be accessed directly from graduate student and faculty offices through a high speed backbone. Researchers have access to the national Research Internet (Internet 2) via a 155 Mbps gateway.

Courses

PHY 005 Concepts In Physics 4 Credits
Fundamental discoveries and concepts of physics and their relevance to current issues and modern technology. For students not intending to major in science or engineering. Lectures, demonstrations, group activities, and laboratories using modern instrumentation and computers. This is a non-calculus course; no previous background in physics is assumed. Three class meetings and one laboratory period per week.

Attribute/Distribution: NS

PHY 009 Introductory Physics I Completion 1-2 Credits
For students who have Advanced Placement or transfer credit for 2 or 3 credits of PHY 11. The student will be scheduled for the appropriate part of PHY 11 to complete the missing material. The subject matter and credit hours will be determined by the Physics Department for each student. Students with AP Physics C credit for mechanics will take the thermodynamics and kinetic theory part of PHY 11 for one credit.

Consent of department required.

Prerequisites: MATH 021 or MATH 031 or MATH 051 or MATH 076 or MATH 075

Can be taken Concurrently: MATH 021, MATH 031, MATH 051, MATH 076, MATH 075

Attribute/Distribution: NS

PHY 010 General Physics I 4 Credits
Statics, dynamics, conservation laws, thermodynamics, kinetic theory of gases, fluids. Primarily for architecture, biological science, earth and environmental science students.

Prerequisites: MATH 021 or MATH 031 or MATH 051 or MATH 076 or MATH 075

Can be taken Concurrently: MATH 021, MATH 031, MATH 051, MATH 076, MATH 075

Attribute/Distribution: NS

PHY 012 Introductory Physics Laboratory I 1 Credit
A laboratory course taken concurrently with PHY 10 or 11. Experiments in mechanics, heat, and DC electrical circuits. One three-hour laboratory period per week.

Prerequisites: PHY 010 or PHY 011

Can be taken Concurrently: PHY 010, PHY 011

Attribute/Distribution: NS

PHY 019 Introductory Physics II Completion 1-2 Credits
For students who have Advanced Placement or transfer credit for 2 or 3 credits of PHY 21. The student will be scheduled for the appropriate part of PHY 21 to complete the missing material. The subject matter and credit hours will be determined by the Physics Department for each student. Students with AP Physics C credit for electricity and magnetism will take the optics and modern physics part of PHY 21 for one credit.

Consent of instructor required.

Prerequisites: (PHY 010 or PHY 011) and (MATH 022 or MATH 032 or MATH 052)

Attribute/Distribution: NS

PHY 021 Introductory Physics II 4 Credits
A continuation of PHY 11. Electrostatics and magnetostatics; DC circuits; Maxwell’s equations; waves; physical and geometrical optics; introduction to modern physics. Two lectures and two recitations per week. May not be taken by students who have previously completed PHY 23.

Prerequisites: (PHY 010 or PHY 011) and (MATH 022 or MATH 032 or MATH 052)

Attribute/Distribution: NS

PHY 022 Introductory Physics Laboratory II 1 Credit
A laboratory course to be taken concurrently with PHY 13 or 21. One three-hour laboratory period per week.

Prerequisites: (PHY 012) and (PHY 021 or PHY 013 or PHY 023)

Can be taken Concurrently: PHY 021, PHY 013, PHY 023

Attribute/Distribution: NS

PHY 023 Introductory Physics II with Relativity 4 Credits
A version of PHY 21 for students interested in majoring in physics or astrophysics, or students with a strong interest in related fields. It is well-suited for students with PHY 011 AP credit, or with PHY 021 AP credit who wish to replace that course with a more sophisticated version. The theory of electricity and magnetism is developed from a modern point of view, emphasizing the unity of electric and magnetic fields in the context of special relativity.

Prerequisites: (PHY 010 or PHY 011) and (MATH 022 or MATH 032 or MATH 052)

Attribute/Distribution: NS

PHY 031 Introduction to Quantum Mechanics 3 Credits
Experimental basis and historical development of quantum mechanics; the Schroedinger equation; one-dimensional problems; angular momentum and the hydrogen atom; many-electron systems; spectra; selected applications. Three lectures per week.

Prerequisites: (PHY 013 or PHY 021 or PHY 023) and MATH 205

Can be taken Concurrently: MATH 205

Attribute/Distribution: NS

PHY 091 Measurement and Transducers 1 Credit
Computer-assisted laboratory course, dealing with physical phenomena in mechanics, electricity and magnetism, optics, spectroscopy and thermodynamics. Measurement strategies are developed and transducers devised. Computer simulation, analysis software, digital data acquisition.

Prerequisites: (PHY 021 or PHY 023) and PHY 022

Attribute/Distribution: NS

PHY 190 Electronics 3 Credits
DC and AC circuits, diodes, transistors, operational amplifiers, oscillators, and digital circuitry. Two laboratories and one recitation per week.

Prerequisites: (PHY 013 or PHY 021 or PHY 023) and PHY 022

Attribute/Distribution: NS

PHY 212 Electricity and Magnetism I 3 Credits
Electrostatics, magnetostatics, and electromagnetic induction.

Prerequisites: (PHY 021 or PHY 013 or PHY 023) and MATH 205

Can be taken Concurrently: MATH 205

Attribute/Distribution: NS
PHY 213 Electricity and Magnetism II 3 Credits
Maxwell’s equations, Poynting’s theorem, potentials, the wave equation, waves in vacuum and in materials, transmission and reflection at boundaries, guided waves, dispersion, electromagnetic field of moving charges, radiation, Lorentz invariance and other symmetries of Maxwell’s equations.
Prerequisites: PHY 212
Attribute/Distribution: NS

PHY 215 Classical Mechanics I 4 Credits
Kinematics and dynamics of point masses with various force laws; conservation laws; systems of particles; rotating coordinate systems; rigid body motions; topics from Lagrange’s and Hamilton’s formulations of mechanics; continuum mechanics.
Prerequisites: (PHY 021 or PHY 013 or PHY 023) and MATH 205
Can be taken Concurrently: MATH 205
Attribute/Distribution: NS

PHY 220 Advanced Physics Laboratory I 3 Credits
In a lab/lecture format, students learn basic elements needed for experimental, observational and computational work in physics, astrophysics and other technical areas. This course and its continuation as PHY 221 include topics such as electronics, optics, vacuum systems, data acquisition and analysis, curve fitting, scientific computing, interfacing of computers to experiments, and modern machining. These methods will be utilized in the examination of various physical systems; e.g., atomic and molecular spectroscopy, astronomical observations, condensed-matter phenomena, and others.
Prerequisites: (PHY 021 or PHY 023) and PHY 022 and CSE 002
Attribute/Distribution: NS

PHY 221 Advanced Physics Laboratory II 2 Credits
This is a continuation of PHY 220.
Prerequisites: (PHY 021 or PHY 023) and PHY 022 and PHY 220
Attribute/Distribution: NS

PHY 262 Advanced Physics Laboratory 2 Credits
Laboratory practice, including machine shop, vacuum systems, and computer interfacing. Experiment selected from geometrical optics, interference and diffraction, spectroscopy, lasers, fiber optics, and quantum phenomena.
Prerequisites: (PHY 013 or PHY 021 or PHY 023) and PHY 022
Attribute/Distribution: NS

PHY 273 Research 2-3 Credits
Participation in current research projects being carried out within the department.
Repeat Status: Course may be repeated.

PHY 273 Research 2-3 Credits
Participation in current research projects being carried out within the department.
Repeat Status: Course may be repeated.

PHY 281 Basic Physics I 3 Credits
A course designed especially for secondary-school teachers in the master teacher program. Presupposing a background of two semesters of college mathematics through differential and integral calculus and of two semesters of college physics, the principles of physics are presented with emphasis on their fundamental nature rather than on their applications. Open only to secondary-school teachers and those planning to undertake teaching of secondary-school physics.
Attribute/Distribution: NS

PHY 282 Basic Physics II 3 Credits
Continuation of PHY 281.
Prerequisites: PHY 010 or PHY 011 or PHY 281
Attribute/Distribution: NS

PHY 291, 292 Independent Study 1-3 Credits
Prerequisites: Consent of instructor and department chair.

PHY 300 Apprentice Teaching 1-4 Credits

PHY 311 (ASTR 311) Astrophysics 3 Credits
Observation and theory of X-ray and gamma-ray sources, quasars, pulsars, radio galaxies, neutron stars, black holes. Results from ultraviolet, X-ray and gamma-ray satellites. Generally offered in the spring of odd-numbered years.
Prerequisites: (PHY 021 or PHY 023) and (MATH 023 or MATH 033)
Can be taken Concurrently: MATH 023, MATH 033
Attribute/Distribution: NS

PHY 312 (ASTR 312) High-Energy Astrophysics 3 Credits
Observation and theory of X-ray and gamma-ray sources, quasars, pulsars, radio galaxies, neutron stars, black holes. Results from ultraviolet, X-ray and gamma-ray satellites. Generally offered in the spring of odd-numbered years.
Prerequisites: (PHY 021 or PHY 023) and (MATH 023 or MATH 033)
Can be taken Concurrently: MATH 023, MATH 033
Attribute/Distribution: NS

PHY 331 (ASTR 331) Integrated Bioelectronics/Biophotonics Laboratory 2 Credits
Experiments in design and analysis of bioelectronics circuits, micropatterning of biological cells, micromanipulation of biological cells using electric fields, analysis of pacemakers, instrumentation and computer interfaces, ultrasound, optic, laser tweezers and advanced imaging and optical microscopy techniques for biological applications.
Prerequisites: (PHY 013 or PHY 021) and PHY 022 and (PHY 190 or ECE 081)
Attribute/Distribution: NS

PHY 332 (ASTR 332) High-Energy Astrophysics 3 Credits
Basic principles of thermodynamics, kinetic theory, and statistical mechanics, with emphasis on applications to classical and quantum mechanical physical systems.
Prerequisites: (PHY 013 or PHY 021 or PHY 023) and (MATH 023 or MATH 032 or MATH 052)
Attribute/Distribution: NS

PHY 342 (ASTR 342) Relativity and Cosmology 3 Credits
Special and general relativity. Schwarzschild and Kerr black holes. Super massive stars. Relativistic theories of the origin and evolution of the universe. Generally offered in the spring of even-numbered years.
Prerequisites: (PHY 021 or PHY 023) and (MATH 023 or MATH 033)
Can be taken Concurrently: MATH 023, MATH 033
Attribute/Distribution: NS

PHY 348 Plasma Physics 3 Credits
Single particle behavior in electric and magnetic fields, plasmas as fluids, waves in plasmas, transport properties, kinetic theory of plasmas, controlled thermonuclear fusion devices. Must have senior standing or consent of the department chair.
Prerequisites: (PHY 021 or PHY 023) and MATH 205
Attribute/Distribution: NS

PHY 352 Modern Optics 3 Credits
Paraxial optics, wave and vectorial theory of light, coherence and interference, diffraction, crystal optics, and lasers.
Prerequisites: MATH 205 and (PHY 212 or ECE 202)
Attribute/Distribution: NS

PHY 355 Nonlinear Optics 3 Credits
This course will introduce the fundamental principles of nonlinear optics. Topics include nonlinear interaction of optical radiation with matter, multi-photon interactions, electro-optics, self and cross phase modulation, and the nonlinear optical susceptibilities that describe all these effects in the mainframe of electromagnetic theory.
Prerequisites: PHY 031 and (PHY 213 or ECE 203)
Can be taken Concurrently: PHY 213, ECE 203
Attribute/Distribution: NS
PHY 362 Atomic and Molecular Structure 3 Credits
Review of quantum mechanical treatment of one-electron atoms, electron spin and fine structure, multi-electron atoms, Pauli principle, Zeeman and Stark effects, hyperfine structure, structure and spectra of simple molecules.
Prerequisites: PHY 031 or CHM 341
Attribute/Distribution: NS

PHY 363 Physics of Solids 3 Credits
Introduction to the theory of solids with particular reference to the physics of metals and semiconductors.
Prerequisites: (PHY 031 or MAT 316 or CHM 341) and PHY 340
Can be taken Concurrently: PHY 340
Attribute/Distribution: NS

PHY 364 Nuclear and Elementary Particle Physics 3 Credits
Models, properties, and classification of nuclei and elementary particles; nuclear and elementary particle reactions and decays; radiation and particle detectors; accelerators; applications.
Prerequisites: PHY 031 and MATH 205
Attribute/Distribution: NS

PHY 365 Physics Of Fluids 3 Credits
Concepts of fluid dynamics; continuum and molecular approaches; waves, shocks and nozzle flows; nature of turbulence; experimental methods of study.
Prerequisites: (PHY 212 or ECE 202) and (PHY 340 or ME 104)
Can be taken Concurrently: PHY 212, ECE 202, PHY 340, ME 104
Attribute/Distribution: NS

PHY 369 Quantum Mechanics I 3 Credits
Prerequisites: PHY 031 and MATH 205
Can be taken Concurrently: PHY 215
Attribute/Distribution: NS

PHY 372 Special Topics In Physics 1-3 Credits
Selected topics not sufficiently covered in other courses.
Repeat Status: Course may be repeated.
Attribute/Distribution: NS

PHY 380 Introduction to Computational Physics 3 Credits
Numerical solution of physics and engineering problems using computational techniques. Topics include linear and nonlinear equations, interpolation, eigenvalues, ordinary differential equations, partial differential equations, statistical analysis of data, Monte Carlo, and molecular dynamics methods.
Prerequisites: MATH 205
Can be taken Concurrently: MATH 205
Attribute/Distribution: NS

PHY 389 Honors Project 1-8 Credits
Repeat Status: Course may be repeated.

PHY 411 Survey Nuclear Particles and Elementary Particle Physics 3 Credits
Intended for non-specialists. Fundamentals and modern advanced topics in nuclear and elementary particle physics. Topics include: nuclear force, structure of nuclei, nuclear models and reactions, scattering, elementary particle classification, SU(3), quarks, gluons, quark flavor and color, leptons, gauge theories, GUT, the big bang.
Prerequisites: PHY 369

PHY 420 Mechanics 3 Credits
Includes the variational methods of classical mechanics, methods of Hamilton and Lagrange, canonical transformations, Hamilton-Jacobi Theory.

PHY 421 Electricity & Magnetism I 3 Credits
Electrostatics, magnetostatics, Maxwell’s equations, dynamics of charged particles, multipole fields.

PHY 422 Electricity & Magnetism II 3 Credits
Electrodynamics, electromagnetic radiation, physical optics, electrodynamics in anisotropic media. Special theory of relativity.
Prerequisites: PHY 421

PHY 424 Quantum Mechanics II 3 Credits
General principles of quantum theory; approximation methods; spectra; symmetry laws; theory of scattering.
Prerequisites: PHY 369

PHY 425 Quantum Mechanics III 3 Credits
Prerequisites: PHY 424

PHY 428 Methods of Mathematical Physics I 3 Credits
Analytical and numerical methods of solving the ordinary and partial differential equations that occur in physics and engineering. Includes treatments of complex variables, special functions, product solutions and integral transforms.

PHY 429 Methods of Mathematical Physics II 3 Credits
Continuation of Physics 428 to include the use of integral equations.

PHY 431 Theory Of Solids 3 Credits
Prerequisites: PHY 363 and PHY 424

PHY 442 Statistical Mechanics 3 Credits
General principles of statistical mechanics with application to thermodynamics and the equilibrium properties of matter.
Prerequisites: PHY 340 and PHY 369

PHY 443 Nonequilibrium Statistical Mechanics 3 Credits
A continuation of PHY 442. Applications of kinetic theory and statistical mechanics to nonequilibrium processes; nonequilibrium thermodynamics.
Prerequisites: PHY 442

PHY 446 Atomic and Molecular Physics 3 Credits
Advanced topics in the experimental and theoretical study of atomic and molecular structure. Topics include fine and hyperfine structure, Zeeman effect, interaction of light with matter, multi-electron atoms, molecular spectroscopy, spectral line broadening atom-atom and electron-atom collisions and modern experimental techniques.
Prerequisites: PHY 442

PHY 455 Physics of Nonlinear Phenomena 3 Credits
Basic concepts, theoretical methods of analysis and experimental development in nonlinear phenomena and chaos. Topics include nonlinear dynamics, including period-multiplying routes to chaos and strange attractors, fractal geometry and devil’s staircase. Examples of both dissipative and conservative systems will be drawn from fluid flows, plasmas, nonlinear optics, mechanics and waves in disordered media. Must have graduate standing in science or engineering, or consent of the chairman of the department.

PHY 462 Theories of Elementary Particle Interactions 3 Credits
Relativistic quantum theory with applications to the strong, electromagnetic and weak interactions of elementary particles.
Prerequisites: PHY 425

PHY 467 Nuclear Theory 3 Credits
Theory of low-energy nuclear phenomena within the framework of non-relativistic quantum mechanics.

PHY 471 Continuum Mechanics 3 Credits
An introduction to the continuum theories of the mechanics of solids and fluids. This includes a discussion of the mechanical and thermodynamical bases of the subject, as well as the use of invariance principles in formulating constitutive equations. Applications of theories to specific problems are given.

PHY 472 Special Topics In Physics 1-3 Credits
Selected topics not sufficiently covered in other courses.
Repeat Status: Course may be repeated.

PHY 474 Seminar In Modern Physics 3 Credits
Discussion of important advances in experimental physics.
Repeat Status: Course may be repeated.
PHY 475 Seminar in Modern Physics 3 Credits
Discussion of important advances in theoretical physics.
Repeat Status: Course may be repeated.

PHY 482 Applied Optics 3 Credits
Review of ray and wave optics with extension to inhomogenous media, polarized optical waves, crystal optics, beam optics in free space (Gaussian and other types of beams) and transmission through various optical elements, guided wave propagation in planar waveguides and fibers (modal analysis), incidence of chromatic and polarization mode dispersion, guided propagation of pulses, nonlinear effects in waveguides (solitons), periodic interactions in waveguides, acousto-optic and electro-optics.
Prerequisites: PHY 352

PHY 490 Thesis 1-6 Credits

PHY 491 Research 3 Credits
Research problems in experimental or theoretical physics.
Repeat Status: Course may be repeated.

PHY 492 Research 3 Credits
Continuation of PHY 491.
Repeat Status: Course may be repeated.

PHY 499 Dissertation 1-15 Credits
Repeat Status: Course may be repeated.

Political Science

Richard K. Matthews, Ph.D NEH Distinguished Professor and Chair
E-mail: rm02@lehigh.edu / Phone: 610-758-3343 / Fax: 610-758-3348
http://cas.lehigh.edu/pol

The major in political science is designed to promote understanding of political ideas, institutions and processes and to develop skills in analyzing and evaluating political problems.

A balanced program within the discipline, one that exposes the student to various areas of inquiry in political institutions and political processes as well as in the comparative and philosophical perspectives of political analysis, has been the way in which the goals of the major program generally have been achieved. While the major program outlined below will prove adequate for most student needs, it may be that some special factors such as late transfer or unusual interests and/or abilities the outlined program does not accommodate some students. In that case the students may, in consultation with their advisers, develop a major program that in their judgment will more adequately fulfill those needs.

The faculty adviser to the student majoring in political science is designated by the department. The adviser consults with the student and approves the major program. The adviser attempts to help the student relate courses offered by the department to the student's educational goals. The adviser may also act as a resource for the student, and may suggest courses in other disciplines, language courses, and courses in research techniques that may be of benefit.

A variety of experiential opportunities are available to undergraduates majoring in political science. The department, for example, offers a Community Politics Internship every semester that includes opportunities for internship placements in either local government, private agencies or law offices. Students are also encouraged to apply for off-campus internship opportunities, e.g., American University’s Washington Semester Program and The Philadelphia Center’s Internship in Philadelphia.

Completion of the political science major is considered suitable training for the undergraduate who wishes to go on to law school, to become a social science teacher, or to work as a governmental official, party or civic leader, public affairs commentator, or staff member of a government research bureau. In addition, the business sector continues to provide opportunities in areas such as banking, insurance, and marketing for bachelor of arts graduates with training in the social sciences. Graduate study is advisable for students contemplating certain careers: college teaching, research, or public management, for example.

Professors: Richard K. Matthews, PhD (University of Toronto); Edward P. Morgan, PhD (Brandeis University); Laura K Olson, PhD (University of Colorado Boulder)

Associate Professors: Saladin M. Ambar, PhD (Rutgers University); Frank L. Davis, PhD (University of North Carolina); Nandini Deo, PhD (Yale University); Vera L. Fennell, PhD (University of Chicago); Breena Holland, PhD (University of Chicago); Jennifer M. Jensen, PhD (University of North Carolina); Janet Laible, PhD (Yale University); Holona L. Ochs, PhD (University of Kansas); Albert H. Wurth, Jr., PhD (University of North Carolina Chapel Hill)

Assistant Professors: Sean Beienburg, PhD (Princeton University); Anthony R DiMaggio, PhD (University of Illinois at Chicago)

Professors of Practice: Karen Beck Pooley, PhD (University of Pennsylvania); Mark Orrs, PhD (Columbia University)

Emeriti: Dave Curtis Amidon, Jr., MA (The Pennsylvania State University); Donald D. Barry, PhD (Syracuse University); Howard R. Whitcomb, PhD (Syracuse University); W. Ross Yates, PhD (Yale University)

The three core courses are required. Individual exceptions may be made, for good reasons, by the major adviser with the approval of the department chair.

Major Requirements

| POLS 001 | American Political System | 4 |
| POLS 003 | Comparative Politics | 4 |
| Select one of the following: | 4 |
| POLS 100 | Introduction to Political Thought |
| POLS 101 | Ancient Political Heritage |
| POLS 102 | Modern Political Heritage |

Electives
Select seven of the following with at least two courses from each of the two fields listed below:

American Politics, Public Law and Interdisciplinary

<p>| POLS 103 | Introduction to Public Administration |
| POLS 104 | Political Sociology |
| POLS 106 | The Politics of the Environment |
| POLS 109 | Global Citizenship and its Discontents |
| POLS 110 | Introduction to Public Policy |
| POLS 115 | Technology As Politics |
| POLS 120 | Politics of Women |
| POLS 205 | The Political Development of American Race Relations |
| POLS 232 | The Vietnam War in Politics, Media, and Memory |
| POLS 240 | Law and Order. The Politics of Crime and Punishment |
| POLS 274 | Political Parties and Elections |
| POLS 282 | First Ladies and the Changing Role of Women |
| POLS 302 | Comparative State Politics |
| POLS 304 | Governors and Presidents |
| POLS 305 | Seminar: Urban Policy and Planning |
| POLS 306 | Public Policy Process |
| POLS 307 | The Politics of Mental Health Policy |
| POLS 309 | Nonprofit Administration |
| POLS 310 | Social Entrepreneurship: How to Change the World |
| POLS 312 | Urban Environmental Policy Workshop |
| POLS 314 | Urban Agriculture Policy, Planning and Practice |
| POLS 317 | The American Presidency |
| POLS 326 | Organizing For Democracy |
| POLS 328 | U.S. Politics and the Environment |
| POLS 329 | Propaganda, Media, and American Politics |
| POLS 331 | Community Politics Internship |</p>
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<tr>
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<tbody>
<tr>
<td>POLS 333</td>
<td>Social Psychology of Politics</td>
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<td>POLS 348</td>
<td>Land Use, Growth Management, and the Politics of Sprawl</td>
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<td>POLS 351</td>
<td>Constitutional Law and Politics</td>
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<td>POLS 352</td>
<td>Civil Rights and Civil Liberties</td>
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<td>POLS 354</td>
<td>U.S. Health Care Politics</td>
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<td>POLS 358</td>
<td>Interest Groups, Factions, and Coalitions in American Politics</td>
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<td>POLS 359</td>
<td>U.S. Congress</td>
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<td>POLS 360</td>
<td>Public Administration</td>
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<td>POLS 363</td>
<td>Public Opinion Research</td>
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<td>POLS 368</td>
<td>Political Economy</td>
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<td>POLS 373</td>
<td>Globalization and Social Well-Being</td>
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<td>POLS 375</td>
<td>Seminar: Green Polity</td>
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<td>POLS 376</td>
<td>Seminar: National Social Policy</td>
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<td>POLS 378</td>
<td>Honors Thesis In Political Science</td>
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<td>POLS 379</td>
<td>Honors Thesis In Political Science</td>
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<td>POLS 100</td>
<td>Introduction to Political Thought</td>
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<td>POLS 105</td>
<td>Environmental Policy and Planning</td>
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<td>POLS 106</td>
<td>Environmental Values and Ethics</td>
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<td>POLS 125</td>
<td>International Political Economy</td>
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<td>POLS 324</td>
<td>Politics Of Western Europe</td>
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<td>POLS 325</td>
<td>Nationalism in Comparative Perspective</td>
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<td>POLS 335</td>
<td>Latin American Political Systems</td>
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<td>POLS 336</td>
<td>U.S. Foreign Policy and Latin America</td>
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<td>POLS 337</td>
<td>Religion and Politics in Latin America</td>
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<td>POLS 338</td>
<td>Markets, Justice, And Law</td>
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<td>POLS 339</td>
<td>The Rise of the State in Modern East Asia</td>
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<td>POLS 340</td>
<td>Domination</td>
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<td>POLS 342</td>
<td>Gender and Third World Development</td>
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<td>POLS 343</td>
<td>Global Politics of Race: Asia and Africa</td>
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<td>POLS 350</td>
<td>Religion and Politics in Comparative Perspective</td>
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<td>POLS 355</td>
<td>Environmental Justice and the Law</td>
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<td>POLS 356</td>
<td>Seminar: Political Philosophy</td>
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<td>POLS 357</td>
<td>Politics Of Authenticity</td>
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<td>POLS 364</td>
<td>Issues In Contemporary Political Philosophy</td>
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<td>POLS 367</td>
<td>American Political Thought</td>
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<td>POLS 370</td>
<td>Seminar: The Citizen versus the Administrative State</td>
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</table>

**Total Credits**: 40

POLITICAL SCIENCE HONORS

Students must have at least a 3.2 cumulative grade point average, and a 3.3 major grade point average, in order to proceed with departmental honors. Students with honors must complete ten courses in the major, including an independent study focusing on the honors thesis.

**POLITICAL SCIENCE HONORS**

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**Masters of Arts in Politics and Policy**

**Political Science**

For Graduate Students the department offers a graduate program leading to the Master of Arts degree. The applicant for admission is required to demonstrate adequate undergraduate preparation.

**COMMUNITY FELLOWS PROGRAM**

Students interested in state or local public service or nonprofit work may also elect to apply to the Community Fellows program in which the student works for 15 hours per week for a local non-profit organization on a project related to community (re)development. For more information on the Community Fellows program, please see the program website www.lehigh.edu/communityfellows.

Graduate students will be required to write a major paper (one semester) or a Master’s thesis (two semesters) that will be defended before a panel of faculty members. Those participating in the Community Fellows program will be required to write a paper summarizing and analyzing their community fellows experience.

The Master of Arts program is intended for high-achieving students with a social science and liberal arts background who have a keen interest in the study of politics and/or are interested in the Community Fellows program and related experiential learning opportunities. The Master of Arts prepares students for further study in political science, public policy, or the law as well as careers in business, public service, or nonprofit organizations.

**Courses**

**POLS 001 American Political System 4 Credits**

Constitutional principles; organization and operation of the national government; and dynamics of power within the U.S. political system.

**Attribute/Distribution**: SS

**POLS 003 (GS 003) Comparative Politics 4 Credits**

The political systems of foreign countries; approaches to the study of comparative politics.

**Attribute/Distribution**: SS

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1. One of the electives may, with the consent of the department, be in a cognate field.
POLS 100 (GS 100, PHIL 100) Introduction to Political Thought 4 Credits
A critical examination of political ideologies: Liberalism, Marxism, Fascism, and Islamism.
Attribute/Distribution: ND

POLS 101 Ancient Political Heritage 4 Credits
Important political thinkers from the pre-Socratics to early, modern political theorists like Machiavelli.
Attribute/Distribution: SS

POLS 102 Modern Political Heritage 4 Credits
 Begins where POLS 101 ends: from early, modern theorists (e.g., Hobbes) up to contemporary thinkers (e.g., Marcuse).
Attribute/Distribution: SS

POLS 103 Introduction to Public Administration 4 Credits
This course presents the intellectual history of the study of public administration in a manner that is intended to inform career choices for those who might consider public service and provide a broad introduction to the field of public administration. Students will gain a comprehensive perspective on the public administration discipline by exploring the pervasive puzzles, ethical dilemmas, and the critical issues in governance to date.
Attribute/Distribution: SS

POLS 104 (SOC 104) Political Sociology 4 Credits
An introduction to political sociology through an examination of the major sociological questions concerning power, politics, and the state. Covers questions concerning state formation, nationalism, social movements, globalization, political culture and participation, and civil society.
Attribute/Distribution: SS

POLS 105 (ES 105) Environmental Policy and Planning 4 Credits
Analysis of the framework that has been established to protect the environment and promote sustainable growth. Focus on the roles of the different branches of the U.S. government and the relative responsibilities of state and local governments within this framework. Consideration of the political nature of environmental issues and the social forces influencing environmental protection in different areas of domestic environmental policy, such as climate change, toxic waste disposal, and natural resources conservation.
Attribute/Distribution: SS

POLS 106 (ES 106) Environmental Values and Ethics 4 Credits
An introduction to the ethical perspectives and values that shape human relationships to the natural environment in contemporary society. What are the moral implications of these relationships for justice and human collective action? Given these implications, what policy responses to environmental problems are morally or politically justifiable? In answering these questions, the course explores ethical ideas developed in different schools of environmental thought, such as deep ecology and ecofeminism, in addition to ideas that emerge from social movements, such as environmental justice and bioregionalism.
Attribute/Distribution: SS

POLS 107 The Politics of the Environment 4 Credits
A survey of the major environmental, resource, energy and population problems of modern society, focusing on the United States. The politics of man’s relationship with nature, the political problems of ecological scarcity and public goods, and the response of the American political system to environmental issues.
Attribute/Distribution: SS

POLS 108 Global Citizenship and its Discontents 4 Credits
The purpose of the course is to consider the nature-and desirability-of citizenship, both as an ideal and as applied (if possible) in the global context. What exactly does it mean to be a “citizen?” Does citizenship require particular actions, thoughts, or values? What are the legal, political, and moral obligations of this designation? What exactly do you owe to your neighbor, or to someone on the other side of the world? Readings range from Socrates to the Manefesto of the Unabomber.
Attribute/Distribution: SS

POLS 109 Introduction to Public Policy 4 Credits
Introduces students to the basic theories, principles, institutions, and processes of public policy in the U.S. The objectives are to provide students with an understanding of how social problems are defined, how potential solutions to those problems move through the policy process, and gain an empirical perspective on the consequences, as well as insight regarding the normative dimensions of policy making. Students will develop knowledge of the framework for understanding policy and engage in critical thinking regarding the nature of policy.
Attribute/Distribution: SS

POLS 115 Technology As Politics 4 Credits
Relationship of technology and technological change with politics and public policy. Review of theories of political significance of technology, including technological determinism, technology assessment, technological progress and appropriate technology. Specific issues in technology with emphasis on U.S.
Attribute/Distribution: ND

POLS 133 (AAS 133, FREN 133, HIST 133, LAS 133, MLL 133) Lehigh in Martinique: Globalization and Local Identity 3-4 Credits
History, culture, and politics of the French Caribbean island of Martinique, from its position as a key site of the 18th century Atlantic World economy to becoming an official French department and outpost of the European Union. Interdisciplinary perspectives on the complex nature of social identity, historical memory and impact of globalization. No French is required. Offered during winter inter-term through Lehigh Study Abroad.

POLS 179 (WGSS 179) Politics of Women 4 Credits
Selected social and political issues relating to the role of women in American society. Focuses on such questions as economic equality, poverty, and work roles, the older woman, gender gap, political leadership, reproduction technology, and sexual violence.
Attribute/Distribution: SS

POLS 201 (ASIA 201, GS 201) Democracy and Dictatorship in South Asia 4 Credits
Theories of democracy and democratization explored in the South Asian context. Relationship of democracy to economic development and identity considered. How do historical legacies of colonialism and conflict shape contemporary outcomes.
Attribute/Distribution: SS

POLS 205 (AAS 205) The Political Development of American Race Relations 4 Credits
This course examines the distinctive role race has played in shaping the political history of the United States.
Attribute/Distribution: SS

POLS 225 (IR 225) International Political Economy 4 Credits
Principles governing the interaction between the economic and political components of international phenomena. Political aspects of trade, investment, and global economic order. Political underpinnings of international economic relations. Domestic and international political consequences of economic policy and international economic relations.
Prerequisites: IR 010 and ECO 001
Attribute/Distribution: SS

POLS 230 (AAS 230) Social Movements and Legacies of the 1960s 0,4 Credits
The lessons and legacies of 1960s social and political movements. Students examine civil rights, black power movements, the New Left, campus protests, the Vietnam war and antiwar movement, the counterculture, women’s and ecology movements and assess their connection to democracy, today’s world and their own lives.
Attribute/Distribution: SS

POLS 232 The Vietnam War in Politics, Media, and Memory 4 Credits
Examines the meaning of the American war in Vietnam as interpreted and disputed in American politics, the mass media, and private and public memory. Reviews the political history and context of the war, personal experiences and critical perspectives on the war, and characterizations of the war in mainstream news media and popular film.
Attribute/Distribution: SS
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<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tr>
<td>POLS 240</td>
<td>Law and Order. The Politics of Crime and Punishment</td>
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<td>POLS 274</td>
<td>Political Parties and Elections</td>
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<td>POLS 300</td>
<td>Apprentice Teaching</td>
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<td>Governors and Presidents</td>
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<td>POLS 305</td>
<td>(ES 305) Seminar: Urban Policy and Planning</td>
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<td>POLS 306</td>
<td>Public Policy Process</td>
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<td>POLS 307</td>
<td>The Politics of Mental Health Policy</td>
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<td>(ENTP 309) Nonprofit Administration</td>
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<td>POLS 310</td>
<td>(ENTP 310) Social Entrepreneurship: How to Change the World</td>
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<td>POLS 312</td>
<td>(ES 312) Urban Environmental Policy Workshop</td>
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<td>POLS 314</td>
<td>(ES 314) Urban Agriculture Policy, Planning and Practice</td>
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<td>POLS 317</td>
<td>The American Presidency</td>
<td>3-4</td>
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<td>POLS 321</td>
<td>Research In Political Science</td>
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<td>POLS 323</td>
<td>Politics Of The European Union</td>
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The course explores the legal and political consequences of various theories of crime, punishment and social control in the United States. Topics include policing, racial profiling, trial court proceedings and the administration of justice, growing incarceration rates and the prison industry, capital punishment, the jury system, and the nature of legal obligation.

The role of presidential wives since Martha Washington will be examined with particular attention focused on the decades since 1932, beginning with Eleanor Roosevelt.

The course will examine the growth of that authority and its effect on public policy over the past 100 years. We will explore key figures and eras in American political history and the role governors and presidents have played in reshaping the locus of power in public affairs.

The course is an introductory planning course, with an emphasis on housing and community development policy. It will examine historical and contemporary aspects of urban politics; the economic, demographic, and spatial evolution of American cities; and various urban problems, such as the spatial mismatch between people and jobs, housing quality and affordability, and residential segregation. Finally, the course will review how planners have addressed conditions in cities and regions over time.

Power relations and their impacts on selected public policy issues, specifically taxation, housing, environment, poverty, energy, the military, and health.

What is normal behavior, and how do we come to understand mental illness? How do the resulting policies, to address mental health, impact society? This course is designed to facilitate thoughtful discourse on the various ways in which society regulates access to opportunities, facilitates integration or alienation, and constructs the social world.

This course will address key questions in nonprofit sector research, policy, and management and familiarize students with factors that tend to make the nonprofit sector distinct. Students will gain an understanding of the scope and character of nonprofit activity in the U.S. and abroad. We will explore current debates in nonprofit policy and evaluate critical challenges facing the organization and management of nonprofits.

The marketplace does not always have to be harsh. Social entrepreneurship uses market-based approaches to address needs and solve problems in our society. Students in this seminar-style course will learn how to identify community problems, convince the community that it is a problem worth solving, design the response, and implement it. Hands-on projects. Must have at least junior standing or consent of the minor director.

Seminar on how to value the environment for the purpose of designing and analyzing environmental policies. Review of the "contingent valuation method" currently used to price environmental resources, and assessment of this method's empirical and normative strengths and weaknesses. Evaluation of "deliberative monetary valuation" as an improved method for environmental assessment. Consideration of non-monetary approaches to environmental valuation as alternatives to understanding the environment's relationship to human well-being in policy contexts.

An urban environmental planning and policy course in which students explore an issue affecting the local community, evaluate current policy responses and possible alternatives, and present recommendations to public officials, local organizations, and community members. Student research and analysis will draw on primary and secondary data, as well as feedback from conducting individual interviews, focus groups, and community meetings. Prior projects include determining how Bethlehem's new City Revitalization improvement Zone (CRIZ) might best benefit the South Side of Bethlehem, PA.

Review of urban agriculture and planning in growing social movement to strengthen neighborhoods, promote healthier living, and create localized and sustainable food economies. Students consider these programs in relation to national farm policy and develop urban agriculture projects with community partners. Case studies illustrate how improving food access, beautifying vacant land, and reducing farm-to-table distances, are creatively and successfully combined. Students will receive hands-on gardening and farming experience at a community garden.

Role of the executive in the American political process. Includes an analysis of the historical development, selection process, and scope of executive power. Emphasizes domestic and foreign policy initiatives of selected presidents from FDR to today.

Models in the explanation of political phenomena, appropriateness of measurement techniques; construction of research designs; rationale and application of statistical analyses; individual projects involving the construction and testing of models employing a major social science data set. Consent of instructor required.

The institutions and policy-making processes of the European Union. Topics include the creation of the single market and the euro, environmental and agricultural policy, regional development and the policy challenges of eastward enlargement.

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<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisites</th>
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<tr>
<td>POLS 240</td>
<td>Law and Order. The Politics of Crime and Punishment</td>
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<td>POLS 274</td>
<td>Political Parties and Elections</td>
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<td>POLS 282</td>
<td>First Ladies and the Changing Role of Women</td>
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<td>POLS 304</td>
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<td>POLS 305</td>
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<td>POLS 306</td>
<td>Public Policy Process</td>
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<td>POLS 309</td>
<td>(ENTP 309) Nonprofit Administration</td>
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<td>POLS 310</td>
<td>(ENTP 310) Social Entrepreneurship: How to Change the World</td>
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<td>POLS 312</td>
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<td>POLS 314</td>
<td>(ES 314) Urban Agriculture Policy, Planning and Practice</td>
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<td>POLS 317</td>
<td>The American Presidency</td>
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<td>POLS 321</td>
<td>Research In Political Science</td>
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<tr>
<td>POLS 323</td>
<td>Politics Of The European Union</td>
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POLS 324 Politics Of Western Europe 3,4 Credits
Comparative discussion of systems of government in Western Europe and of major policy questions facing these states in the post-war era. Topics include the evolution of social welfare systems, the impact of economic crises and globalization on Western European political economy, and immigration and identity politics.
Prerequisites: POLS 003
Attribute/Distribution: SS

POLS 325 (GS 325) Nationalism in Comparative Perspective 3,4 Credits
Examination of major theoretical and policy debates in contemporary studies of nationalism. Focus on the emergence and endurance of nationalist movements in the modern era. Discussion of efforts to evaluate the legitimacy of nationalist claims and to resolve nationalist conflict.
Prerequisites: POLS 003

POLS 326 Organizing For Democracy 3-4 Credits
Seminar on the theory and practice of community and political organizing and their relationship with democracy and power in the United States, complementing semester-long student field placements with community groups and local organizations. Student teams help enhance the political voice of under-resourced community groups through organization-building, outreach, and policy input at the local level. Consent of instructor required.
Attribute/Distribution: ND

POLS 328 (ES 328) U.S. Politics and the Environment 4 Credits
An examination of contemporary American politics and policy dealing with environmental issues. Current controversies in the legislative and regulatory areas will be covered to examine environmental issues and the political process. Significant portions of the course readings will be taken from government publications.

POLS 329 Propaganda, Media, and American Politics 3-4 Credits
The role of propaganda and mass media in sustaining hegemony in the United States. Emphasis on television, advertising and mass culture, public relations, news media, and political propaganda pertaining to U.S. foreign and domestic policy. Students compare critical counter-hegemonic theories to political speeches, documents, news reports, and media encounters that shape much of American political life.

POLS 330 Community Politics Internship 4 Credits
Integrated fieldwork and academic study. Seminar, research paper, and journal; internship with government and social service agencies, political groups, elected officials, and law offices. Consent of instructor required.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

POLS 331 Social Psychology of Politics 4 Credits
Political behavior viewed from a psychological and social psychological perspective.
Prerequisites: (ANTH 001 or SOC 001 or PSYC 001)

POLS 335 Latin American Political Systems 4 Credits
Democratic, authoritarian and revolutionary paths to contemporary political issues. Political, economic and social implications of contemporary “democratic” regimes and neo-liberal economic policies. Discussion groups and student presentations on prospects for democratic peace and prosperity in the future.
Prerequisites: (POLS 003)

POLS 336 U.S. Foreign Policy and Latin America 3-4 Credits
U.S. historical relationship with Central America, Caribbean and South America with emphasis on economic and military dominance. Contemporary issues such as U.S. invasions of Panama and Grenada, U.S. Cuban relations, the militarization of the “drug war,” counter-insurgency. Written analysis of competing U.S. interests across time and regions.
Prerequisites: (POLS 003)

POLS 337 Religion and Politics in Latin America 4 Credits
Indigenous and “imported” religious structures, the prominent role of the Catholic Church in Latin America, and the recent explosion of Protestant/ Pentecostal churches. Emphasis on the intersection of religious belief and power (i.e., gender, local politics, national development, etc.). Short papers integrate material with students’ knowledge of religious/political phenomena. Discussion groups analyze philosophical foundations of belief.
Prerequisites: (POLS 003 and POLS 336)

POLS 338 Markets, Justice, And Law 3,4 Credits
The exploration of the various ways in which markets shape cultural, social, ethical, and political practices in contemporary society. Normative justification for market as an institutional arrangement that is neutral between different views of “the good”. Ethical critique of this normative justification and implications of the critique for law and policy.

POLS 339 (ASIA 339) The Rise of the State in Modern East Asia 4 Credits
An examination of the role of Asian nationalism in the construction of the modern state form in Asia.

POLS 340 Domination 4 Credits
Is hierarchy in human societies inevitable? How do we make sense of justice and equality if domination is an inescapable aspect of the social world? Our consideration of these questions will draw on a wide range of literatures including primatology, political philosophy, anthropology, and gender studies. We will also use non-academic sources such as films and novels to explore the world of domination and resistance.

POLS 342 (GS 342, WGSS 342) Gender and Third World Development 3-4 Credits
Focus on gender implications of contemporary strategies for Third World economic growth, neo-liberalism. How do economic theories affect ‘real people?’ How do economic theories affect men vs. women? What is the role of people who want to ‘help?’ Some background in economic theories and/or Third World politics desired, but not required.
Prerequisites: POLS 001 or WGSS 001

POLS 343 (AAS 343, ASIA 343, GS 343) Global Politics of Race: Asia and Africa 4 Credits
An examination of the concept of “race” and its impact on domestic and international politics.

POLS 348 Land Use, Growth Management, and the Politics of Sprawl 3-4 Credits
An intro to the issues of Land Use Planning, Community, Growth Mgmt, & Sprawl. Will examine the history of urban development in America, from the earliest settlements to the auto suburbs. Also explore such planning & development factors as comprehensive plans, zoning, & the influence of infrastructure on development. Concludes with an assessment of the revival of city centers, alternatives to sprawl, & comparisons to development patterns in other countries.

POLS 350 Religion and Politics in Comparative Perspective 4 Credits
This research seminar attempts to identify the conditions under which religious parties arise and become influential, how religion influences popular understandings of secular politics and the extent to which religion is a necessary feature of modern public discourse. These topics are explored through country specific cases from around the world.
POLS 351 Constitutional Law and Politics 4 Credits
Exploration of the process of legal reasoning, the place of the United States Supreme Court in the American political system, the multiple influences on judicial decision-making, and various interpretive debates over the meaning of the U.S. Constitution. Following this introduction to the interplay of law and politics, the focus turns to particular domains within the canon of constitutional law, including cases pertaining to the Supreme Court’s jurisdiction and capacity; the separation of powers between the three branches of government; federalism (federal-state-local relations); the “taking” clause; election law; the powers of Congress; “police powers” at the state level; and, foreign affairs and constitutional crises. POLS 001 is strongly recommended. 
Attribute/Distribution: ND

POLS 352 Civil Rights and Civil Liberties 3-4 Credits
A continuation of themes, issues, and debates of the previous semester (POLS 351). This course addresses the major cases and controversies within several legal domains, including the freedoms of and from religion; freedom of speech; freedom of association; freedom of the press; the right to bear arms; the rights of criminal defendants and suspects; the right to privacy; capital punishment; and, the equal protection of the law. 
Requisites: POLS 351 
Attribute/Distribution: ND

POLS 354 (HMS 354) U.S. Health Care Politics 4 Credits
Health care programs, policies, and their impact on American society. Topics include approaches to health care; public sector plans (Medicare and Medicaid); managed care; the employer-sponsored system; medically uninsured; vested interests and lobbyists; movements for national health care; and options for change. 
Attribute/Distribution: SS

POLS 355 (ES 355) Environmental Justice and the Law 4 Credits
This course explores the various ways in which environmental law and policy can have discriminatory effects. It examines the rise and evolution of environmental justice movement, and the impact of environmental justice claims on administrative rule making at state and federal level. Reviewing the history of case law concerning environmental justice suits filed under the 1964 Civil Rights Act, it also examines the future of environmental justice in environmental law and policy. 
Requisites: POLS 105 or ES 105 
Attribute/Distribution: SS

POLS 356 Seminar: Political Philosophy 3-4 Credits
Critical examination of several of the “great books” and/or “great ideas” in political thought. Students will help select the material for critical discussion. 
Attribute/Distribution: SS

POLS 357 Politics Of Authenticity 4 Credits
Works in political philosophy, psychoanalytic theory, literature, and film that discuss knowing and being one’s self will be critically discussed. If you feel a life of “quiet desperation” is inevitable, this course is for you. 
Attribute/Distribution: SS

POLS 358 Interest Groups, Factions, and Coalitions in American Politics 4 Credits
The rise of interest group power. Social, economic, and political reasons for groups’ increasing influence. Value of different group resources and influence in particular national policy arenas. Types of more, and less, powerful interests, and the implications of this distribution of power for American politics. 
Attribute/Distribution: SS

POLS 359 U.S. Congress 3-4 Credits
Elections for the House and Senate and their significance for the way in which Congress functions. The formal structure of party leadership and committees, House and Senate organizational and functional differences, and informal and formal power of legislation and oversight. Congressional relations with the president, bureaucracy, and Supreme Court. 
Requisites: POLS 001 
Attribute/Distribution: SS

POLS 360 Public Administration 3-4 Credits
The nature of administration; problems of organization and management; public personnel policies; budgeting and budgetary system; forms of administrative responsibility. 
Attribute/Distribution: ND

POLS 363 Public Opinion Research 4 Credits
This course examines fundamental processes and tools employed in public opinion research. This class is designed to provide students with the ability to develop, implement and evaluate various forms of public opinion research including surveys, focus groups and individual interviews. Students will be introduced to numerous aspects of public opinion research including questionnaire design, sampling, interviewing, data analysis, focus group moderation, and varied forms of data collection. 
Attribute/Distribution: SS

POLS 364 (PHIL 364) Issues In Contemporary Political Philosophy 3-4 Credits
Selected topics in contemporary political philosophy, such as the Frankfurt school, existentialism, legitimation, authenticity, participatory democracy, and the alleged decline of political philosophy. May be repeated for credit with the consent of instructor. 
Repeat Status: Course may be repeated. 
Attribute/Distribution: SS

POLS 367 (PHIL 367) American Political Thought 3-4 Credits
A critical examination of American political thought from the founding of the Republic to the present. Writings from Madison, Hamilton, and Jefferson to Emma Goldman, Mary Daly, Malcolm X, Henry Kariel, and others will be discussed. 
Attribute/Distribution: SS

POLS 368 Political Economy 3-4 Credits
Relational of democratic politics to government and market, and significance of economic power in the American polity. Economic rationale for the place of the market and economic institutions in polity. Emphasis on information in comparison of economic approaches to public policy and organization (public goods, market failure, and collective action) with traditional political science approaches (group mobilization and conflict, non-decisions and symbolic action). 
Attribute/Distribution: SS

POLS 370 Seminar: The Citizen versus the Administrative State 4 Credits
Administrative power and policy. Constitutional and judicial control of administration. Remedies against improper administrative acts. Major emphasis will be on the United States, with some attention given to analogous issues in other countries. 
Attribute/Distribution: SS

POLS 373 Globalization and Social Well-Being 4 Credits
This course examines how the various dimensions of globalization impact people by exploring factors that reflect and affect quality of life. Students will gain an understanding of the complexities resulting from the growing interconnectedness and interdependencies of global relations. The course is intended to get people thinking creatively about opportunities for connections that preserve human dignity. 
Attribute/Distribution: SS

POLS 375 (ES 375) Seminar: Green Polity 4 Credits
Development of guidelines and applications for public policy and political action directed toward environmental sustainability and political feasibility. Focus on problem-solving and policy design, connecting sustainable environmental goals with workable and responsive institutional designs. 
Attribute/Distribution: SS

POLS 376 Seminar: National Social Policy 3-4 Credits
A readings/research seminar on current social policy questions. Analyzes, from alternatives political perspectives, such issues as Social Security, Medicare, health care, welfare reform, income inequality, and taxation. Students research a specific social issue of their choice. Class discussion on individual research and common readings. 
Attribute/Distribution: SS
POLS 378 Honors Thesis in Political Science 1-4 Credits
Opportunity for undergraduate majors in Political Science to pursue an extended project for senior honors. Department permission required.
Attribute/Distribution: SS

POLS 379 Honors Thesis in Political Science 4 Credits
Continuation of POLS 378. Consent of department required.
Prerequisites: POLS 378
Attribute/Distribution: ND

POLS 381 Special Topics 1-4 Credits
A seminar on a topic of special interest in a particular political institution, process, or policy. Consent of department chair required.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

POLS 382 Special Topics 1-4 Credits
A seminar on a topic of special interest in a particular political institution, process, or policy. Consent of department chair required.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

POLS 401 Introduction to Politics and Policy 3 Credits
Structured around a generative theme, such as inequality and justice, or community and the environment, each faculty member will discuss this issue from the perspective of his/her specialty.

POLS 402 Methods of Policy Analysis 3 Credits
Approaches or models used to analyze public policy. Assumptions underlying each model and critiques of each may include a number of the following approaches: institutional, process, rational, group, incremental, and/or elite.

POLS 403 Creativity, Ideas, and Methods in Political Science 3 Credits
Explores the challenges and creative possibilities of turning ‘research interests’ into doable research projects – such as research papers, MA theses, or doctoral dissertations. Discusses the domains of qualitative methodology and how social scientists seek to understand, represent, and analyze the social world. Topics: the politics of interpretation, observation, and quantification in social research, and critiques of assumptions about power and causality.

POLS 404 Environmental Valuation: Policy Design/Legal Analysis 3 Credits

POLS 405 (ES 405) Seminar: Urban Policy and Planning 3 Credits
This course is an introductory planning course, with an emphasis on housing and community development policy. It will examine historical and contemporary aspects of urban politics; the economic, demographic, and spatial evolution of American cities; and various urban problems, such as the spatial mismatch between people and jobs, housing quality and affordability, and residential segregation. Finally, the course will review how planners have addressed conditions in cities and regions over time.

POLS 407 The Politics of Mental Health Policy 3 Credits
What is normal behavior, and how do we come to understand mental illness? How do the resulting policies to address mental health, impact society? This course is designed to facilitate thoughtful discourse on the various ways in which society regulates access to opportunities, facilitates integration or alienation, and constructs the social world.

POLS 408 American Politics Core 3 Credits
A survey of American politics utilizing readings reflecting a variety of methodological approaches and theoretical perspectives. Readings include but are not limited to works widely regarded as “classics” in American political science.

POLS 409 Nonprofit Administration 3 Credits
This course will address key questions in nonprofit sector research, policy, and management and familiarize students with factors that tend to make the nonprofit sector distinct. Students will gain an understanding of the scope and character of nonprofit activity in the U.S. and abroad. We will explore current debates in nonprofit policy and evaluate critical challenges facing the organization and management of nonprofits.

POLS 411 (ES 411) Environmental Valuation for Policy Design 3 Credits
Seminar on how to value the environment for the purpose of designing and analyzing environmental policies. Review of the "contingent valuation method" currently used to price environmental resources, and assessment of this method's empirical and normative strengths and weaknesses. Evaluation of "deliberative monetary valuation" as an improved method for environmental assessment. Consideration of non-monetary approaches to environmental valuation as alternatives to understanding the environment's relationship to human well-being in policy contexts.

POLS 412 (ES 412) Urban Environmental Policy Workshop 3 Credits
An urban environmental planning and policy course in which students explore an issue affecting the local community, evaluate current policy responses and possible alternatives, and present recommendations to public officials, local organizations, and community members. Student research and analysis will draw on primary and secondary data, as well as feedback from conducting individual interviews, focus groups, and community meetings. Prior projects include determining how Bethlehem's new City Revitalization improvement Zone (CRIZ) might best benefit the South Side of Bethlehem, PA.

POLS 413 Modern Political Philosophy 3 Credits
A study of selected modern political philosophers and their continuing effect on politics and political philosophy.

POLS 414 (ES 414) Urban Agriculture Policy, Planning and Practice 3 Credits
Review of urban agriculture and greening programs in growing social movement to strengthen neighborhoods, promote healthier living, and create localized and sustainable food economies. Students consider these programs in relation to national farm policy and develop urban agriculture projects with community partners. Case studies illustrate how improving food access, beautifying vacant land, and reducing farm-to-table distances, are creatively and successfully combined. Students will receive hands-on gardening and farming experience at a community garden.

POLS 415 State and Local Government 3 Credits
Comparative state government, urban politics, intergovernmental relations, regional and local government.

POLS 416 American Environmental Policy 3 Credits
Formation, implementation and impact of environmental policies in the U.S. An examination of the scope of environmental problems, the development of environment as an issue, the role of interest groups and public opinion, the policy-making process, and the various approaches to implementing environmental policy. Special attention to current issues and administrative approaches and to the distinctive character of environmental protection as a political issue.

POLS 421 Research Methods 3 Credits
Models in the explanation of political phenomena, appropriateness of measurement techniques; construction of research designs; rationale and application of statistical analyses; individual projects involving the construction and testing of models employing a major social science data set.

POLS 423 Politics of the European Union 3 Credits
The institutions and policy-making processes of the EU. Topics include the creation of the single market and the euro, environmental and agricultural policy, regional development and the policy challenges of eastward enlargement.
POLS 425 Nationalism in Comparative Perspective 3 Credits
Examination of major theoretical and policy debates in contemporary studies of nationalism. Focus on the emergence and endurance of nationalist movements in the modern era. Discussion of efforts to evaluate the legitimacy of nationalist claims and to resolve nationalist conflict.

POLS 426 Organizing For Democracy 3 Credits
Seminar on the theory and practice of community and political organizing and their relationship with democracy and power in the United States, complementing semester-long student field placements with community groups and local organizations. Student teams help enhance the political voice of under-resourced community groups through organization-building, outreach, and policy input at the local level. Consent of instructor required.

POLS 427 American Democracy: Decline or Revival? 3 Credits
Theories of democracy, analysis of its decline, and possible scenarios for a revived democratic culture. Research projects on topics of personal interest; class participation in hands-on project in local democracy-building.

POLS 428 Media & Democracy 3 Credits
General & theoretical considerations about democracy, the political economy of the mass media, and analysis of ways in which the media influence political discourse in the United States and globalized media culture. Hands-on analysis of media samples: news coverage, political advertising, public relations advertising, and interactive learning on how group might utilize the media to express its voice effectively.

POLS 429 Propaganda, Media & American Politics 3 Credits
The role of propaganda and mass media in sustaining hegemony in the United States. Emphasis on television, advertising and mass culture, public relations, news media, and political propaganda pertaining to U.S. foreign and domestic policy. Students compare critical, counter-hegemonic theories to political speeches, documents, news reports, and media encounters that shape much of American political life.

POLS 430 Social Movements & Legacies of 1960s 3 Credits
The lessons and legacies of 1960s social and political movements. Students examine civil rights, black power movements, the New Left, campus protests, the Vietnam war and antiwar movement, the counterculture, women's and ecology movements and assess their connection to democracy, today's world, and their own lives.

POLS 431 (ES 431) Public Management 3 Credits
The study of bureaucracy and problems of public and nonprofit organization and management; executive leadership; personnel management systems and regulatory administration.

POLS 433 The Politics Of Health Care 3 Credits
Examination of state-directed political, economic and social development in health care. Emphasis on international politics. Issues ranging from the role of the private sector to government-supported programs; focus on ways to restructure the system, based on alternatives in selected nations.

POLS 435 Power, Persuasion and the American Presidency 3 Credits
Examination of selected modern presidents, from FDR to the current occupant of the White House, and their effectiveness as communicators and policy makers.

POLS 438 Markets, Justice, And Law 3 Credits
The exploration of the various ways in which markets shape cultural, social, ethical, and political practices in contemporary society. Normative justification for market as an institutional arrangement that is neutral between different views of "the good". Ethical critique of this normative justification and implications of the critique for law and policy.

POLS 439 The Rise of the State in Modern East Asia 3 Credits
An examination of the role of Asian nationalism in the construction of the modern state form in Asia.

POLS 440 Domination 3 Credits
Is hierarchy in human societies inevitable? How do we make sense of justice and equality if domination is an inescapable aspect of the social world? Our consideration of these questions will draw on a wide range of literatures including primatology, political philosophy, anthropology, and gender studies. We will also use non-academic sources such as films and novels to explore the world of domination and resistance.

POLS 443 Global Politics of Race: Asia and Africa 3 Credits
An examination of the concept of "race" and its impact on domestic and international politics.

POLS 448 (HIST 448) Land Use, Growth Management, and the Politics of Sprawl 3 Credits
An intro to the issues of Land Use Planning, Community, Growth Mgmt, & Sprawl. Will examine the history of urban development in America, from the earliest settlements to the auto suburbs. Also explore such planning & development factors as comprehensive plans, zoning, & the influence of infrastructure on development. Concludes with an assessment of the revival of city centers, alternatives to sprawl, & comparisons to development patterns in other countries.

POLS 450 Religion and Politics in Comparative Perspective 3 Credits
This research seminar attempts to identify the conditions under which religious parties arise and become influential, how religion influences popular understandings of secular politics and the extent to which religion is a necessary feature of modern public discourse. These topics are explored through country specific cases from around the world.

POLS 451 Comparative Politics Core 3 Credits
Discussion of major recent works in comparative politics that exemplify on-going substantive debates and methodological problems in the field. Topics: state-building and the construction of social order, institutions, political economy, democracy, development, and political mobilization.

POLS 452 Civil Rights and Civil Liberties 3 Credits
An examination of the concept of "race" and its impact on domestic and international politics. Reviewing the history of case law concerning environmental justice claims on administrative rule making at state and federal level. Examines major recent works in comparative politics that exemplify on-going substantive debates and methodological problems in the field. Topics: state-building and the construction of social order, institutions, political economy, democracy, development, and political mobilization.

POLS 455 (ES 455) Environmental Justice & The Law 3 Credits
Examination of state-directed political, economic and social development in and among Asian states, with an addition focus on the relationships between the domestic policies of various Asian states and relations with non-Asian states.

POLS 456 Seminar: Political Philosophy 3 Credits
Critical examination of several of the "great books" and/or "great ideas" in political thought.

POLS 457 Politics Of Authenticity 3 Credits
Works in political philosophy, psychoanalytic theory, literature, and film that discuss knowing and being one’s self will be critically discussed. If you feel a life of “quiet desperation” is inevitable, this course is for you.
POLS 462 Seminar: American Political Thought 3 Credits
Focus on a narrow topic or theorist in the field, e.g., the work of Jefferson, Madison, Hamilton, or Tocqueville. Students will be required to write a major paper and present it to the class.

POLS 463 Public Opinion Research 3 Credits
This course examines fundamental processes and tools employed in public opinion research. This class is designed to provide students with the ability to develop, implement and evaluate various forms of public opinion research including surveys, focus groups and individual interviews. Students will be introduced to numerous aspects of public opinion research including questionnaire design, sampling, interviewing, data analysis, focus group moderation, and varied forms of data collection.

POLS 464 Community Fellowship I 3 Credits
15 hours/week in regional agency on specific project relating to regional redevelopment with regularly scheduled contact hours with the faculty advisor.

POLS 465 Community Fellowship II 3 Credits
15 hours/week in regional agency on specific project relating to regional redevelopment with regularly scheduled contact hours with the faculty advisor.

POLS 466 Legal Problems 3 Credits
This course involves an examination of the role of legal rules, agents, institutions, and values in our society. Primary emphasis will be given to the American legal system, although we will evaluate U.S. principles and politics through a comparative lens as well.

POLS 467 Political Economy 3 Credits
Relationship of democratic politics to government and market, and significance of economic power in the American polity. Economic rationale for the place of the market and economic institutions in polity. Emphasis on information in comparison of economic approaches to public policy and organization (public goods, market failure and collective action) with traditional political science approaches (group mobilization and conflict, non-decisions and symbolic actions).

POLS 468 Globalization and Social Well-Being 3 Credits
This course examines how the various dimensions of globalization impact people by exploring factors that reflect and affect quality of life. Students will gain an understanding of the complexities resulting from the growing interconnectedness and interdependencies of global relations. The course is intended to get people thinking creatively about opportunities for connections that preserve human dignity.

POLS 469 (ES 475) Seminar: Green Polity 3-4 Credits
Development of guidelines and applications for public policy and political action directed toward environmental sustainability and political feasibility. Focus on problem-solving and policy design, connecting sustainable environmental goals with workable and responsive institutional designs.

POLS 470 Advanced Computer Applications 3 Credits
Uses of computers in social sciences, including data collection, management, analysis, presentation, and decision-making; includes weekly lab.

POLS 471 Special Topics 1-3 Credits
Individual inquiry into some problem of government. Reading, field work, and other appropriate techniques of investigation. Conferences and reports.
Repeat Status: Course may be repeated.

POLS 472 Special Topics 1-3 Credits
Continuation of POLS 471.
Repeat Status: Course may be repeated.

POLS 490 Thesis 1-6 Credits

Polymer Science and Engineering

Lehigh has a diverse group of faculty members with strong, primary interest in polymer science and engineering. In order to provide better opportunities for courses and research in this interdisciplinary field, activities are coordinated through the Center for Polymer Science and Engineering (CPSE), and its academic Polymer Education Committee. Polymer faculty from traditional departments of chemical engineering, chemistry, materials science and engineering, physics, and mechanical engineering and mechanics, are participants of the CPSE. There are two ways in which qualified graduate students, with degrees in the above or related fields, may participate. Students may pursue graduate studies within an appropriate department. Departmental procedures must be followed for the degree sought. The student’s adviser must be in that department and the student receives a normal departmental degree, with emphasis in polymer courses and research. Such students are encouraged to pursue a graduate certificate in polymer science and engineering. Alternatively, students may elect to pursue studies toward an interdisciplinary M.S., M.E., or Ph.D. degree in polymer science and engineering. The procedures for this latter case are summarized as follows.

Students are admitted through one of the participating departments and must meet that department’s admissions criteria. When the student is ready (must have taken/be taking at least one polymer course and be in good standing in the department), the student petitions to transfer to the Polymer Science and Engineering graduate program. After the petition is approved, his/her degree program becomes Polymer Science and Engineering, but the student remains in the home department.

Master of Science Degree in Polymer Science and Engineering
Master of Science Degree in Polymer Science and Engineering requires a total of 24 credits in course work and six credits in research. The masters thesis is directed and signed by a faculty member of the Center for Polymer Science and Engineering and co-signed by the chairman of the Polymer Education Committee or the director of the CPSE.

Master of Engineering Degree in Polymer Science and Engineering
Master of Engineering Degree in Polymer Science and Engineering requires a total of 30 credits of course work. This option is intended for those students who do not work in a laboratory setting, or for whom thesis research is not practical, but who wish to obtain an advanced education in polymer science and engineering.

Ph.D. in Polymer Science and Engineering
For the Ph.D., the student must satisfactorily complete a qualifying examination administered by the Polymer Education Committee; satisfactorily complete graduate course work determined in consultation with the doctoral committee; pass a general examination administered by the Polymer Education Committee; and defend to the satisfaction of the doctoral committee, a dissertation in the field of polymer science and engineering. Students deficient in polymer science or related topics may be required by their committee to take remedial course work.

The doctoral committee consists of the research adviser, at least two other members of the center for polymer science and engineering, and at least one outside person. The committee’s composition is subject to approval by the Polymer Education Committee and the Graduate and Research Committee of the university.

For more information, write to Dr. Raymond A. Pearson, Director, Center for Polymer Science and Engineering, Whittaker Laboratory, 5 E. Packer Avenue, Lehigh University, Bethlehem, PA 18015, or Dr. James E. Roberts, Seeley G. Mudd Building #6, Chairman, Polymer Education Committee, Lehigh University, 6 E. Packer Avenue, Bethlehem, PA 18015 or Ms. Lisa Archiga, Graduate Coordinator Whittaker Laboratory, 5 E. Packer Avenue, Lehigh University, Bethlehem, PA 18015. Please address applications to one of the participating departments.

Psychology

The Psychology Department offers B.A. and B.S. undergraduate degrees, an undergraduate minor in general psychology, and M.Sc. and Ph.D. graduate degrees.

Psychology is the science of mind, brain, and behavior. Undergraduate study in Psychology provides:

- A knowledge base about how people think, feel, and act as individuals and in groups, from infancy to old age
- An understanding of how psychological principles can be applied in everyday life to improve the human condition
- Working knowledge of empirical research methods for psychology and ethical issues in research and application
An appreciation of individual, sociocultural, and international diversity
Familiarity with the relationship of psychological processes to brain processes
Critical thinking, communication, and teamwork skills

Psychology majors pursue careers in many areas such as: business including marketing and industrial/organizational psychology; education; medicine/health; mental and behavioral health professions including clinical, counseling, and sports psychology; law; human services; and basic and applied research positions. The knowledge and skills provided by a degree in Psychology are valuable to all such careers.

For more information, please visit our website: http://psychology.cas2.lehigh.edu/

Professors. Mark H. Bickhard, PhD (University of Chicago); Diane T. Hyland, PhD (Syracuse University); Deborah Laible, PhD (University of Nebraska-Lincoln); Barbara C. Matt, PhD (Stanford University); Gordon B. Moskowitz, PhD (New York University); Ageliki Nicolopoulou, PhD (University of California Berkeley)

Associate Professors. Catherine M. Arrington, PhD (Michigan State University); Susan E Barrett, PhD (Brown University); Amanda C. Brandon, PhD (University of Michigan Ann Arbor); Christopher T. Burke, PhD (New York University); Michael J. Gill, PhD (University Texas, Austin); Almut Hupbach, PhD (Universitat Trier); Padrraig G O'Seaghdha, PhD (University of Toronto); Dominic J. Packer, PhD (University of Toronto)

Emeriti. William Newman, PhD (Stanford University); Martin L. Richter, PhD (Indiana State Univer); George K. Shortess, PhD (Brown University)

B.A. MAJOR PROGRAM IN PSYCHOLOGY

The Bachelor of Arts in psychology is a social science major requiring 12 courses (approximately 45 credit hours) in psychology as described below. The B.A. requires three core courses, four 100-level breadth courses, a 100-level recitation section accompanying one of the breadth courses, and four 300-level seminars. Students must also fulfill college and university degree requirements. This flexible program permits development of one or more minors in other fields or the undertaking of a double major. Transfer credits and study abroad course work may be applied toward the major; however, students must take a minimum of two 100-level breadth courses, three 300-level seminars, and PSYC 210 at Lehigh to complete a psychology major from Lehigh.

Required Core Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSYC 001</td>
<td>Introduction to Psychology</td>
<td>4</td>
</tr>
<tr>
<td>PSYC 110</td>
<td>Statistical Analysis of Behavioral Data</td>
<td>1</td>
</tr>
<tr>
<td>PSYC 210</td>
<td>Experimental Research Methods and Laboratory</td>
<td>4</td>
</tr>
</tbody>
</table>

Breadth Courses

Four 100-level courses, with a minimum of one from each of the following three areas, are required of all majors.

<table>
<thead>
<tr>
<th>Area</th>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognition and Cognitive Neuroscience</td>
<td>PSYC/COGS 117</td>
<td>Cognitive Psychology</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>PSYC/COGS 176</td>
<td>Cognitive Neuroscience</td>
<td>3</td>
</tr>
<tr>
<td>Developmental</td>
<td>PSYC 107</td>
<td>Child Development</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>PSYC 109</td>
<td>Adulthood and Aging</td>
<td>3</td>
</tr>
<tr>
<td>Social and Personality</td>
<td>PSYC 121</td>
<td>Social Psychology</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>PSYC 153</td>
<td>Personality</td>
<td>3</td>
</tr>
</tbody>
</table>

100-level Recitation

One 100-level recitation section accompanying one of the above breadth courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSYC 182</td>
<td>Child Development Recitation</td>
<td>1</td>
</tr>
<tr>
<td>PSYC 183</td>
<td>Cognitive Psychology Recitation</td>
<td>1</td>
</tr>
<tr>
<td>PSYC 184</td>
<td>Cognitive Neuroscience Recitation</td>
<td>1</td>
</tr>
</tbody>
</table>

Seminars

Four 300-level seminars are required of all B.A. students. Seminars need to span at least two areas. (See list of seminars per area in Psychology Concentrations section below).

Total Credits

42-45

1 The fourth 100-level breadth course must be selected from any of the above courses or PSYC 138.
2 Students can not use PSYC 300, PSYC 310, PSYC 391, PSYC 392, PSYC 393 or PSYC 394 to fulfill this requirement. All other 300-level psychology courses can be used to fulfill this requirement.

Optional Concentration

Students in the B.A. program may choose to complete an optional concentration. Concentrations are available in four areas: Cognition and Cognitive Neuroscience, Developmental; Social and Personality; and Clinical and Behavioral Health. Completion of a concentration involves selecting specific 100-level breadth courses and 300-level seminars within the concentration. See listings of individual concentration courses below.

Recommended Electives

The B.A. program in psychology is a flexible preparation for a number of fields. With suitable selection of additional courses, students can prepare themselves for graduate study in any subfield of psychology or for careers in areas for which psychology is a desirable and relevant major such as neuroscience, law, social work, marketing, management, and education.

Depending on the specific subfield of interest, many courses in other departments within CAS, and in other Colleges, may be relevant. Examples include Biological Sciences (especially the Behavioral Neuroscience program), Philosophy, Sociology and Anthropology, Marketing, Economics, Management, Education, and in the interdisciplinary programs of Cognitive Science; Women, Gender, and Sexuality Studies; Health, Medicine, and Society; Global Studies; and Africana Studies.

For graduate programs in psychology, neuroscience, and related fields, additional coursework in research and statistics is desirable, as is engagement in supervised research and participation in the honors program.

Preparation for programs in health-related areas such as nursing, medicine, and dentistry will include additional coursework in biology, chemistry, and physics. Students should consult with the appropriate pre-professional advisors to determine specific requirements.

Students interested in applying psychology to fields such as law, marketing, social work, management, or education should consult with faculty in those areas to discuss relevant courses.

B.S. MAJOR PROGRAM IN PSYCHOLOGY

The Bachelor of Science in psychology is a highly structured and comprehensive behavioral science major requiring 13 courses (approximately 49 credit hours) in psychology and 10 collateral courses (approximately 35-40 credit hours) as described below. Students must also fulfill college and university degree requirements. Students pursuing a wide-range of post-graduate plans may find this program fits their needs and interests. One difference between the B.S. in psychology and other B.S. programs is that the collateral requirements for the B.S. in psychology allow for a level of breadth that is not always possible in B.S. programs. The collateral courses for the B.S. in psychology span three areas (Mathematics and Computer Science; Natural Science; and Social and Cognitive Science). Hence, students with wide-ranging interests may find that they can pursue their varied interests while fulfilling the collateral requirements for this B.S. program. For students considering graduate programs in psychology, neuroscience, and related fields, additional coursework in research and statistics is desirable, as is engagement in supervised research and participation in the honors program.

Students in the B.S. program must complete a concentration in Cognition and Cognitive Neuroscience; Developmental; Social and Personality; or Clinical and Behavioral Health. Progression through the...
program is best served through early commitment. Students who do not declare their majors early may find it difficult to complete the B.S. major program. Transfer credits and study abroad course work may be applied toward the major; however, students must take a minimum of two 100-level breadth courses, three 300-level seminars, and PSYC 210 at Lehigh to earn a psychology major from Lehigh.

**Requirements for the B.S. in Psychology**

**Collateral Requirements**

For students in the B.S. program, collateral courses can be used to fulfill the college distribution requirements in mathematics, natural science, and social science. To fulfill natural science college distribution requirements, at least one course must include the associated lab. Please consult the course listings for information on prerequisites.

**Mathematics and Computer Science** 7-8

Select two from the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 012</td>
<td>Basic Statistics</td>
</tr>
<tr>
<td>MATH 043</td>
<td>Survey of Linear Algebra</td>
</tr>
<tr>
<td>Any of the calculus courses or above</td>
<td></td>
</tr>
<tr>
<td>CSE 001</td>
<td>Breadth of Computing</td>
</tr>
<tr>
<td>&amp; CSE 002</td>
<td>and Fundamentals of Programming</td>
</tr>
<tr>
<td>Any CSE course 12 or above</td>
<td></td>
</tr>
</tbody>
</table>

**Natural Science** 14-16

Select at least one from the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS 010</td>
<td>Bioscience in the 21st Century</td>
</tr>
<tr>
<td>BIOS 041</td>
<td>Biology Core I: Cellular and Molecular</td>
</tr>
<tr>
<td>EES 025</td>
<td>The Environment and Living Systems</td>
</tr>
<tr>
<td>EES 028</td>
<td>Conservation and Biodiversity</td>
</tr>
</tbody>
</table>

Plus three additional courses from the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any BIOS course 010 or above</td>
<td></td>
</tr>
<tr>
<td>Any CHM course 030 or above</td>
<td></td>
</tr>
<tr>
<td>Any PHY course 010 or above</td>
<td></td>
</tr>
<tr>
<td>EES courses 25 or 28</td>
<td></td>
</tr>
</tbody>
</table>

**Social and Cognitive Science** 7-8

Select two from the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any Anthropology (ANTH), Sociology and Anthropology (SOAN), Sociology (SOC), Philosophy (PHIL), Cognitive Science (COGS).</td>
<td></td>
</tr>
<tr>
<td>Any area studies (Asian, Africana, etc.); Global Studies (GS); Health, Medicine, and Society (HMS); Science, Technology, and Society (STS); or Women, Gender, and Sexuality Studies (WGSS).</td>
<td></td>
</tr>
</tbody>
</table>

**Additional Coursework** 7-8

Select any two additional courses from the above lists.  

**Total Credits** 35-40

1. Courses may not be cross-listed with Psychology.
2. Courses must have a SS designation.
3. Students are strongly encouraged to discuss their interests and career goals with their advisor before selecting courses.

**Psychology Requirements**

**Required Core Courses** 12

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSYC 001</td>
<td>Introduction to Psychology</td>
</tr>
<tr>
<td>PSYC 110</td>
<td>Statistical Analysis of Behavioral Data</td>
</tr>
<tr>
<td>PSYC 210</td>
<td>Experimental Research Methods and Laboratory</td>
</tr>
</tbody>
</table>

**Breadth Courses** 14-16

Four 100-level courses, with a minimum of one from each of the following three areas, are required of all majors.  

**Cognition and Cognitive Neuroscience**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSYC/COGS 117</td>
<td>Cognitive Psychology</td>
</tr>
<tr>
<td>PSYC/COGS 176</td>
<td>Cognitive Neuroscience</td>
</tr>
</tbody>
</table>

**Developmental**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSYC 107</td>
<td>Child Development</td>
</tr>
<tr>
<td>PSYC 109</td>
<td>Adulthood and Aging</td>
</tr>
</tbody>
</table>

**Social and Personality**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSYC 121</td>
<td>Social Psychology</td>
</tr>
<tr>
<td>PSYC 153</td>
<td>Personality</td>
</tr>
</tbody>
</table>

**100-level Recitation** 1

One 100-level recitation section accompanying one of the above breadth courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSYC 182</td>
<td>Child Development Recitation</td>
</tr>
<tr>
<td>PSYC 183</td>
<td>Cognitive Psychology Recitation</td>
</tr>
<tr>
<td>PSYC 184</td>
<td>Cognitive Neuroscience Recitation</td>
</tr>
<tr>
<td>PSYC 185</td>
<td>Personality Recitation</td>
</tr>
<tr>
<td>PSYC 186</td>
<td>Social Psychology Recitation</td>
</tr>
</tbody>
</table>

**Seminars** 18-20

Five 300-level seminars are required of all B.S. students. Seminars need to span at least two areas. (See list of seminars per area in Psychology Concentrations section below.)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSYC 300, PSYC 310, PSYC 391, PSYC 392, PSYC 393, PSYC 394</td>
<td></td>
</tr>
</tbody>
</table>

**Total Credits** 45-49

1. The fourth 100-level breadth course is determined by the concentration being pursued.
2. Students can not use PSYC 300, PSYC 310, PSYC 391, PSYC 392, PSYC 393, PSYC 394 or to fulfill this requirement. All other 300-level psychology courses can be used to fulfill this requirement.

**PSYCHOLOGY CONCENTRATIONS**

Concentrations are available in four areas: Cognition and Cognitive Neuroscience; Developmental; Social and Personality; and Clinical and Behavioral Health. Students in the B.A. major program may choose to complete a concentration. Students in the B.S. major program are required to complete a concentration. Completion of a concentration involves selecting two specific 100-level breadth courses and three 300-level seminars within the concentration area.

**Cognition and Cognitive Neuroscience Concentration**

Specified 100-level breadth courses, take both:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSYC/COGS 117</td>
<td>Cognitive Psychology</td>
</tr>
<tr>
<td>PSYC/COGS 176</td>
<td>Cognitive Neuroscience</td>
</tr>
</tbody>
</table>

300-level seminars, choose three:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSYC 304</td>
<td>Memory Development from Infancy to Old Age</td>
</tr>
<tr>
<td>PSYC 307</td>
<td>Higher Order Cognition</td>
</tr>
<tr>
<td>PSYC 320</td>
<td>Psychology of Language</td>
</tr>
<tr>
<td>PSYC/HMS 344</td>
<td>Health Care Reasoning and Decision Making</td>
</tr>
<tr>
<td>PSYC 347</td>
<td>Cognitive Neuroscience of Memory</td>
</tr>
<tr>
<td>PSYC 351</td>
<td>Children's Thinking</td>
</tr>
<tr>
<td>PSYC 358</td>
<td>Inside the Infant Mind</td>
</tr>
<tr>
<td>PSYC 362</td>
<td>Cognition in Practice &amp; Policy</td>
</tr>
<tr>
<td>PSYC 369</td>
<td>Memory Under Construction</td>
</tr>
<tr>
<td>PSYC 377</td>
<td>Attention and Attentional Failures</td>
</tr>
</tbody>
</table>

**Developmental Concentration**

Specified 100-level breadth courses, take both:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSYC 107</td>
<td>Child Development</td>
</tr>
<tr>
<td>PSYC 109</td>
<td>Adulthood and Aging</td>
</tr>
</tbody>
</table>

300-level seminars, choose three:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSYC 304</td>
<td>Memory Development from Infancy to Old Age</td>
</tr>
<tr>
<td>PSYC/WGSS 318</td>
<td>Seminar in Gender and Psychology</td>
</tr>
<tr>
<td>PSYC 328</td>
<td>Educational Psychology</td>
</tr>
<tr>
<td>PSYC 346</td>
<td>Child Development and Social Policy</td>
</tr>
<tr>
<td>PSYC 351</td>
<td>Children's Thinking</td>
</tr>
<tr>
<td>PSYC 352</td>
<td>Adolescence and Emerging Adulthood</td>
</tr>
<tr>
<td>PSYC 358</td>
<td>Inside the Infant Mind</td>
</tr>
<tr>
<td>PSYC 363</td>
<td>Personality and Social Development in Childhood</td>
</tr>
<tr>
<td>PSYC 364</td>
<td>Children and Narratives</td>
</tr>
</tbody>
</table>
Human Development in Cross-Cultural Perspective
Children, Psychology, and the Law
Development of Good and Evil
Emotional Development
Attachment Theory & Research: The Study of Close Relationships Across the Lifespan
Child and Adolescent Health Psychology

Social and Personality Concentration
Specified 100-level breadth courses, take both:
- PSYC 121 Social Psychology
- PSYC 153 Personality

300-level seminars, choose three:
- PSYC/HMS 302 Stress and Coping
- PSYC 311 The Psychology of Stereotyping, Prejudice, and Discrimination
- PSYC 313 Person Perception
- PSYC 314 Social Cognition
- PSYC/WGSS 318 Seminar in Gender and Psychology
- PSYC 332 The Psychology of Morality
- PSYC 341 Social Psychology and Social Issues
- PSYC/HMS 349 Participatory and Action Research in Psychology
- PSYC 350 The Psychology of Evil
- PSYC 353 Social Justice and Social Change
- PSYC 363 Personality and Social Development in Childhood
- PSYC 364 Children and Narratives
- PSYC/GS 365 Human Development in Cross-Cultural Perspective
- PSYC 375 Development of Good and Evil
- PSYC 378 Emotional Development
- PSYC 383 Attachment Theory & Research: The Study of Close Relationships Across the Lifespan
- PSYC 384 Self and Identity

Clinical and Behavioral Health Concentration
Specified 100-level breadth courses, take both:
- PSYC 138 Abnormal Psychology
- PSYC 153 Personality

300-level seminars, choose three:
- PSYC/HMS 302 Stress and Coping
- PSYC/HMS 327 Health Psychology
- PSYC/HMS 334 The Psychology of Body Image and Eating Disorders
- PSYC 338 Phenomenology and Theory of Childhood Disorders
- PSYC/HMS 344 Health Care Reasoning and Decision Making
- PSYC 346 Child Development and Social Policy
- PSYC/HMS 348 Drugs and Behavior
- PSYC 354 Psychological Assessment
- PSYC 367 Clinical Psychology
- PSYC 378 Emotional Development
- PSYC 380 Sports Psychology
- PSYC/HMS 386 Child and Adolescent Health Psychology

DEPARTMENT HONORS IN PSYCHOLOGY

Students in either the B.A. or B.S. degree programs may undertake a program that leads to graduation with department honors. The honors program permits majors of unusual academic ability and interest to explore topics in greater depth than the curricula normally allow. Under faculty supervision, a student normally spends the first semester of the senior year enrolled in PSYC 391 doing library research, learning the appropriate methodology, and preparing a written proposal and oral presentation. In the second semester, while the student is enrolled in PSYC 392, the proposal is implemented, culminating in a written honors thesis and oral presentation.

In the junior year, students may apply for the honors program with the department Honors Program Director. To be eligible to participate in the honors program, a student must maintain overall and major GPAs of 3.5.

MINOR PROGRAM

General Psychology

The general psychology minor consists of a minimum of five courses in psychology including the introductory course (PSYC 001). Each course must be at least three credits. Students must take a minimum of three psychology courses at Lehigh to complete a psychology minor. Students should declare this minor in the Psychology Department office.

FOR GRADUATE STUDENTS

The Department of Psychology offers a distinctive, research-intensive graduate program centered on Human Cognition and Development with specializations in cognitive, developmental and social psychology. The department accepts mainly Ph.D. students, who obtain a master’s degree in the process of working for the doctorate. However, well-qualified students may also be accepted for a Master of Science degree. Students are trained primarily for positions at universities, and in basic or applied research settings. For more information visit: http://psychology.cas2.lehigh.edu/content/welcome-graduate-program-psychology.

In addition we offer two non-degree Certificate Programs in collaboration with other departments and programs. The Graduate Certificate in Stereotypes, Prejudice, Discrimination, and Intergroup Relations is administered by the Psychology Department. Information is available via: http://psychology.cas2.lehigh.edu/content/stereotypes-prejudice-discrimination-and-intergroup-relations-graduate-certificate.

The Graduate Certificate in Cognitive Science is administered by the Cognitive Science Program. Information is available at: http://psychology.cas2.lehigh.edu/content/cognitive-science-graduate-certificate.

Requirements for a Ph.D. in the Department of Psychology

All graduate students are expected to be involved in research throughout their graduate careers. There are also several formal research requirements of the program.

First-Year Apprenticeship

First-year students are expected to choose an advisor and begin to work on research projects as early as possible. An oral report of the student’s research activities is made to the department. Students will submit a draft Master’s Thesis Proposal by June 1 of the first year of the Ph.D. program.

Master’s Thesis

A master’s thesis (usually empirical or data-based) is required. An oral presentation of the thesis is made to the department. Students entering with a master’s degree may instead conduct an equivalent non-degree Pre-dissertation Project.

Third-Year independent scholarly activity

Third year students will work toward formulation of their dissertation proposal by completing a literature review or writing a small grant proposal. By the end of the third year of the Ph.D. program, students will choose a dissertation committee, and meet to report on their research activities.

Doctoral Dissertation

This is an original piece of scholarly work usually involving empirical research, although original theoretical or historical research is possible with faculty approval.

Course work

For the Ph.D., the minimum course requirements include:
• Three core courses covering cognitive psychology (PSYC 403), developmental psychology (PSYC 402), and social cognition (PSYC 406);
• Two courses in statistics and research methodology (PSYC 421 and PSYC 422);
• At least three graduate seminars (PSYC 430 and above);
• Two elective courses, approved by the advisor;
• A professional development seminar (PSYC 409)

Teaching
Students are encouraged to participate in teaching as appropriate for their training throughout their graduate years. Normally, students begin as teaching assistants and progress to teaching independently.

General Examination
A general examination is required for all doctoral candidates and will be completed at the end of the second year of the Ph.D. program. Readings and questions for the exam will be compiled by faculty in the student’s specialization area.

Requirements for a Master of Science in the Department of Psychology
Research
Master of Science students will complete the First-Year Apprenticeship and Master’s Thesis requirements as described in the Ph.D. section above.

Coursework
For the M.Sc., the minimum course requirements include:
• Two core courses covering cognitive psychology (PSYC 403), developmental psychology (PSYC 402), or social cognition (PSYC 406);
• Two courses on statistics and research methodology (PSYC 421, and PSYC 422 or approved equivalent);
• Two elective courses, approved by the advisor;
• A professional development seminar (PSYC 409)

Evaluation
Graduate students are evaluated on their performance in coursework, research and scholarship, teaching assistantship assignments, and the general examination. The faculty provides each student with an annual written evaluation of their progress in the graduate program.

Financial Support
Support for Ph.D. students is available in the form of teaching and research assistantships, fellowships and scholarships.

How To Apply
Information about admission and financial aid can be obtained from the Department of Psychology or found at: https://psychology.cas2.lehigh.edu/node/67. While a strong undergraduate background in psychology is desirable, promising students with majors other than psychology are encouraged to apply. Completed application forms, plus transcripts, letters of recommendation, and a report of scores on the Graduate Record Exam and advanced tests in psychology should be submitted no later than January 1 of the year of admission. New students are normally accepted for entrance into the program only for the fall semester.

Courses
PSYC 001 Introduction to Psychology 4 Credits
Psychology as a science of behavior. Natural science aspects such as learning, sensation-perception, and physiological bases; and social science aspects such as human development, intelligence, and personality. Methodologies appropriate to these areas, and related societal problems.
Attribute/Distribution: SS

PSYC 107 Child Development 4 Credits
Survey of theories and research concerning perceptual, cognitive, social, and personality development through infancy and childhood. May not be taken pass/fail. Open to Freshman with departmental permission.
Prerequisites: PSYC 001 or SOC 001
Attribute/Distribution: SS

PSYC 109 Adulthood and Aging 4 Credits
Social science approaches to the latter two-thirds of life. Cognitive and personality development; attitudes toward aging; social behavior of older adults; widowhood; retirement. May not be taken pass/fail. Open to Freshman with departmental permission.
Prerequisites: PSYC 001 or SOC 001
Attribute/Distribution: SS

PSYC 110 Statistical Analysis of Behavioral Data 4 Credits
Principles of experimental design and statistical analysis: characteristics of data and data collection; descriptive statistics; hypothesis testing theory and practice; correlation, chi-square, t-test, analysis of variance. Three hours lecture and one hour computer lab. Department permission required. Open to Freshman with departmental permission.
Attribute/Distribution: ND

PSYC 115 (REL 115) Religion And Psychology 4 Credits
A study of the origins, development and consequences of religion from a psychological perspective. Attention will be given to classic and contemporary sources, with a focus on major psychoanalytic theorists of religion (Freud, Jung, Erikson); psychological analyses of religious experience (e.g., Wm. James, Victor Frankl); and the diverse cultural and religious forms that structure the connection between religion and psychology (e.g., Buddhist psychology, Japanese Morita therapy).
Attribute/Distribution: HU

PSYC 117 (COGS 117) Cognitive Psychology 4 Credits
The architecture and dynamics of the human mind: How we acquire knowledge through perception, represent and activate it in memory, and use it to communicate, make decisions, solve problems, and reason creatively. May not be taken pass/fail.
Prerequisites: PSYC 001 or COGS 007
Attribute/Distribution: SS

PSYC 121 Social Psychology 4 Credits
Theories, methods of investigation, and results of research on the way social and psychological processes interact in human behavioral settings. Topics include analysis of self and relationships, dynamics of small groups, attitudes and persuasion, prejudice, prosocial and antisocial behavior. Open to Freshman with departmental permission.
Prerequisites: SOC 001 or PSYC 001
Attribute/Distribution: SS

PSYC 138 (HMS 138) Abnormal Psychology 4 Credits
Examines research and theory on the patterns, causes, and treatment of various forms of abnormal behavior.
Prerequisites: PSYC 001
Attribute/Distribution: SS

PSYC 153 Personality 4 Credits
Examination of the major theoretical frameworks psychologists use to understand human thought, feeling, and behavior. Whereas these frameworks each emphasize very different concepts (e.g., the unconscious mind vs. culture vs. neurotransmitters), they are united in their effort to answer the question: Why does a given individual think, feel, or behave as she does?
Prerequisites: PSYC 001 or SOC 001
Attribute/Distribution: SS

PSYC 160 Independent Study 1-3 Credits
Readings on topics selected in consultation with a staff member. Consent of faculty sponsor required.
Repeat Status: Course may be repeated.
Prerequisites: PSYC 001
Attribute/Distribution: SS

PSYC 161 Supervised Research 1-3 Credits
Apprenticeship in ongoing faculty research program. Literature review, experimental design, data collection and analysis, and professional writing under faculty supervision. Consent of faculty sponsor required.
Repeat Status: Course may be repeated.
Prerequisites: PSYC 001 or COGS 007
Attribute/Distribution: SS
PSYC 162 Psychological Field Work 1-3 Credits
Work-study practice including supervised experience in one of several local agencies. Development of familiarity with the operations of the agency and working with individual patients or students. Must have completed two additional psychology courses. Consent of instructor required.
Repeat Status: Course may be repeated.
Prerequisites: PSYC 001
Attribute/Distribution: SS

PSYC 176 (COGS 176) Cognitive Neuroscience 4 Credits
Perception and cognitive neuroscience as the link between mental processes and their biological bases. Visual and auditory perception; the control of action; neuropsychological syndromes of perception, language, memory and thought; neural network (connectionist) models of mental processes. May not be taken pass/fail.
Prerequisites: PSYC 001 or COGS 007

PSYC 182 Child Development Recitation 1 Credit
Research, discussion, and analysis of topics in child development.
Prerequisites: PSYC 107
Can be taken Concurrently: PSYC 107
Attribute/Distribution: ND

PSYC 183 Cognitive Psychology Recitation 1 Credit
Research, discussion, and analysis of topics in cognitive psychology.
Prerequisites: PSYC 117 or COGS 117
Can be taken Concurrently: PSYC 117, COGS 117

PSYC 184 Cognitive Neuroscience Recitation 1 Credit
In depth exploration of selected areas of higher level cognition such as thinking and reasoning, metacognition, expertise, executive processes, language and thought.
Prerequisites: PSYC 117 or COGS 117
Attribute/Distribution: SS

PSYC 307 Higher Order Cognition 4 Credits
Experimental and nonexperimental research design; Sampling and selection from populations; Data exploration; Quantitative and qualitative measurement and analysis; Computer-based data collection; and other specialized topics.
Prerequisites: PSYC 210

PSYC 311 The Psychology of Stereotyping, Prejudice, and Discrimination 4 Credits
We first examine the basic cognitive processes that make stereotyping a functional aspect of everyday cognition, and then turn toward examining emotional, motivational, and personality differences that affect one's level of prejudice. Finally, we will study the role of social forces in transmitting prejudice (parents, schools, religion, media) and the impact of societal prejudice (discrimination) on those who are the targets of prejudice. How stereotypes, prejudice, and discrimination are understood, measured, expressed, and altered is the focus of the course.
Prerequisites: PSYC 153 or PSYC 121
Attribute/Distribution: SS

PSYC 310 Advanced Research Methods in Psychology 4 Credits
Research, discussion, and analysis of topics in social psychology.
Prerequisites: PSYC 121
Can be taken Concurrently: PSYC 121

PSYC 314 Social Cognition 3,4 Credits
Examine the cognitive processes through which people make sense of social groups, individual others, themselves, and the world. Topics include judgment and decision making, attitudes and persuasion, ordinary personology, stereotyping and prejudice, and the self.
Prerequisites: PSYC 121
Attribute/Distribution: SS

PSYC 317 Psychology of Emotion 4 Credits
A selective overview of the scientific study of emotion. Topics will include: historical and modern theories of emotion, physiological and neuropsychological aspects of emotions, evidence that facial expressions of emotion may be universal among humans, and the role of emotion in cognition.
Prerequisites: PSYC 110
Attribute/Distribution: SS

PSYC 318 (WGSS 318) Seminar in Gender and Psychology 4 Credits
A selective overview of the scientific study of emotion. Topics will include: historical and modern theories of emotion, physiological and neuropsychological aspects of emotions, evidence that facial expressions of emotion may be universal among humans, and the role of emotion in cognition.
Prerequisites: PSYC 110
Attribute/Distribution: SS

PSYC 302 (HMS 302) Stress and Coping 4 Credits
How does stress affect the psychological system, and what psychological mechanisms are in place to help people overcome environmental stressors? This seminar examines classic and contemporary theories and research on stress, coping, and social support.
Prerequisites: PSYC 121 or PSYC 153 or HMS 160 or HMS 180
Attribute/Distribution: SS

PSYC 304 Memory Development from Infancy to Old Age 4 Credits
Memory development throughout the lifespan. We will discuss methods invented to study memory in preverbal infants, and the amazing memory capacities they have revealed. We will explore memory components that develop during early and middle childhood, look at memory in adults, and consider the normal and pathological decline of memory in older age, and possible ways of slowing aging processes down.
Prerequisites: PSYC 117 or COGS 117 or PSYC 176 or COGS 176 or COGS 007
Attribute/Distribution: SS

PSYC 300 Apprentice Teaching 1-4 Credits
Designing, conducting, and reporting psychological experiments. Laboratory exercises, report writing, and a group research project. Consent of department required.
Prerequisites: PSYC 001 and PSYC 110

PSYC 307 Memory Development from Infancy to Old Age 4 Credits
Memory development throughout the lifespan. We will discuss methods invented to study memory in preverbal infants, and the amazing memory capacities they have revealed. We will explore memory components that develop during early and middle childhood, look at memory in adults, and consider the normal and pathological decline of memory in older age, and possible ways of slowing aging processes down.
Prerequisites: PSYC 117 or COGS 117 or PSYC 176 or COGS 176 or COGS 007
Attribute/Distribution: SS

PSYC 301 The Psychology of Language 4 Credits
Psychological processes involved in language comprehension, production, and use. Topics include the relation of language to thought; word meaning; speech perception; language acquisition; sign language; language in society.
Prerequisites: PSYC 117 or PSYC 176 or COGS 007 or COGS 117 or COGS 176
Attribute/Distribution: SS
PSYC 321 Language Development 4 Credits
Descriptive and theoretical accounts of the development of language. Primary focus is on the development of spoken language in infancy and early childhood. Involves observation of children at various stages of language development.
Prerequisites: PSYC 107 or PSYC 117 or COGS 117
Attribute/Distribution: SS
PSYC 327 (HMS 327) Health Psychology 4 Credits
This course provides an overview of the psychological study of health. The course explores psychological theories that aim to explain health behavior (e.g., why do people smoke?) and the role of psychology in understanding the experience of illness. This course also examines how psychological research and theory can be applied to promote health behavior (e.g., how can we design interventions to promote physical activity).
Prerequisites: PSYC 001
Attribute/Distribution: SS
PSYC 328 Educational Psychology 4 Credits
Overview of historical, contemporary, and emerging issues in the field of educational psychology. Implications of various social, cognitive and behavioral educational-psychological theories for teaching and learning in the classroom.
Prerequisites: PSYC 107
Attribute/Distribution: SS
PSYC 332 The Psychology of Morality 4 Credits
We begin with the Big Questions: Are human beings intrinsically good? How potent is our intrinsic capacity for goodness? What does it mean to be “good” or “moral”? How can we answer these questions? Next, we examine a variety of motives, capacities, and emotions that can promote our “good” behavior. Some examples include empathy, compassion (and other moral emotions), the justice motive, the norm enforcement motive, moral intuitions, social bonds, and perhaps even our general capacity for reason.
Prerequisites: PSYC 121
Attribute/Distribution: SS
PSYC 334 (HMS 334, WGSS 334) The Psychology of Body Image and Eating Disorders 4 Credits
The course addresses the psychosocial aspects of the development of healthy and unhealthy body image and eating disorders. The roles of personality traits/individual factors, family and interpersonal functioning, and cultural factors will be examined, as will the impact of representations of body image in mass media. Public health and psychological interventions for prevention and treatment will be explored. Personal accounts/memoirs, clinical case presentations, and documentary and dramatic films will be incorporated in the presentation of topics.
Attribute/Distribution: SS
PSYC 335 (BIOS 335) Animal Behavior 3 Credits
Discussion of the behavior of invertebrates and vertebrates and analysis of the physiological mechanisms responsible for behavioral actions, and adaptive value of specific behavior patterns.
Prerequisites: BIOS 121 and BIOS 122
Attribute/Distribution: NS
PSYC 338 Phenomenology and Theory of Childhood Disorders 4 Credits
The nature, classification, and treatment of childhood disorders.
Prerequisites: PSYC 107
Attribute/Distribution: SS
PSYC 341 Social Psychology and Social Issues 4 Credits
This course examines the methods, concepts, and research findings associated with the effort to apply social psychology to the understanding and amelioration of social problems. Special attention will be paid to the topic of human conflict.
Attribute/Distribution: SS
PSYC 344 (HMS 344) Health Care Reasoning and Decision Making 4 Credits
Health care professionals diagnose physical and mental illnesses and create treatment plans to improve their patients’ health. How do these professionals make decisions related to these important issues? We will explore the literature on how medical and mental health professionals reason and make decisions about health care issues. Topics to be covered include diagnosis, treatment decisions, access to care, and how these reasoning processes are swayed. Consideration will be given to patient decision-making as well.
Prerequisites: PSYC 117 or COGS 117 or COGS 007 or HMS 160 or HMS 180
Attribute/Distribution: SS
PSYC 346 Child Development and Social Policy 4 Credits
This course explores the intersection of child development research and social policy. We will examine what we know about healthy child development from current research and how it can help inform and improve existing programs, policies, and recommendations for children and families. Topics include critical social policy issues such as child care, early childhood education, child abuse, divorce and child custody, adolescent pregnancy, poverty, bullying, and technology and media.
Prerequisites: PSYC 107
Attribute/Distribution: SS
PSYC 347 Cognitive Neuroscience of Memory 4 Credits
This seminar explores the brain systems and neural mechanisms involved in the formation and retrieval of memories. Topics include mechanisms of storage, retrieval and forgetting in normal and clinical populations, emotional memory systems, superior autobiographical memory, role of sleep, and effects of stress on memory.
Prerequisites: PSYC 117 or COGS 117 or PSYC 176 or COGS 176
Attribute/Distribution: NS
PSYC 348 (HMS 348) Drugs and Behavior 4 Credits
Why are some people more vulnerable to substance use problems than others? How can we effectively address substance abuse in our society? This course explores theories and research on the complex psychological, social, and biological factors that contribute to substance use and disorders. Topics include theories of addiction, characteristics of illegal and legal drugs, risk and protective factors, and research on substance abuse prevention.
Prerequisites: PSYC 001 or HMS 160 or HMS 180
Attribute/Distribution: SS
PSYC 349 (HMS 349) Participatory and Action Research in Psychology 4 Credits
Action research is used to understand important real-world social problems and promote social action. Participatory research engages community members as equals to help identify areas of focus and to design studies and interventions. This course provides an overview of the rich history of these approaches in psychology, an in-depth look at how they can be used effectively, and an opportunity to gain hands-on experience.
Prerequisites: PSYC 121 or PSYC 153 or HMS 160 or HMS 180
Attribute/Distribution: SS
PSYC 350 The Psychology of Evil 4 Credits
It has been said that no animal could ever be as cruel as a human being. Indeed, human beings have a notable propensity for inflicting harm on other human beings: Physical assault, homicide, torture, and even genocide. What is the psychology behind such actions? What are the root causes? In exploring these questions, we will consider the issue of what, if anything, can be done to reduce evil in the world.
Prerequisites: PSYC 121 or PSYC 153
Attribute/Distribution: SS
PSYC 351 Children’s Thinking 4 Credits
This course examines the development of children’s thinking from infancy through adolescence. We will discuss current research and theories on the content of children’s knowledge and how mental abilities develop. We will also consider the implications of research on children’s thinking for real-world questions about parenting, education, and policy-making. Topics include memory, concepts, social cognition, language, reading, mathematics, and individual and cultural differences.
Prerequisites: PSYC 107 or PSYC 117 or COGS 007 or COGS 117
Attribute/Distribution: SS

PSYC 352 Adolescence and Emerging Adulthood 4 Credits
Adolescence is a dynamic development period encompassing multiple interrelated changes in the biological, cognitive, psychological, and social domains. This course will cover theories and research in adolescence and explore connections between research and policy. We will also consider whether emerging adulthood is a separate stage of development.
Prerequisites: PSYC 107
Attribute/Distribution: SS

PSYC 353 Social Justice and Social Change 4 Credits
How do people decide to engage in collective action to challenge social injustice? We will examine motivations and tactics of resistance, as well as barriers to change, against the historical backdrop of the civil rights movement and in the context of current societal and global disparities.
Prerequisites: PSYC 121
Attribute/Distribution: SS

PSYC 354 Psychological Assessment 4 Credits
Basic concepts in the construction, selection, administration, scoring, and interpretation of assessment procedures commonly used in psychology. Selection and evaluation of assessment procedures.
Supervised experience administering, scoring, and interpreting assessment procedures.
Prerequisites: PSYC 110
Attribute/Distribution: SS

PSYC 358 Inside the Infant Mind 4 Credits
How do babies understand and learn about the world? This course explores the origin and development of human knowledge by venturing inside the infant mind. Topics include current research and theory on infants’ understanding of objects, number, language, and people. Research examining thinking in non-human primates is also considered to shed light on what aspects of knowledge are and are not uniquely human.
Prerequisites: PSYC 107 or PSYC 117 or COGS 007 or COGS 117
Attribute/Distribution: SS

PSYC 362 Cognition in Practice & Policy 3-4 Credits
Taking the study of cognition from principle to practice, this course examines how basic research and theory informs understanding of human performance in real-world settings. Topics will be chosen from domains such as automobile safety, environmental and medical decision-making, human-technology interaction, spatial navigation, and breakdown of cognition under fatigue and alcohol. Public policy implications will be considered.
Prerequisites: PSYC 117 or COGS 007 or COGS 117
Attribute/Distribution: SS

PSYC 363 Personality and Social Development in Childhood 4 Credits
Issues related to social development (e.g., attachment, social competence), social contexts (e.g., family, day care), and personality development (e.g., sex roles, aggression, temperament) from infancy through adolescence.
Prerequisites: PSYC 107
Attribute/Distribution: SS

PSYC 364 Children and Narratives 4 Credits
Examines the complex role of narratives-told to and by children, and enacted by children in play-in children’s experience and development. Compares and seeks to integrate different approaches in psychology and other disciplines. In the process, we will also be addressing three basic questions: what is narrative, how is it significant, and how should we study it?
Prerequisites: PSYC 107
Attribute/Distribution: SS

PSYC 365 (GS 365) Human Development in Cross-Cultural Perspective 4 Credits
The formation of mind and personality is shaped in profound ways by the sociocultural contexts within which individuals develop. This course introduces students to basic theoretical and methodological issues and explores important examples of cross-cultural variation and diversity, using comparisons between different societies and between different subcultures within American society. Topics include cognition, language, personality, moral development, socio-emotional development, identity, attachment, and socialization. Materials drawn from anthropology, sociology and education in addition to psychology.
Prerequisites: PSYC 109 or PSYC 107 or PSYC 121
Attribute/Distribution: SS

PSYC 366 Seminar in Cognitive Aging 4 Credits
Information processing by older adults: perception, attention, memory, speech and text processing and comprehension. The course will also examine the effects on cognitive processing of such diseases as Alzheimer’s and Parkinson’s.
Prerequisites: PSYC 109
Attribute/Distribution: SS

PSYC 367 Clinical Psychology 4 Credits
The science and profession of helping people overcome psychological problems. Theories of human personality and abnormality in relation to techniques for assessing and treating psychosocial problems and in the light of empirical evidence of validity and effectiveness. Professional issues are also covered.
Prerequisites: PSYC 153 and PSYC 138
Attribute/Distribution: SS

PSYC 368 Children, Psychology, and the Law 4 Credits
Covers psychological research on child witnesses, child victims, juvenile crime, children’s rights and decision-making capabilities, divorce and custody. Implications of psychological research for social policy and legal reform will be discussed.
Prerequisites: PSYC 107
Attribute/Distribution: SS

PSYC 369 Memory Under Construction 4 Credits
Investigation of the constructive nature of human memory through hands-on exercises, reading and discussion. Includes exploration of personal memories, a memory expanding project, and a final project. Coverage includes autobiographical memory, expert memory, and memory disorders.
Prerequisites: PSYC 117 or PSYC 176 or COGS 007
Attribute/Distribution: SS

PSYC 375 Development of Good and Evil 4 Credits
The goal of the course is to trace the origins of children’s good (i.e., prosocial and moral) and evil (i.e., aggressive and bullying) behavior. We will examine the psychological (e.g., genetic), cognitive (e.g., social information processing), and contextual factors (e.g., media, parenting, neighborhoods, and peers) that contribute to the development of children’s good and evil behavior.
Prerequisites: PSYC 107
Attribute/Distribution: SS
PSYC 377 Attention and Attentional Failures 4 Credits
Attention allows us to function in complex environments where there is more information than we could possibly process all at once and failures of attention can have drastic consequences. Experimental and neuropsychological evidence will be surveyed for topics including basic attentional phenomena, the role of attention in everyday tasks, and the impact of attentional failures from mind wandering to neuropsychological deficits like ADHD.
Prerequisites: PSYC 117 or PSYC 176 or COGS 007 or COGS 117 or COGS 176
Attribute/Distribution: SS

PSYC 378 Emotional Development 4 Credits
The course will cover selected topics in emotional development from infancy through adulthood. Topics will include: infant attachment (learning to love), romantic attachment (being in love), emotion regulation, sympathy/empathy, anger/aggression, temperament, etc. We will also discuss the ways in which significant relationships with peers and parents shape children's emotional development.
Prerequisites: PSYC 107
Attribute/Distribution: SS

PSYC 380 Sports Psychology 4 Credits
Theory, research and application comprise this focal area of psychology. The course will allow students to explore the theory and research giving rise to individual, team, and peak performance assessment and interventions. Topics will include assessment, affect modulation, imagery, cognitive formulation, and psychodynamic development.
Prerequisites: PSYC 110 or PSYC 153

PSYC 381 Special Topics in Psychology 4 Credits
Topics vary from semester to semester. Topics are presented at an advanced level. Previous course work in psychology and consent of faculty sponsor is required.
Repeat Status: Course may be repeated.

PSYC 382 (BIOS 382) Endocrinology of Behavior 3 Credits
Hormonal effects upon animal and human behavior. Emphasis on neuroendocrinology of steroid hormone involvement in reproductive behaviors.
Prerequisites: BIOS 121
Attribute/Distribution: NS

PSYC 383 Attachment Theory & Research: The Study of Close Relationships Across the Lifespan 4 Credits
This course will examine the influence of close relationships across the lifespan on personality development. We will examine the influence of parents, peers, siblings, and romantic relationships using traditional attachment theory. In addition, we will also explore how attachment quality is measured and the clinical applications of attachment theory.
Prerequisites: PSYC 107
Attribute/Distribution: SS

PSYC 384 Self and Identity 4 Credits
We will examine different types of identity (e.g., personal, relational, collective) and the cognitive processes that allow for a multifaceted yet unified sense of self. We will study how self-related motives (e.g., enhancement, consistency, distinctiveness) influence self-knowledge, self-regulation, and mental health. Finally, we will explore the origins of self from evolutionary, neuroscientific, and cultural perspectives.
Prerequisites: PSYC 121 or PSYC 153
Attribute/Distribution: SS

PSYC 386 (HMS 386) Child and Adolescent Health Psychology 4 Credits
Focuses on developmental research and theory related to health and wellness issues in children and adolescents. Topics include children's understanding of biology and disease, disease management, medical consent, education and policy efforts to promote children's health.
Prerequisites: PSYC 107
Attribute/Distribution: SS

PSYC 389 Honors Project 1-8 Credits
Repeat Status: Course may be repeated.

PSYC 391 Thesis 4 Credits
Written report: Literature review and design of project in selected area of psychology. Only open to students in the honors program. Consent of Honors Program Coordinator required.
Prerequisites: PSYC 210
Attribute/Distribution: ND

PSYC 392 Honors Thesis 3 Credits
Execution of project designed in PSYC 391. Final report and oral presentation. Only open to students in the honors program. Consent of Honors Program Coordinator required.
Prerequisites: PSYC 391

PSYC 393 Independent Research 1-3 Credits
Individual research projects designed and executed in collaboration with faculty sponsor. Regular meetings with sponsor to give progress reports and receive feedback. Student reads relevant literature and writes report in APA format. Consent of faculty sponsor required.
Repeat Status: Course may be repeated.
Prerequisites: PSYC 210 or PSYC 161

PSYC 394 Senior Research Project 3 Credits
Literature review, design and execution of project in selected area of psychology. Intended for senior majors in psychology. Consent of faculty sponsor required.
Repeat Status: Course may be repeated.

PSYC 402 (EDUC 402) Developmental Psychology 3 Credits
Survey of theories and research concerning perceptual, cognitive, social, and personality development through infancy and childhood. Must have graduate standing or consent of instructor.

PSYC 403 Cognitive Psychology 3 Credits
Survey of theories and research in cognitive psychology. Must have graduate standing or consent of instructor.

PSYC 404 (BIOS 404) Behavioral Neuroscience 3 Credits
Theoretical and empirical issues in biopsychology. Must have graduate standing or consent of instructor.

PSYC 406 Social Cognition 3 Credits
Theory and research on cognitive processes in personality and social functioning. The self, personality consistency and change, causal attributions, social judgment, goals and self-regulation, and mood and emotion. Topics may vary. Must have graduate standing or consent of instructor.

PSYC 409 Professional Seminar I 1 Credit
For students entering the Ph.D. program: Acculturation to graduate school and the Psychology Ph.D. program in particular; professional issues of relevance to individuals at the outset of a research career in psychology. Department permission required.

PSYC 410 Professional Seminar II 1 Credit
For students nearing graduation: Professional issues of special relevance to Psychology Ph.D. students preparing for academic or nonacademic postdoctoral employment. Department permission required.

PSYC 412 First Year Research Project 1-3 Credits
Research project or paper to be completed by June of the first year of the Ph.D. program under the direction of a faculty advisor. May be repeated in second semester of program.
Repeat Status: Course may be repeated.

PSYC 421 Statistical Analysis of Psychological Data 1-3 Credits
First of a two-semester sequence covering essential issues in statistical analysis as practiced by psychologists. Topics include data description, probability, z and t-tests, general linear model, simple correlation/regression, univariate analysis of variance, chi-square. Emphasis on connecting research designs to appropriate statistical tests, data interpretation, and implementation in statistical packages. Department permission required.
PSYC 422 Statistical Analysis of Psychological Data II 3 Credits
Second course of the two-semester statistics sequence. Topics include advanced analysis of variance designs, analysis of covariance, multivariate analysis, multiple regression, and analysis of categorical data. Emphasis on connecting research designs to appropriate statistical tests, data interpretation, and implementation in statistical packages. Consent of department required.
Prerequisites: PSYC 421

PSYC 423 (COGS 423) Foundations of Cognitive Science 3 Credits
Survey of fundamental theory and methodologies from artificial intelligence, linguistics, cognitive psychology, philosophy, and neuroscience, as well as salient research problems such as knowledge acquisition and representation, natural language processing, skill acquisition, perception and action, and the philosophical question of intentionality.

PSYC 433 Cognitive Neuroscience Techniques 3 Credits
This glimpse into the toolkit of modern cognitive neuroscience provides an overview of a range of techniques from psychopharmacology and single cell recording, to human neuroimaging and neuropsychology.
The course introduces different techniques with a focus on issues of temporal and spatial resolution, costs and benefits, and appropriateness for different research questions. Students will develop the skills to be knowledgeable consumers of the modern literatures in psychology and related fields that are increasingly incorporating a range of neuroscience methods.
Prerequisites: PSYC 403

PSYC 443 Seminar In Language Acquisition 3 Credits
Special topics in language acquisition. Content will vary each time the seminar is offered.
Prerequisites: PSYC 402 or PSYC 403

PSYC 446 Developmental Theories and Special Populations 3 Credits
Traditional developmental theories focus on normative development. Children with disabilities have a unique set of experiences that pose special challenges for these theories. In the developmental literature, children with disabilities have sometimes been the focus of studies because they provide a “tests case” for specific theoretical predictions. In this course, we will consider some of these theoretical issues and the insights that have been gained by focusing on special populations.
Prerequisites: PSYC 402

PSYC 448 Seminar In Psychology of Language 3 Credits
Topics in language comprehension and production. Content will vary from year to year.
Prerequisites: PSYC 403

PSYC 450 Special Topics in Mathematical Models and Statistics 3 Credits
Selected topics in the application of mathematics to psychological research.
Repeat Status: Course may be repeated.

PSYC 460 Special Study 1-9 Credits
Study of some special topic not covered in the regular course offerings.
Repeat Status: Course may be repeated.

PSYC 461 Research Seminar 1-9 Credits
Original research designed and executed in collaboration with the faculty.
Repeat Status: Course may be repeated.

PSYC 462 Stereotypes, Prejudice, Discrimination 3 Credits
An in-depth survey of the social psychological literature on stereotypes, prejudice, and discrimination. Topics will include: Origin of stereotypes, mental representation of stereotypes, cognitive and behavioral consequences of stereotypes, inevitability of stereotyping, nature of prejudice in contemporary American society, context-specificity of discriminatory behavior, and theories of intergroup conflict reduction.
Prerequisites: PSYC 406

PSYC 464 Naive Realism in Social Judgement 3 Credits
This seminar examines the variety of unconscious influences that impact on social judgment, with a focus on the cognitive processing mechanisms through which influence is exerted. These influences include contributions to judgment from attitudes, goals, accessible constructs, mindsets, stereotypes, expectancies, heuristics, and theories about social objects.
Prerequisites: PSYC 402

PSYC 466 Prosocial Cognition, Emotion, and Behavior 3 Credits
In this course we will examine such phenomena as compassion, caregiving, sympathy, justice motivation, and helping. We will begin with an examination of human nature: Is prosociality fundamental to human nature? Subsequently, we will examine how prosociality can be nurtured by particular developmental experiences. Finally, we will examine the literature on the nature of prosociality in adulthood: What cognitive capacities support prosociality? What situational factors promote prosociality? What emotional qualities promote prosociality? What belief systems are linked to prosociality?
Prerequisites: PSYC 406

PSYC 476 Seminar In Cognition 3 Credits
Selected topics in human information processing, including such areas as attention, memory, language and comprehension, and decision-making. Area of emphasis will vary from year to year.
Prerequisites: PSYC 403

PSYC 478 (COGS 478) Ontological Psychology 3 Credits
Principles and constraints for the modeling of psychological phenomena: Representation, perception, memory, knowing, emotions, consciousness, language, and rationality.

PSYC 480 Seminar in Cognitive Development 3 Credits
Selected topics in cognitive development in infancy and childhood, including such areas as conceptual development, memory development, the development of reasoning abilities, and language acquisition. Emphasis will vary from year to year.
Prerequisites: PSYC 402

PSYC 481 Selected Topics in Social and Personality Development 3 Credits
Topics include emotional and sex-role development, peer relations, and social competence. Emphasis will vary from year to year.
Prerequisites: PSYC 402

PSYC 482 Seminar In Adult Development 3 Credits
Application of lifespan developmental theory and methodology to personality, social, and cognitive development in adulthood.
Prerequisites: PSYC 402

PSYC 483 Seminar In Cultural Psychology 3 Credits
Major theoretical approaches and empirical debates in cultural psychology, with a focus on the interplay of individual and sociocultural elements in the formation of mind, the emergence of the self, and the definition and reproduction of culture.
Prerequisites: PSYC 402

PSYC 484 (WGSS 484) Psychology of Gender 3 Credits
Major theoretical approaches and empirical debates in the psychology of gender, with a focus on the interplay of nature and nurture in producing gender similarities, gender differences and gender variation in personality, social behaviors, cognitive abilities, achievement, sexuality, and mental health. Methodological issues in gender research. Consent of instructor required.

PSYC 490 Thesis Research 1-6 Credits
Master's Thesis or Pre-dissertation Project research directed by committee.
**PSYC 495 Narrative & Psychology 3 Credits**
This course explores the increasing significance of narrative analysis in psychology by delineating the conceptual foundations of a narrative perspective and considering arguments for narrative as an integrative paradigm in psychological research. Particular emphasis will be on narrative development, the formation of identity, moral understanding, and other domains. Some specific topics will be narrative development, autobiographical memory, self-narrative, identity development, narratives of conflict, and the role of narrative in socialization and education.

**PSYC 499 Dissertation Research 1-15 Credits**
Ph.D. dissertation research directed by dissertation committee.

**Religion Studies**

**Department Home Page**

The religion studies department is committed to the academic investigation of religion as an intrinsic and vital dimension of human culture. The scholarly study of religion is an integral facet of a liberal arts education. The student of religion is engaged in the critical and interpretative task of understanding patterns of religious thought and behavior as aspects of the human cultural experience.

Religion studies is interdisciplinary in that it draws upon humanistic and social scientific modes of inquiry. These include historical, philosophical, sociological, anthropological, and psychological perspectives. Religion studies is a cross-cultural, comparative discipline concerned with the character and significance of the major religious traditions of the world. The student of religion confronts ethical problems and basic issues of value and meaning raised by modern multicultural and technological society.

**Professors.** Dena S Davis, JD (University of Virginia); Michael L. Raposa, PhD (University of Pennsylvania); Lloyd H Steffen, PhD (Brown University); Benjamin G. Wright, III, PhD (University of Pennsylvania)

**Associate Professors.** Jodi Eichler-Levine, PhD (Columbia University); Hartley Lachter, PhD (New York University); Monica R. Miller, PhD (Chicago Theological Seminary); Robert Thomas Rozehnal, PhD (Duke University)

**Assistant Professors.** Khurrum Hussain, PhD (Yale University); Annabella Pitkin, PhD (Columbia University)

**Emeriti.** Alice L. Eckardt, MA (Lehigh University); Norman J. Girardot, PhD (University of Chicago); Kenneth L. Kraft, PhD (Princeton University); Laurence J. Silberstein, PhD (Brandeis University); Lenore E. Chava Weissler, PhD (University of Pennsylvania)

**MAJOR IN RELIGION STUDIES**
The major in religion studies consists of 32 credit hours of coursework (eight courses). Requirements include:

- In consultation with a major advisor from the departmental faculty, students will devise a balanced plan of study responsive to individual needs and interests. The curriculum for each major will demonstrate exposure to a diversity of approaches to the interdisciplinary, transcultural field of religion studies.
- At least four courses at the 100 level or above.
- REL 374 Seminar for Majors

The department recommends that in consultation with a major advisor, students concentrate in one of the major religious traditions, or in a comparative or thematic approach to the study of religion. The concentration should include at least four courses. Language study appropriate to the concentration is desirable.

Students are particularly encouraged to consider a joint or double major with another major field from any of the three colleges at the university.

**DEPARTMENTAL HONORS**
Religion studies majors are admitted to honors by invitation of the departmental faculty toward the end of the student’s junior year. To be eligible, a student must have attained at least a 3.25 average in his or her major program by the end of the junior year. Upon admittance to honors, the student will work out a special program of studies for the senior year with the major advisor, culminating in the writing of a senior essay.

**MINOR IN RELIGION STUDIES**
The minor in religion studies consists of a total of 16 credits. The specific courses to be taken by each student are to be decided upon jointly by the student and the departmental advisor. Ordinarily, the student will be expected to take one introductory course unless specifically exempted by the department chair.

**Courses**

**REL 001 Sacred Scriptures in Religious Traditions 4 Credits**
An encounter with the different sacred books of the world’s major religions. Both the books and differing attitudes in these traditions towards sacred books are examined. Books investigated include the Bhagavad Gita, the Analects of Confucius, the Qur’an and the Jewish and Christian Bibles.

**Attribute/Distribution: HU**

**REL 002 (HMS 002) Death and Dying: Religious and Ethical Perspectives 4 Credits**
Introduces students to the study of religion, world religions and ethics through an exploration of death and dying. Rituals, practices and texts focused on death provide the basis for comparative study of Asian and Western religious approaches to the meaning and mystery of death as it confronts individuals and communities. Attention will also be given to moral justification for deaths brought about by human actions (i.e., killings). Specific issues include suicide, war deaths, abortion, euthanasia and state-sponsored execution.

**Attribute/Distribution: HU**

**REL 003 (PHIL 003) Global Religion, Global Ethics 4 Credits**
Introduction to philosophical and religious modes of moral thinking, with attention given to ethical issues as they arise cross-culturally and through religious traditions. The course will reference the United Nations Millennium Goals to consider family life and the role of women, social justice, the environment, and ethical ideals. Particular focus varies but may include one or more of the following: abortion and reproductive health, the death penalty, religiously motivated violence, and problems of personal disorder (heavy drinking, anorexia, vengeance).

**Attribute/Distribution: HU**

**REL 005 Spiritual Exercises in Religious Traditions 4 Credits**
Explores a variety of religious disciplines developed in various traditions, ranging from the practice of yoga and the martial arts to various forms of prayer, meditation, and asceticism.

**Attribute/Distribution: HU**

**REL 006 Religion and Ecological Crisis 4 Credits**
Past and present responses to nature in world religions. Contemporary topics include the animal rights debate, ecofeminism, and the development of environmental ethics. Is “the end of nature” at hand? Why is the environment a religious issue?

**Attribute/Distribution: HU**

**REL 009 Spiritual Journeys 4 Credits**
A comparative survey of spiritual traveling-from overland pilgrimages to inward journeys in search of truth. Through autobiographies, diaries, poetry and films, students encounter the experiences of seekers from diverse religious traditions, including Hinduism, Buddhism, Christianity and Islam.

**Attribute/Distribution: HU**

**REL 010 (ASIA 010, PHIL 010) Intro to Buddhism: Love Death and Freedom 4 Credits**
This course introduces students to Buddhist practices, philosophical systems, and cultural forms, from Buddhism’s Indian origins to its spread in East Asia and Tibet. Students will explore how Buddhists have approached the problem of death, the possibility of freedom, and the forms of social and individual love and concern. Course materials include poetry, biographies, philosophical writings, art and film.

**Attribute/Distribution: HU**
REL 012 (ASIA 012) Mountains, Buddhas, Ancestors: Introduction to East Asian Religions 4 Credits
This course explores the principal religions of East Asia, including Buddhism, Daoism, Confucianism, Shinto, and Shamanic Traditions. What is each tradition’s view of human potential? How is ultimate reality depicted and experienced? What do home altars, boisterous festivals, and silent meditation halls have in common? Several primary texts are read in translation.
Attribute/Distribution: HU

REL 013 (GS 013) Religion and Food 4 Credits
This course explores the complex connections between religion and food. We will examine food-related rituals, including Jewish Passover seders, Christian communion, and Hindu puja; the role of gastronomy in forming religious and ethnic identity; and the global ethics of food and sustainability. We will also probe the notion of food itself as sacred. Are “foodies” engaging in their own sort of sacred actions? How does food connect with the sublime? The class will include tastings and outings as scheduling permits.
Attribute/Distribution: HU

REL 014 "Virtual" Religion 4 Credits
The contemporary world is replete with social phenomena that resemble religious thought and practice—sports fandom, trekkies, nationalistic rituals, online gaming, military camaraderie and codes, environmental activism, etc. In this course we will explore and discuss many of these “virtually” religious phenomena through the lens of the study of religion.
Attribute/Distribution: HU

REL 025 (AAS 025) Introduction to Black Religions and Hip-Hop 4 Credits
Rapper KRS ONE once stated that, “Rap is something you do and Hip-Hop is something you live.” This course thinks through the global evolution of Hip-Hop culture and the public and academic study of Black Religions as responses to structural and historical inequality and the search for meaning in culture by considering themes of resistance, constraint, power, the body, deviance, and morality over and against race, class, gender, and sexuality from a range of academic and cultural sources.
Attribute/Distribution: HU

REL 044 (GS 044) Religious Fundamentalism in Global Perspective 4 Credits
This course will explore the rise of fundamentalist religious movements and their involvement in violent conflicts. Topics to be considered will include the relationship between fundamentalist religious ideologes and terrorism, and the kinds of responses that fundamentalist religious movements present to the development of a global marketplace and the spread of secular nationalisms.
Attribute/Distribution: HU

REL 060 (ASIA 060) Religions of South Asia 4 Credits
A thematic introduction to the foundational religious traditions of South Asia: Hinduism, Jainism, Buddhism, Sikhism and Islam. Students explore the social and spiritual dimensions of these religious worlds through scripture, ritual practices, narrative and teaching traditions, music and art.
Attribute/Distribution: HU

REL 062 (GS 062) Explorations in Dialogue 4 Credits
Course critically investigates inter-religious dialogue, an important issue in the contemporary academic study of religion. Focus will be on the problem of inter-religious encounter; religion and globalization; different models of dialogue; and the questions of power and identity. At least two traditions will be put into conversation for any proposed offering (e.g., Christian-Buddhist, Jewish-Muslim, Jewish-Christian).
Attribute/Distribution: HU

REL 073 (JST 073) The Jewish Tradition 4 Credits
Judaism is both a textual tradition and a lived religion. Students read basic Jewish texts—Bible, Talmud, Midrash—and study the ways Jews sanctify the life cycle through rites of passage, and the round of the year through the festival cycle.
Attribute/Distribution: HU

REL 075 The Christian Tradition 4 Credits
Introduction to the Christian tradition from its early variety and subsequent classical definition in the church councils up to the enlightenment. Special emphasis will be placed on the multiformal interpretations of the Christian message.
Attribute/Distribution: HU

REL 077 (ASIA 077, GS 077) The Islamic Tradition 4 Credits
A thematic introduction to Islamic history, doctrine and practice. Topics include: Qur’an; prophecy and sacred history; ritual practices; community life; legal interpretation; art and aesthetics; mysticism; politics and polemics.
Attribute/Distribution: HU

REL 079 Religion and Fantasy Literature 4 Credits
A survey of the religious themes that entered fantasy literature in the 1960s in the works of C. S. Lewis and J. R. R. Tolkien, and the humanist resistance to those themes in works by J. K. Rowling, Philip Pullman, or others.
Attribute/Distribution: HU

REL 081 (JST 081) Jewish Mysticism 4 Credits
This course explores the complex connections between religion and food. We will examine food-related rituals, including Jewish Passover seders, Christian communion, and Hindu puja; the role of gastronomy in forming religious and ethnic identity; and the global ethics of food and sustainability. We will also probe the notion of food itself as sacred. Are “foodies” engaging in their own sort of sacred actions? How does food connect with the sublime? The class will include tastings and outings as scheduling permits.
Attribute/Distribution: HU

REL 089 Special Topics 1-4 Credits
Repeat Status: Course may be repeated.

REL 102 (AAS 102, ENGL 102, JST 102) Promised Lands: Jewish and African American Children’s Literature 4 Credits
In the Hebrew Bible, Psalm 137 asks, “How can we sing the Lord’s song in a strange land?” For Jews, blacks, and black Jews, this was and is a poignant question. This course examines how these two rich, often overlapping and interacting groups tell their stories in literature for children and young adults, with a particular focus on the mediation of traumatic pasts. What does it mean to imagine promised lands beyond such pasts—and can they be reached?
Attribute/Distribution: HU

REL 111 (JST 111) Jewish Scriptures/Old Testament 4 Credits
The religious expression of the Hebrews, Israelites, and Jews as found in the Jewish Scriptures (TANAK/Christian Old Testament). Near Eastern context of Hebrew religion, the Patriarchs, the Exodus, the monarchy, prophecy, Exile and Return. Emphasis on historical, literary, critical problems, and newer socio-historical methods.
Attribute/Distribution: HU

REL 112 (JST 112) The Beginnings of Judaism and Jewish Origins: Jewish Diversity in the Greco-Roman World 4 Credits
The variety of approaches to Judaism in the period following the Babylonian exile through the second century C.E. The literature studied will include Apocrypha, Pseudepigrapha, and the Dead Sea Scrolls.
Attribute/Distribution: HU

Early Christianity from its beginnings until the end of the second century. Coverage includes the Jewish and Hellenistic matrices of Christianity, traditions about the life of Jesus and his significance, and the variety of belief and practice of early Christians. Emphasis on encountering primary texts.
Attribute/Distribution: HU

REL 115 (PSYC 115) Religion And Psychology 4 Credits
A study of the origins, development and consequences of religion from a psychological perspective. Attention will be given to classic and contemporary sources, with a focus on major psychoanalytic theorists of religion (Freud, Jung, Erikson); psychological analyses of religious experience (e.g., Wm. James, Victor Frankl); and the diverse cultural and religious forms that structure the connection between religion and psychology (e.g., Buddhist psychology, Japanese Morita therapy).
Attribute/Distribution: HU
REL 116 (HMS 116, PHIL 116) Bioethics 4 Credits
Moral issues that arise in the context of health care and related biomedical fields in the United States today, examined in the light of the nature and foundation of moral rights and obligations. Topics include: confidentiality, informed consent, euthanasia, medical research and experimentation, genetics, and the distribution of health care.
Attribute/Distribution: HU

REL 119 (ASIA 119, GS 119) The Podcast and the Lotus 4 Credits
Buddhism is increasingly a global phenomenon. Contemporary Buddhist teachers stay in touch with students via podcasts, WeChat, Twitter and Facebook. Buddhists from Singapore, Tibet, Japan, Mexico, Taiwan or Pennsylvania now meet via new technology. This class asks, how is Buddhism a "modern" religion? Students explore issues of conversion, modernity, globalization, new technology, migration and travel. Sources include autobiography, film, travel writing, political essays, interviews, social media, ethnography.
Attribute/Distribution: HU

REL 121 (JST 121) Sources for the Life of Jesus: the Jewish and Christian Context 4 Credits
Ancient sources that claim to provide information about Jesus of Nazareth. Approaches taken to Jesus' life and career; early Christian interpretations of the significance of Jesus; methodology in assessing evidence for the historical Jesus and his message.
Attribute/Distribution: HU

REL 122 Archaeology and the Bible 4 Credits
In this course we will examine the way that archaeological work can inform the study of the Bible. One important consideration is how archaeological data have been used either to confirm or falsify the biblical texts. We will look at how archaeologists work and how archaeological data and the Bible intersect. We will examine in detail several archaeological sites in order to understand better the difficulties in interpreting the material remains that archaeologists dig up.
Attribute/Distribution: HU

REL 123 "This is How the World Will End": Endtime Thinking in Judaism and Christianity 4 Credits
Thinking about how the world will end was an important feature of certain types of ancient Judaism. Early Christianity took over many of these ideas, and they became fundamental to later Christian theologies, including many that continue to be advocated today. This course will look at ancient Jewish and Christian texts that speak about the end of the world and will trace some of them through more contemporary developments in these two religious traditions.
Attribute/Distribution: HU

REL 124 (PHIL 124) Philosophy Of Religion 4 Credits
A critical look, from a philosophical perspective, at some fundamental problems of religion: The nature of religious experience and belief, reason and revelation, the existence and nature of God, the problem of evil, and religious truth.
Attribute/Distribution: HU

REL 125 Comparative Religious Ethics 4 Credits
How have thinkers within the three major Abrahamic traditions handled ethical questions and dilemmas throughout history? This course will focus on many issues including but not limited to violence and pacifism, debates concerning revelation versus reason, the different accounts of justice and peace, the nature of scripture and the divine. We will look comparatively both within and across these traditions.
Attribute/Distribution: HU

REL 129 (JST 129, PHIL 129) Jewish Philosophy 4 Credits
Consideration of how major Jewish thinkers from the first to 21st centuries confronted questions at the intersection of religion and philosophy: the existence and nature of God, free will, evil, divine providence, miracles, creation, revelation, and religious obligation.
Attribute/Distribution: HU

REL 138 (JST 138, WGSS 138) Sex, Gender, Jews 4 Credits
How do Jews of all genders tell their stories? What are the varied Jewish approaches to sexuality? How have feminist movements affected Jewish rituals? In this course, we will consider how religion, gender, sexuality, race, and class intersect in the lives of Jews, with a particular focus on North America. Topics and will include: Jewish women's memoirs; the voices of LGBTQ Jews; recent innovations in Jewish ritual and leadership; Jewish masculinities; and the gendering of Jewish children's literature, among others.
Attribute/Distribution: HU

REL 139 (ANTH 139, JST 139) Jewish Folklore 4 Credits
Examines the transformation of folk and popular Judaism from the Old World, through the period of immigration to America, to ethnic and later forms of American Jewish culture. Attention paid to concept of folklore revivals and their meanings. Four case studies: folk tales and storytelling, klezmer music, life-cycle rituals, and food.
Attribute/Distribution: SS

REL 140 (GS 140) Globalization and Religion 4 Credits
This course examines the complexity of globalization and its multi-layered impact on religious identity and piety. Though comparative in methodology and historical framework, the class will give special attention to Islam and Hinduism in South Asia. Topics include: European colonialism; Orientalism and its legacy; religious nationalism; Islamophobia; and the Internet and mass media.
Attribute/Distribution: HU

REL 141 (PHIL 141) Medieval Islamic Philosophy 4 Credits
The medieval era was the golden age of Islamic civilization. Science, mathematics, theology, philosophy, logic, jurisprudence, and many other disciplines flourished during that time. Islamic scientific and philosophical thoughts were greatly influenced by the Greek intellectual tradition, and in turn the Islamic intellectual tradition influenced European thoughts during the Middle Ages and beyond. The course is an introduction to medieval Islamic philosophy. There is no indigenous Islamic philosophy other than medieval Islamic philosophy. Reading selections include works by al-Kind#, al-R#z#, al-F#r#b#, Ibn S#n# (Avicenna), al-Ghaz#l#, Ibn #ufayl, and Ibn Rushd (Averroes). The goal is to attain a thorough understanding of the reading selections instead of covering a large number of treatises.
Attribute/Distribution: HU

REL 143 (GS 143) Religious Nationalism in a Global Perspective 4 Credits
Religion has become a renewed political force on the world stage in recent years. This course will focus on how religion has often provided both the Ideological language and the organizing principles for many modern nationalisms. Our exploration of this topic will take the form of case studies from various parts of the world, including but not limited to Pakistan, Israel, No. Ireland, India, Iran and USA.
Attribute/Distribution: HU

REL 145 (ASIA 145, GS 145) Islam and the Modern World 4 Credits
Examines how numerous Muslim thinkers-religious scholars, modernists, and Islamists-have responded to the changes and challenges of the colonial and post-colonial eras. Special emphasis is placed on the public debates over Islamic authority and authenticity in contemporary South Asia.
Attribute/Distribution: HU

REL 147 (ASIA 147, GS 147) Pilgrims, Bandits, Traders, Nuns: Traveling Religious Identities in Asia 4 Credits
This course examines religious networks linking Chinese, Tibetan, Himalayan, and Inner Asian people, places, and institutions to Asia and the world. We explore examples of 19th, 20th century and present day transnational religious identities, emerging from trade, religious travel and pilgrimage, refugee migrations, labor migrations, and modern day leisure travel. We consider religious identity, nationalism, transnationalism, and globalization, using literary, historical, and ethnographic sources, and film, video, and popular media.
Attribute/Distribution: HU
REL 148 (GS 148) Islam Across Cultures 4 Credits
Explores the Muslim world’s diversity and dynamism in multiple cultural contexts—from the Middle East and North Africa, to Asia and America—through literature, ethnography, and films. Topics include: travel and trade networks; education; women and gender; Islam and cultural pluralism; colonialism; and identity politics.
Attribute/Distribution: HU

REL 149 Modern Islamic Ethics 4 Credits
This course will focus on developments in Islamic thinking and ethics that emerge from the modern encounter between Muslim societies and the West. We will discuss Islamic modernism and fundamentalism through short primary texts from a variety of modern Muslim thinkers.
Attribute/Distribution: HU

REL 152 (JST 152) American Judaism 4 Credits
Diverse cultural and social forms through which American Jews express their distinct identity. Is American Jewry an example of assimilation and decline or creative transformation? What, if anything, do American Jews share in common? Compatibility of Judaism with individualism, pluralism, and voluntarism. How have the Holocaust and the State of Israel shaped the self-understanding of American Jewry?
Attribute/Distribution: HU

REL 154 (HIST 154, JST 154) The Holocaust: History and Meaning 4 Credits
The Nazi Holocaust in its historical, political and religious setting. Emphasis upon the moral, cultural and theological issues raised by the Holocaust.
Attribute/Distribution: HU

REL 155 (JST 155) Judaism and Comic Books 4 Credits
Is The Thing Jewish? What does Superman have to do with the bible? Do Orthodox Jewish girls fight trolls? In this course, we will closely examine comic books and graphic novels in order to expand our understanding of what Jewishness might mean. With a POW! and a BAM!, we will consider many topics “from Krakow to Krypton,” including American Jewish history, how representations of Jews are gendered, global Jewish traditions, monsters and mutations, biblical adaptations, and more!
Attribute/Distribution: HU

REL 157 (HIST 157) Europe in the Age of the Reformation 4 Credits
The breakup of the religious culture of medieval Christian Europe in the reformation movements of the sixteenth century. The origins and varieties of Protestantism; the intersection of religious ideas and politics in Germany, Switzerland, Britain, France, and the Netherlands; the “wars of religion” and the emergence of the European state system.
Attribute/Distribution: HU

REL 159 Roman Catholicism in the Modern World 4 Credits
A survey of the various intellectual, cultural, political and ecclesiastical developments that have shaped contemporary Roman Catholic life and thought.
Attribute/Distribution: HU

REL 162 (ASIA 162) Zen Buddhism 4 Credits
Attribute/Distribution: HU

REL 166 (ASIA 166, GS 166) Religious Nationalism in South Asia 4 Credits
This course explores the conflation and conflict of religion and politics in one of the most complex, dynamic and volatile regions on the planet (South Asia). Through literature, film and scholarly writings, students will examine the history of cooperation and conflict between the Muslim and Hindu communities in South Asia—from the movements for national independence to twenty-first century identity politics.
Attribute/Distribution: HU

REL 167 (ASIA 167) Engaged Buddhism 4 Credits
Examines a contemporary international movement that applies Buddhist teachings and practices to social, political, and environmental issues. Topics include: important thinkers, forms of engagement, and areas of controversy.
Attribute/Distribution: HU

REL 171 (SOC 171) Religion And Society 4 Credits
An introduction to the sociology of religion. Covers classical and contemporary approaches to defining and studying the role of religion in society. Emphasis on understanding religious beliefs and practices in the United States, the sources and contours of religious change, and the effects of religion on individuals and society. Specific topics include religious fundamentalism, religious conversion, religious practices and authority, secularization, religion in public life, religion in social change, religious terrorism, and the ways in which religion impacts our personal health, educational attainment, and family life.
Attribute/Distribution: SS

REL 174 (JST 174) Contemporary Theology 4 Credits
Major 20th century movements within Christian and Jewish theology understood as responses to the world at large. May be repeated for credit as the subject matter varies.
Attribute/Distribution: HU

REL 180 (HIST 180) Religion and the American Experience 4 Credits
The historic development of major American religious groups from colonial times to the present; their place in social and political life, and the impact of the national experience upon them.
Attribute/Distribution: HU

REL 182 (WGSS 182) Sex and Gender in the Bible 4 Credits
The Bible is often invoked—and often simplistically—as an authoritative source in contemporary discussions about the role of women and what kinds of human sexual expression is acceptable. This course will explore how sex and gender are constructed in different biblical periods and biblical books. We will see that things are not nearly as simple as they are often made out to be.
Attribute/Distribution: HU

REL 184 (WGSS 184) Religion, Gender and Power 4 Credits
Gender differences as one of the basic legitimations for the unequal distribution of power in Western society. Feminist critiques of the basic social structures, cultural forms, and hierarchies of power within religious communities, and the ways in which religious groups have responded.
Attribute/Distribution: HU

REL 185 (HIST 185, JST 185) Modern Jewish History 1800-2000 4 Credits
This course examines the emergence of distinct forms of Jewish culture in the modern age that challenge or depart from traditional Jewish sources and authority. Included are an examination of Freud’s psychology, Chagall’s paintings and Woody Allen’s films.
Attribute/Distribution: HU
REL 187 Science, Technology, and the Religious Imagination 4 Credits
Impact of the scientific and technological culture on the Western religious imagination. Roots of science and technology in religious ideas and images. Ways of knowing and concepts of experience in religion and science.
Attribute/Distribution: HU

REL 188 Religion and Literature 4 Credits
Religious themes in the modern novel or the spiritual autobiography. Melville, Tolstoy, Camus, Updike, Walker, and Morrison; or Woolman, Tolstoy, Malcolm X, Wiesel, Frederick Douglass, Sojourner Truth, Kukai.
Attribute/Distribution: HU

REL 192 (ASIA 192, PHIL 192) Lehigh in Japan: Kyoto I 3 Credits
This is one of 2 courses that will be part of an intensive international summer school course to take start Summer 2016 in Kyoto University. Students will study aspects of Western and Japanese philosophical thought in a small group led by local and international speakers. Participants in the class will also be local and international. Students will be expected to attend all classes for a number of hours over a period of two weeks.
Attribute/Distribution: HU

REL 193 (ASIA 193, PHIL 193) Lehigh in Japan: Kyoto II 3 Credits
A second component of the Philosophy summer school in Kyoto will involve a series of excursions to galleries, museums, temples, shrines, stores, and restaurants. Students can expect to develop their understanding of both Japanese aesthetics and the way in which the philosophical systems present in Japan have influenced the Japanese aesthetic sensibility. Students will be required to submit a series of shorter pieces of writing and a final project.
Attribute/Distribution: HU

REL 212 Globalization in the Ancient Mediterranean 4 Credits
We often think of globalization as a modern phenomenon. Yet as early as the twelfth century BCE, transportation, trade, political and religious networks tied the Mediterranean basin together. This course will examine in three periods— the Late Bronze Age, the Hellenistic period, and the Roman period—how these networks were organized and how they affected a range of Mediterranean and Near Eastern peoples. We will use some modern approaches to globalization as analytical tools for understanding the ancient world.
Attribute/Distribution: HU

REL 213 (CLSS 213, HIST 213) Ancient Roman Religion 4 Credits
Attribute/Distribution: SS

REL 220 (ASIA 220) Poet, Meditator, King: Classics of East Asian Religion 4 Credits
Classic texts of East Asia and an introduction to the traditions they represent. What do these texts teach about reality, humanity, divinity, virtue and society? How is the path of personal and social transformation presented?
Attribute/Distribution: HU

REL 221 (ASIA 221) Topics in Asian Religions 4 Credits
Selected thematic and comparative issues in various Asian religious traditions. May include Buddhism and Christianity; religion and martial arts, Asian religions in America, Taoist meditation, Zen and Japanese business, Buddhist ethics. (H/S).
Repeat Status: Course may be repeated.

REL 222 Topics In Western Religions 4 Credits
Selected historical, thematic, and comparative issues in Judaism, Christianity, and Islam.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

REL 224 (PHIL 224) Topics in the Philosophy of Religion 4 Credits
Selected problems and issues in the philosophy of religion. Must have completed one HU designated course in Philosophy.
Attribute/Distribution: HU

REL 225 Topics in Religion and Ethics 4 Credits
Analysis of various moral problems and social value questions. Possible topics include: environmental and non-human animal ethics, medical ethics, drug and alcohol abuse; spiritual meaning of anorexia.
Attribute/Distribution: HU

REL 226 (HMS 226) From Black Death to AIDS: Plague, Pandemic, Ethics, and Religion 4 Credits
An investigation into the way religion and morality shape interpretations of plague and pandemics. Three specific pandemics are examined: the bubonic plague of the 14th century, the 1918 influenza pandemic, and the current global AIDS crisis. Moral issues provoked by institutional, political and social responses to pandemic disease are also considered.
Attribute/Distribution: HU

REL 228 Theories Of Religion 4 Credits
The nature and function of religion. What is religion? Does it have a universal, cross-cultural and transcendent essence? Drawing on numerous academic disciplines, the course engages the major issues and most influential authors in the academic study of comparative religions.
Attribute/Distribution: HU

REL 230 (JST 230) Kabbalah: Jewish Mystical Tradition 4 Credits
Explores the history of the quest to know God, through mystical experience or theosophical speculation, as found in Jewish tradition. Examines such issues as the tensions between institutional religion and personal religious experience, between views of God as immanent in the world or transcending it, and between imagery for God and religious experience of God.
Attribute/Distribution: HU

REL 231 (JST 231) Classic Jewish Texts 4 Credits
Many people know that the Hebrew Bible ("Old Testament") is a foundational scripture for Judaism. Fewer are familiar with the post-biblical Jewish classics. Yet these works shaped the understanding of God, the identity of the Jewish people, and the vision of history and of the ethical life that inform Judaism today. As students read the Talmud, Midrash, and traditional prayer-book, they will become familiar with the wisdom of the rabbinic sages, and the central concepts of Judaism.
Attribute/Distribution: HU

REL 241 (PHIL 241) Critics of Religion 4 Credits
A seminar devoted to an analysis of the critiques of religion in the writings of Benedict Spinoza, Friedrich Nietzsche, Sigmund Freud, Michel Foucault and William E. Connolly.
Attribute/Distribution: HU

REL 247 (ASIA 247, GS 247) Islamic Mysticism 4 Credits
Sufism, the inner or 'mystical' dimension of Islam, has deep historical roots and diverse expressions throughout the Muslim world. Students examine Sufi doctrine and ritual, the master-disciple relationship, and the tradition's impact on art and music, poetry and prose.
Attribute/Distribution: HU

REL 251 (CLSS 251) Classical Mythology 4 Credits
Attribute/Distribution: SS

REL 254 (ASIA 254, ES 254) Buddhism and Ecology 4 Credits
Buddhism's intellectual, ethical, and spiritual resources are reexamined in light of contemporary environmental problems. Is Buddhism the most green of the major world religions? What are the moral implications of actions that affect the environment?
Attribute/Distribution: HU

REL 262 Critics of Modernity 4 Credits
Many modern thinkers find modernity and its forms of social organization and politics to be deeply troubling. Including both religious and non-religious critiques, this course will explore the varying meanings of modernity and how these thinkers challenge such meanings. Critics including but not limited to Gandhi, Hannah Arendt, Reinhold Niebuhr, Sayyid Qutb, Alasadair MacIntyre and Ruhollah Khomeini.
Attribute/Distribution: HU
Science, Technology and Society

Program Director: Stephen H. Cutchliffe, Ph.D.
(Lehigh) [http://cas.lehigh.edu/Roster/Profile.aspx?key=Yk9FYndtL1ZCNG13Y1VODRzdmsNhSzd09&theme=dialog]
Email: shc0@lehigh.edu # Phone: 610-758-3349
Website: http://sts.cas2.lehigh.edu/
Supported by the Office of Interdisciplinary Programs, 610-758-3996; incasip@lehigh.edu
Williams Hall, 31 Williams Drive

Core Faculty
William Best, Professor of Practice (College of Engineering); Gail Cooper, Ph.D. (Department of History); Steve Cutchliffe, Ph.D. (Department of History); Sharon Friedman, Ph.D. (Department of Journalism and Communication); Steve Goldman, Ph.D. (Emeritus); John Smith, Ph.D. (Department of History); and Al Wurth, Ph.D. (Department of Political Science)

The Science, Technology and Society (STS) program is the product of a continuing cross-college effort to create a common ground from which to explore the relations between science, technology and society: between ideas, machines and values.

The STS program serves as a focal point for a wide range of courses that study the natures of science and of technology, and analyze their social and personal implications. It lends coherence and visibility to offerings otherwise dispersed throughout the catalog.

SCIENCE, TECHNOLOGY AND SOCIETY (STS) MAJOR
The major in science, technology and society studies prepares students for graduate study or for a wide variety of career opportunities including policy analysis, planning, or community relations with public or private sector agencies concerned with the social relations of scientific research and technological innovation. The intrinsically cross-disciplinary character of science-technology-society interactions is reflected in the B.A. requirements.

Majors must complete a minimum of 30 credit hours in STS courses, listed below, together with at least 15 credit hours in any traditional academic discipline: engineering, physical or life science, the humanities, or the social sciences. This collateral set of courses should be chosen in consultation with the program director to provide the foundation needed to engage STS studies issues in which that discipline is implicated. The senior seminar provides an opportunity for students to integrate the knowledge they have gained and the skills they have acquired in their coursework.

Opportunities for student research are available, especially through STS 181: Independent Study and STS 391: Honors Thesis.

STS studies is a social science major in the College of Arts and Science, and majors must fulfill the college’s B.A. distribution requirements. A detailed description of the STS studies major requirements follows.

Detailed Description of STS Major Requirements Course List

Core Courses

<table>
<thead>
<tr>
<th>STS Course</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS 011</td>
<td>Technology and Human Values</td>
</tr>
<tr>
<td>HIST 007</td>
<td>Technology in America's Industrial Age</td>
</tr>
<tr>
<td>or HIST 008</td>
<td>Technology in Modern America</td>
</tr>
<tr>
<td>STS/JOUR 124</td>
<td>Politics of Science</td>
</tr>
<tr>
<td>or POLS 115</td>
<td>Technology As Politics</td>
</tr>
<tr>
<td>PHIL 128</td>
<td>Philosophy Of Science</td>
</tr>
<tr>
<td>or PHIL 228</td>
<td>Topics in the Philosophy of Science</td>
</tr>
<tr>
<td>STS 381</td>
<td>Senior Seminar</td>
</tr>
</tbody>
</table>

Electives

Select three additional advanced courses (at least two of which must be at the 100 level or higher) from the list of approved STS studies courses

Concentration Requirement

One of the following: (1)
### STS STUDIES MINOR

The program also offers a minor in science, technology & society studies which is open to all undergraduates. To declare a minor in STS, students must complete a minor declaration form (http://catalog.lehigh.edu/coursesprogramsandcurricula/artsandsciences/scienceandtechnology/2015-16_STS_Minor_Declaration_Form.pdf).

Students electing the minor must take a set of courses totaling a minimum of 15 hours that includes STS 011 Technology and Human Values and electives chosen from the list of all courses eligible for STS studies which follows below.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS 011 Technology and Human Values</td>
<td>4</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
</tr>
<tr>
<td>Three electives from approved STS courses</td>
<td></td>
</tr>
<tr>
<td>(minimum 11 credits)</td>
<td></td>
</tr>
</tbody>
</table>

**Total Credits**: 15

### STS COURSES

Students should consult with the program director when selecting courses for either the major or the minor.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS 011 Technology and Human Values</td>
<td>4</td>
</tr>
<tr>
<td>STS 112 Engineering and Society</td>
<td>4</td>
</tr>
<tr>
<td>STS/HIST/WGSS 117 Pioneering Women: Women in Science, Medicine and Engineering</td>
<td>4</td>
</tr>
<tr>
<td>STS/HIST/HMS 118 History of Modern Medicine</td>
<td>4</td>
</tr>
<tr>
<td>STS/JOUR 124 Politics of Science</td>
<td>4</td>
</tr>
<tr>
<td>STS/JOUR 145 Introduction to the History of Science</td>
<td>4</td>
</tr>
<tr>
<td>STS 181 Independent Study</td>
<td>1-4</td>
</tr>
<tr>
<td>STS/CSE/EMC 252 Computers, the Internet, and Society</td>
<td>3</td>
</tr>
<tr>
<td>STS/ES/HMS/JOUR 323 Health and Environmental Controversies</td>
<td>4</td>
</tr>
<tr>
<td>STS 341 Issues in American Competitiveness: At Home and Abroad</td>
<td>4</td>
</tr>
<tr>
<td>STS 381 Senior Seminar</td>
<td>4</td>
</tr>
<tr>
<td>STS 391 Honors Thesis (fall)</td>
<td>1</td>
</tr>
<tr>
<td>STS 392 Honors Thesis (spring)</td>
<td>3</td>
</tr>
<tr>
<td>STS 481 Readings in Science, Technology and Society</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Credits**: 45-47

### OTHER STS COURSES

These courses, appropriate to STS studies, are offered by various departments. Course descriptions may be found under the catalog entry for the individual department. New courses are frequently added to this list and announced in bulletins published by the STS program. For further information, please contact the program director.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARCH 107 History of American Architecture</td>
<td>4</td>
</tr>
<tr>
<td>ARCH 210 20th Century Architecture</td>
<td>4</td>
</tr>
<tr>
<td>DES 066 Design History</td>
<td>4</td>
</tr>
<tr>
<td>ECO 311 Environmental Economics</td>
<td>3</td>
</tr>
<tr>
<td>ECO 314 Energy Economics</td>
<td>3</td>
</tr>
<tr>
<td>EES/ES 002 Introduction to Environmental Science</td>
<td>3</td>
</tr>
<tr>
<td>EES/ES 004 The Science of Environmental Issues</td>
<td>1</td>
</tr>
</tbody>
</table>

Courses

**STS 011 Technology and Human Values 4 Credits**

Impact of technology on society in relation to ethical problems raised by the exploitation of technological innovations. Illustrations from history, social studies, philosophy, literature, and film.

**Attribute/Distribution**: SS

**STS 112 Engineering and Society 4 Credits**

An examination of the social, political, commercial, and cultural factors that determine the problems engineers are asked to solve as well as the terms of acceptable solutions to those problems. This is a discussion-based course using a mix of books, articles, and videos.

**Attribute/Distribution**: SS

**STS 117 (HIST 117, WGSS 117) Pioneering Women: Women in Science, Medicine and Engineering 4 Credits**

This course analyses the careers of professional women in science, medicine and engineering, principally in the United States. It examines historical barriers to training and entry into these professions; cultural stereotypes that shape women’s options; women’s participation in innovation in their fields; their concern for work/life balance; and their contribution to clients and patients, both male and female. It focuses on three locations of professional work: the laboratory, the clinic, and the job site.

**Attribute/Distribution**: SS
STS 118 (HIST 118, HMS 118) History of Modern Medicine 4 Credits
Introduction to Western medical history from the 18th century to the present day. Students will explore patient/practitioner relationships, examine changing ideas concerning health, sickness, and disease, chart changes in hospital care and medical education, and tackle topics such as eugenics, medical experimentation, and health insurance.

Attribute/Distribution: HU

STS 124 (JOUR 124) Politics of Science 4 Credits
Analysis of the multidimensional interaction between the federal government and the scientific community. Explores historical growth of the science-government connection, the scientific establishment both past and present, and the role of scientific advice to the White House and Congress. Also examines scientific ethics, public attitudes toward science, science-society interactions, and case studies of scientific controversies.

Attribute/Distribution: SS

STS 145 (HIST 145) Introduction to the History of Science 4 Credits
The history of modern science, primarily physical and biological, with emphasis on the development of major theoretical models since the seventeenth century.

Attribute/Distribution: SS

STS 181 Independent Study 1-4 Credits
Consent of program director required. Designation of the course as HU or SS will depend on the instructor and the content of the course.

Repeat Status: Course may be repeated.

Attribute/Distribution: HU, SS

STS 221 (MAT 221) Materials in the Development of Man 3 Credits
Development of materials technology and engineering from the Stone Age to Atomic Age as an example of the interaction between technology and society. In-class demonstration laboratories on composition and structure of materials. Term projects using archaeological materials and alloys. Course intended for, but not limited to, students in the humanities and secondary science education. Engineering students may not use this course for engineering science or technical elective credit.

Attribute/Distribution: SS

STS 252 (EMC 252) Computers, the Internet, and Society 3 Credits
An interactive exploration of the current and future role of computers, the Internet, and related technologies in changing the standard of living, work environments, society and its ethical values. Privacy, security, depersonalization, responsibility, and professional ethics; the role of computer and Internet technologies in changing education, business modalities, collaboration mechanisms, and everyday life.

Attribute/Distribution: SS

STS 323 (ES 323, HMS 323, JOUR 323) Health and Environmental Controversies 4 Credits
Exploration of health, and environmental controversies from the perspectives of scientific uncertainty and mass media coverage. Examines genetic engineering, biotechnology, environmental health risks, and nanotechnology. Includes discussion of ethical and social responsibilities and interactions with the public.

Attribute/Distribution: SS

STS 341 Issues in American Competitiveness: At Home and Abroad 4 Credits
Issues affecting American commercial competitiveness focusing on topics associated with the recent emergence of a new commercial environment in all First World societies. Team taught in a highly interactive setting with industry, public sector, and government experts, in addition to academics from various disciplines and institutions. Students read topical articles and books, participate in team projects and debates, and conduct team research on competitiveness issues they have chosen for a term report.

Attribute/Distribution: SS

STS 381 Senior Seminar 4 Credits
In-depth study of selected topics in science, technology, and society with special attention to methodological issues. Subject matter may vary from semester to semester. Intended for STS majors and minors, but open to others. Consent of program director.

Prerequisites: STS 011

Attribute/Distribution: SS

STS 391 Honors Thesis 1 Credit

Attribute/Distribution: ND

STS 392 Honors Thesis 3 Credits
Directed undergraduate research thesis required of students who apply and qualify for graduation with program honors.

Prerequisites: (STS 391)

Can be taken Concurrently: STS 391

Attribute/Distribution: ND

STS 481 Readings in Science, Technology and Society 3 Credits
Readings seminar on selected themes and topics in science, technology, and society. May be repeated for credit with permission of the program director.

Repeat Status: Course may be repeated.

School Psychology

The School Psychology Program offers two degree programs: An Educational Specialist (Ed.S.) degree and a doctoral degree (Ph.D.). Certification as a school psychologist in the state of Pennsylvania is associated with both degree programs.

Both degree programs are approved by the National Association of School Psychologists (NASP), while the Ph.D. program is additionally accredited by the American Psychological Association (APA). The Pennsylvania Department of Education has approved our program’s certification in school psychology.

Graduates of the Ed.S. program are prepared to serve as school psychologists in school districts. Graduates of the Ph.D. program have a broader range of employment options, including practitioner positions in school district, clinical, and hospital settings, as well as positions as researchers and professors in academic settings.

Fundamental to the School Psychology program is a commitment to a scientist-practitioner model. Students in our degree programs complete coursework and field-based experiences that prepare them to apply critical skills for delivering evidenced-based practices to children and youth. Moreover, our programs operate from an ecological perspective. Students are well prepared to address the contextual influences on children’s educational achievement and health.

The School Psychology program has developed concentrated training opportunities, including coursework and practicum, in unique areas. These opportunities have been initiated through federal funding from the U.S. Department of Education (USDOE), and are sustained by faculty expertise. For example, in the Ed.S. program, students may seek specialized training in Response-to-Intervention, while the Ph.D. program is distinguished by its offering of two concentrations: Pediatric School Psychology and School-Based Prevention.

The USDOE-funded Leadership Program in Pediatric School Psychology is a signature program in the doctoral program. Through specialized and expanded field-based training and coursework, this program provides opportunities for students to go beyond the School Psychology program’s general curriculum for the pediatric school psychology concentration.

For additional information about the School Psychology program, please visit:
http://coe.lehigh.edu/academics/disciplines/sp

Questions regarding APA Accreditation may be addressed to the APA Office of Accreditation at:
Office of Program Consultation and Accreditation
750 First St, NE, Washington, DC 20002-4242
Telephone: (202) 336-5979
TDD/TTY: (202) 336-6123
Fax: (202) 336-5978
Email (apaaccred@apa.org) (General Questions) (apaaccred@apa.org)
Email (aro@apa.org) (Annual Report Online only)

Professors. Christine L. Cole, PhD (University Wisconsin at Madison); George J. DuPaul, PhD (University of Rhode Island)
In this program, students have the opportunity to choose one of the two options for developing specialized expertise. These two core options are: 1) School-Based Prevention subspecialization (additional 18 hours, total of 99), 2) Pediatric/Health subspecialization (additional 18 hours, total of 99).

**DISSERTATION HOURS as necessary - minimum of 2**

### Educational Specialist (Ed.S.) program in School Psychology

**AREA I:**

**RESEARCH CORE (6 hours)**

- **EDUC 403 Research**
- or **SCHP 434 Applied Research Practicum**
- **EDUC 408 Introduction to Statistics**
- or **EDUC 409 Analysis of Experimental Data**

**AREA II:**

**PSYCHOLOGICAL FOUNDATION CORE (12 HOURS)**

- **EDUC 451 Applied Principles of Cognitive Psychology**
  - or **PSYC 403 Cognitive Psychology**
- **PSYC 402 Developmental Psychology**
- **EDUC 491 Advanced Seminars: (with subtitle)**
  - or **PSYC 404 Behavioral Neuroscience**
- **CPSY 471 Diversity and Multicultural Perspectives**

**AREA III:**

**COUNSELING PSYCHOLOGY (3-9 hours)**

- **CPSY 439 Theory and Practice of Group Counseling**
- **CPSY 440 Introduction to Family Counseling**
- **CPSY 442 Counseling and Therapeutic Approaches**
- **CPSY 445 School Counseling I**
- **CPSY 462 Assessment of Personality**
- **CPSY 480 Master's Internship I (Others by advisor approval)**

**Others by advisor approval**

**AREA IV:**

**SPECIAL EDUCATION (3 - 9 HOURS)**

- **PSYC 338 Phenomenology and Theory of Childhood Disorders**
- **SPED 332 Education and Inclusion of Individuals with Special Needs in K-12**
- **SPED 418 Alternative Curricular Approaches**
- **SPED 419 Academic Interventions: PreK-8**
- **EDL 470 Special Topics in Educational Leadership**

**Others by Advisor Approval**

- Autism Subspecialization (6) (Requires 480 clock hours in ASD)
  - Bi-weekly Seminar: Autism Spectrum Disorders (0)
  - Bi-monthly seminar: Diversity Sensitivity Consulting (0)
  - Daily Practicum in Autism Spectrum Disorders (0)
- **SPED 465 Advanced Inclusionary Practices in K-12**

**Others by advisor approval.**

**Specialist in RTI Implementation (25)**

- **SCHP 429 Special Topics in School Psychology**
- **SCHP 437 Advanced Child Psychopathology**
- **SCHP 443 Certification Internship**

**Others by advisor approval.**

**AREA V:**

**PROFESSIONAL SCHOOL PSYCHOLOGY CORE (36 HOURS)**

- **SCHP 407 Crisis Management in the Schools**
- **SCHP 402 Applied Behavior Analysis**
- **SCHP 404 Historical and Contemporary Issues in School Psychology**
Courses

**SCHP 402 (SPED 402) Applied Behavior Analysis 3 Credits**
Theory and application of behavior modification methods in classroom and clinical settings. Topics include behavior analysis, outcome research, task utilization, and single case research.

**SCHP 404 Historical and Contemporary Issues in School Psychology 3 Credits**
History of psychology, education, and school psychology. Roles and function of school psychologist; legal and ethical aspects of school psychology.

**SCHP 406 Research Methods and Design 3 Credits**
This course is designed to provide skills in the use and application of research methodologies and in the conceptizing and writing of research proposals. Specifically, the course is focused on developing conceptual knowledge of specific research methods, interpreting data using specific methods of analysis, and developing independent research skills focused around one’s own research project. The course is primarily designed for doctoral students in School Psychology and Special Education. Permission of instructor is required.

**SCHP 407 (CPSY 407) Crisis Management in the Schools 3 Credits**
This course is designed to provide students with knowledge and skills related to crisis preparedness and intervention in the schools. Relevant theories and research literature will be explored as well as practical elements of crisis response that are applicable to all school systems. In addition, intervention strategies and protocols will be examined and discussed. Permission of instructor is required.

**SCHP 408 Dissertation Proposal Seminar 3 Credits**
The primary purpose of this course is to guide students in their independent research endeavors. Students will learn about the complexities of planning and initiating independent research, focusing on the writing process, methodological issues, and the management of time and data. Knowledge and competencies obtained in this seminar will be applied as students prepare their dissertation proposals.

**SCHP 412 Consultation Procedures 2 Credits**
Observational methodology utilized in consultation; rationale, theory and methods of consultation; individual, group and parent consulting. Study of consultation on the consultation process. Students must also register for one credit of SCHP 431.

**SCHP 422 Assessment of Intelligence 3 Credits**
Administration and interpretation of individual tests of intelligence used in school evaluation and preparation of psychological reports. Consent of instructor required.

**SCHP 423 Behavioral Assessment 3 Credits**
Techniques of behavioral assessment including direct observation, interviews, checklists, rating scales, self-monitoring and role-play tests. Consent of instructor required.

**SCHP 425 Assessment and Intervention in Educational Consultation 3 Credits**
Collection and use of data in designing classroom interventions. Curriculum based assessment, direct behavioral assessment, and structured interviews, and the interrelationship with diagnoses are emphasized within the behavioral consultation model. Utilization of data from actual case studies.

**SCHP 426 Advanced School and Family Interventions 3 Credits**
Overview of school-based and family-based intervention strategies for children and adolescents presenting interpersonal, emotional, developmental or behavioral challenges. Examples of topics covered include crisis intervention, peer-mediated interventions, self-management interventions, behavioral parent training, interventions for child abuse/neglect and computer-assisted instruction.

**Prerequisites:** SCHP 402

**SCHP 427 (CPSY 427) Assessment and Appraisal in Counseling 3 Credits**
Principles of psychological measurement (e.g., tests construction, technology, validity, reliability, functional utility). Ethical, legal, and cultural issues in the administration and interpretation of psychological tests. Case conceptualization, reporting and presentation.

**SCHP 429 Special Topics in School Psychology 1-3 Credits**
Repeat Status: Course may be repeated.

**SCHP 431 Practicum in Consultation Procedures 1-3 Credits**
Supervised experience in conducting school-based consultations.

**SCHP 432 Practicum in Assessment of Intelligence 1-3 Credits**
Supervised experience in the administration and interpretation of intelligence test.

**SCHP 433 Practicum in Behavioral Assessment 1-3 Credits**
Supervised experience in conducting behavioral assessments in school settings.

**SCHP 434 Applied Research Practicum 1-3 Credits**
Designing and conducting research projects in applied settings.

**SCHP 435 Practicum in Assessment & Intervention in Educational Consultation 1-3 Credits**
Supervised experience in conducting curriculum-based assessments and designing intervention strategies for educational problems.

**SCHP 436 Specialized Practicum in School Psychology 1-3 Credits**
Supervised field experience in school psychology with a specific population or setting. Permission of instructor required.

**Repeat Status:** Course may be repeated.

**SCHP 437 Advanced Child Psychopathology 3 Credits**
Advanced training in the definition, classification, etiology, long-term outcome, and treatment of children and adolescents with various psychopathological disorders. Emphasis is placed upon the assessment and treatment of child and adolescent psychopathology in school settings. Must have admission to doctoral program or consent of instructor.

**SCHP 438 Health/Pediatric Psychology 3 Credits**
Introduction to training in the definition, etiology and behavioral/academic characteristics of children and adolescents with medical disorders. Emphasis is placed on the assessment and treatment of educational and behavioral sequelae of medical disorders in both school and health settings. Must have admission to doctoral program in school psychology or consent of instructor.

**SCHP 439 Comprehensive School Health Programs 3 Credits**
Examination of school-wide programs designed to address health care needs of children and adolescents in school settings. Focus is on development of primary prevention and integration of educational, medical, social and community resources. Permission of instructor required.

**SCHP 440 Applications of Pediatric School Psychology 3 Credits**
Focus on further development of students’ knowledge and application of pediatric school psychology. The etiology and developmental course of pediatric medical conditions will be examined, emphasizing the impact on school, family and community environments.

**Prerequisites:** SCHP 438 or SCHP 439
The department offers three bachelor of arts majors: anthropology, sociology, and anthropology, and sociology. The three programs are parallel in structure and requirements and each consists of 40 credit hours of course work. The sociology and anthropology major is an interdisciplinary program for students desiring a wider familiarity with social science fields, whereas the anthropology and sociology majors are for students desiring more traditional, disciplinary programs of study.

Research Opportunities
It is the explicit aim of the department to involve majors, minors and other interested students in the ongoing research activities of faculty members. Second semester sophomore, junior and senior students interested in a supervised research experience are encouraged to consult with the chair or appropriate faculty member. Course credit can be received for research experience.

Internship Opportunities
The department maintains close working relationships with a variety of social agencies and institutions in the area. Majors can earn course credit by carrying out supervised work in field settings—see http://socanthro.cas2.lehigh.edu/ for more details. This experience allows a student to apply the concepts learned in the classroom to a field setting and to evaluate vocational aspirations and interests.

Senior Thesis
All majors are encouraged to do independent research culminating in a senior thesis; this is especially recommended for students intending to go on to graduate or professional school. The time to begin discussing possible projects with faculty is during the second semester of the junior year. The department chairperson should be consulted for further details. Our web site has additional information.

Departmental Honors
To be eligible for departmental honors, students must have at least a 3.5 GPA in the major. In addition, students pursuing honors must take ANTH or SOC 399 and write a thesis during their senior year. Awarding of departmental honors is contingent on both the quality of the thesis, as judged by a department committee, and the candidate’s GPA at time of graduation.

Professors. John B. Gatewood, PhD (University of Illinois Urbana); Judith N. Lasker, PhD (Harvard University); David B. Small, PhD (University of Cambridge); Nicola B. Tannenbaum, PhD (Iowa State University); Cameron Braxton Wesson, PhD (University of Illinois Urbana)

Associate Professors. David Casagrande, PhD (University Georgia Athens); Heather Beth Johnson, PhD (Northeastern University); Jacqueline Krasas, PhD (University of Southern California); Ziad Munson, PhD (Harvard University); Bruce Whitehouse, PhD (Brown University); Yuping Zhang, PhD (University of Pennsylvania)

Assistant Professors. Sirry Mbong Alang, PhD (University of Minnesota); Kelly F. Austin, PhD (North Carolina State University); Hugo Ricardo Ceron Anaya, PhD (University of Essex); Danielle J. Lindemann, PhD (Columbia University)

Professor Of Practice. Sarah Eliza Stanlick Kimball, PhD (Lehigh University)

Emeriti. Roy C. Herrenkohl, Jr., PhD (New York University); James R. McIntosh, PhD (Syracuse University); Robert E. Rosenwein, PhD (University of Michigan Ann Arbor); Robert C. Williamson, PhD (University of Southern California)

B.A. Major Programs

ANTHROPOLOGY

Collateral Requirement
Select one of the following general courses in statistics: 3-4

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 012</td>
<td>Basic Statistics</td>
</tr>
<tr>
<td>ECO 045</td>
<td>Statistical Methods</td>
</tr>
<tr>
<td>PSYC 110</td>
<td>Statistical Analysis of Behavioral Data</td>
</tr>
<tr>
<td>Or equivalent</td>
<td></td>
</tr>
</tbody>
</table>

Introductory

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTH 011</td>
<td>Cultural Diversity and Human Nature 4</td>
</tr>
<tr>
<td>ANTH 012</td>
<td>Human Evolution and Prehistory       4</td>
</tr>
</tbody>
</table>
### Methodology

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOAN 111</td>
<td>Research Methods and Data Analysis</td>
<td>4</td>
</tr>
</tbody>
</table>

### Major Electives

Select five anthropology courses

Select one of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTH 300</td>
<td>Apprentice Teaching</td>
<td>4</td>
</tr>
<tr>
<td>ANTH 393</td>
<td>Supervised Research</td>
<td></td>
</tr>
<tr>
<td>ANTH 394</td>
<td>Field School</td>
<td></td>
</tr>
<tr>
<td>ANTH 395</td>
<td>Internship</td>
<td></td>
</tr>
<tr>
<td>ANTH 399</td>
<td>Senior Thesis</td>
<td>4</td>
</tr>
</tbody>
</table>

### Research, Internship, or Thesis

Select one of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTH 011</td>
<td>Cultural Studies and Globalization</td>
<td></td>
</tr>
<tr>
<td>ANTH 111</td>
<td>Comparative Cultures</td>
<td></td>
</tr>
<tr>
<td>ANTH 121</td>
<td>Environment and Culture</td>
<td></td>
</tr>
<tr>
<td>ANTH 123</td>
<td>Anthropology of Gender</td>
<td></td>
</tr>
<tr>
<td>ANTH 140</td>
<td>Introduction to Linguistics</td>
<td></td>
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<tr>
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<tr>
<td>ANTH 376</td>
<td>Culture and the Individual</td>
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</tr>
</tbody>
</table>

Total Credits: 39-40

1. Note: MATH 012 fulfills the College of Arts and Sciences requirement.
2. At least two of which must be at the 300-level. Individualized study courses ANTH 300, ANTH 393, ANTH 394, ANTH 395, and ANTH 399 cannot be used to fulfill this requirement; however, one SOC course can be substituted as an anthropology elective.
3. Preferably during the senior year, majors must complete at least four credits of experiential learning on a subject or in a context relevant to their major. Students may fulfill this requirement in a variety of ways - research, field school, internship, or thesis.
4. Students who intend going on to graduate or professional school are strongly encouraged to do the senior thesis option, and a senior thesis is required for departmental honors.

### Concentrations within the Anthropology Major

**Anthropology majors may choose to concentrate in cultural or archaeological anthropology.** These optional concentrations in one or the other subfield entail additional constraints on course selection within the major electives category, as described below.

### Concentration in Cultural Anthropology

Anthropology majors electing to concentrate in cultural anthropology must complete at least four courses in cultural anthropology at the 100-level or above. Regular course offerings that would satisfy this concentration include the following:

Select at least four of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ANTH 106</td>
<td>Cultural Studies and Globalization</td>
<td></td>
</tr>
<tr>
<td>ANTH 111</td>
<td>Comparative Cultures</td>
<td></td>
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<tr>
<td>ANTH 121</td>
<td>Environment and Culture</td>
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<td>ANTH 123</td>
<td>Anthropology of Gender</td>
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<tr>
<td>ANTH 140</td>
<td>Introduction to Linguistics</td>
<td></td>
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<tr>
<td>ANTH 182</td>
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Total Credits: 39-40

Students choosing this concentration are strongly encouraged to use their general education electives to complete at least three courses in cultural anthropology; pursue courses in museum studies, mathematics, computer science, history, and the social sciences as interests dictate; and take a wide range of natural science courses of special relevance to archaeologists.

### Sociology and Anthropology

#### Collateral Requirement

Select one of the following general courses in sociology:

<table>
<thead>
<tr>
<th>Course Code</th>
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</thead>
<tbody>
<tr>
<td>MATH 012</td>
<td>Basic Statistics</td>
<td></td>
</tr>
<tr>
<td>ECO 045</td>
<td>Statistical Methods</td>
<td></td>
</tr>
<tr>
<td>PSYC 110</td>
<td>Statistical Analysis of Behavioral Data</td>
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Or equivalent

### Introductory

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<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>ANTH 011</td>
<td>Cultural Diversity and Human Nature</td>
<td></td>
</tr>
<tr>
<td>SOC 001</td>
<td>Introduction to Sociology</td>
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### Theory and Methodology

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<tr>
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<th>Credits</th>
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<tbody>
<tr>
<td>SOAN 111</td>
<td>Research Methods and Data Analysis</td>
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</tr>
<tr>
<td>SOAN 112</td>
<td>Development Of Social Theory (spring)</td>
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</tbody>
</table>

### Major Electives

Select three courses in sociology

Select three courses in anthropology

Total Credits: 43-44

1. Note: MATH 012 fulfills the College of Arts and Sciences' mathematics requirement.
2. One of which must be at the 300-level.
3. Individualized study courses SOC 300, SOC 393, SOC 395, and SOC 399 can be taken as major electives but cannot be used to fulfill the 300 level course requirement.
4. Individualized study courses ANTH 300, ANTH 393, ANTH 394, ANTH 395, ANTH 395, and ANTH 399 can be taken as major electives but cannot be used to fulfill the 300 level course requirement.

### Sociology

#### Collateral Requirement

Select one of the following general courses in statistics:

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Or equivalent

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</tbody>
</table>

### Major Electives

Select five courses in sociology

Total Credits: 20

### Research, Internship, or Thesis
ANTHROPOLOGY

ANTH 011 Cultural Diversity and Human Nature 4
or ANTH 012 Human Evolution and Prehistory
Select any four courses in Anthropology 16

Total Credits

20

SOCIOLGY AND ANTHROPOLOGY

ANTH 011 Cultural Diversity and Human Nature 4
or SOC 001 Introduction to Sociology
Select two courses in sociology at the 100 level or above 8
Select two courses in anthropology at the 100 level or above 8

Total Credits

20

SOCIOLGY

SOC 001 Introduction to Sociology 4
Select any four courses in Sociology 16

Total Credits

20

GRADUATE COURSES IN SOCIOLOGY

The Master's Program in Sociology prepares students to apply sociological perspectives and methods to the analysis of social realities. Grounded in a strong theoretical and substantive understanding of social institutions, social relations, and social policy, as well as in advanced research and data analytic skills, students are prepared to be effective and experienced practitioners in the field of applied social research or to continue into doctoral studies in the field.

Sociology MA program

The Sociology MA program requires 30 hours of course work. Required courses are:

- Quantitative Research 3
- Statistics for Sociological Inquiry 3
- Qualitative Research 3
- Social Theory 3
- Select six electives 18

Total Credits

30

All students take a comprehensive exam. Students choose whether to write a thesis.

COMMUNITY FELLOWS PROGRAM

Applicants for the Sociology MA program may also choose to apply to the Community Fellows Program, a one year Master's Program in which students work for 15 hours a week in a non-profit organization as part of their academic experience. Please see the program website at www.lehigh.edu/communityfellows.
ANTH 145 Human Evolution 4 Credits
Principles of biological anthropology focusing on the evolution of the human species. Topics include evolutionary theory, nonhuman primate diversity and behavior, the relationship between biology and behavior in evolutionary terms, the hominid fossil record, and genetic variability among contemporary human populations.
Attribute/Distribution: NS

ANTH 155 (HMS 155) Medical Anthropology 4 Credits
Medical Anthropology is the study of how conceptions of health, illness, and healing methods vary over time and across cultures. Students will learn how social and cultural factors shape health outcomes in a variety of human contexts, and will study culturally specific approaches to healing, including Western bio-medicine. The course offers a broad understanding of the relationship between culture, health, and healing.
Attribute/Distribution: SS

ANTH 172 North American Archaeology 4 Credits
Development of prehistoric North American indigenous population north of Mexico, beginning with earliest evidence of people in the New World continuing up through European contact.
Attribute/Distribution: SS

ANTH 174 (ARCH 174, ART 174, CLSS 174) Greek Archaeology 3-4 Credits
Ancient Greek culture from the Neolithic to Hellenistic periods. Reconstructions of Greek social dynamics from study of artifacts.
Attribute/Distribution: SS

ANTH 175 Britain After the Romans 4 Credits
Exploration of the archaeological record of the British Isles from the Roman Invasion until the Middle Ages. Focuses on the long-term impacts of incorporation into the Roman Empire on the indigenous cultures of Britain, the culture instability that accompanied the collapse of Roman rule, and the subsequent waves of invasion and immigration from Western Europe that followed. Regional variations within and between various island cultures are addressed.
Attribute/Distribution: SS

ANTH 176 (ARCH 176, ART 176, CLSS 176) Roman Archaeology 4 Credits
Cultures of the Roman Empire. Reconstructions of social, political, and economic dynamics of the imperial system from study of artifacts.
Attribute/Distribution: SS

ANTH 177 Britain Before the Romans 4 Credits
Exploration of the archaeological record of the earliest inhabitants of the British Isles. Focusing primarily on the Paleolithic and Neolithic cultures of ancient Britain, this course examines the transition from foragers to farmers, the construction of monumental earthworks and stoneworks like Avebury and Stonehenge, and culture connections beyond the islands. Regional variations within and between various island cultures are also addressed.

ANTH 178 Mesoamerican Archaeology 4 Credits
Ancient civilizations of Mesoamerica: Olmec, Zapotec, Maya, Toltec, and Aztec. Reconstructions of urban centers, political and economic organizations, and theories of the Mayan collapse.
Attribute/Distribution: SS

ANTH 182 North American Indians 4 Credits
Culture areas of native North America prior to substantial disruption by European influences north of Mexico. Environmental factors and cultural forms.
Attribute/Distribution: SS

ANTH 183 (AAS 183) Peoples and Cultures of Africa 4 Credits
Studies African modernity through a close reading of ethnographies, social stories, novels, and African feature films.
Attribute/Distribution: SS

ANTH 184 (LAS 184) Indigenous Cultures of Latin America 4 Credits
This course examines social change in Latin America from the perspective of indigenous peoples. Main goals are to develop an appreciation for the diversity of cultures found in Latin America, explore anthropological concepts like cultural ecology, ethnicity, acculturation, and religious syncretism, and to apply these concepts to contemporary issues, including cultural survival, human rights, and environmental sustainability.
Attribute/Distribution: SS

ANTH 187 (ASIA 187) Peoples and Cultures of Southeast Asia 4 Credits
Peoples and cultures of Burma, Laos, Cambodia, Thailand, Malaysia, Singapore, Indonesia, and the Philippines. World view, religion, economy, politics, and social organization.
Attribute/Distribution: SS

ANTH 188 (ASIA 188) Southeast Asian Migrants and Refugees 4 Credits
Focus on migrants and refugees from Southeast Asia to the United States; examines cultures and practices while in Southeast Asia, the migration process, and the ways in which the people and their cultural practices have changed in the United States.
Attribute/Distribution: SS

ANTH 300 Apprentice Teaching 1-4 Credits
Repeat Status: Course may be repeated.

ANTH 305 Anthropology Of Fishing 4 Credits
Comparative study of fishing peoples and their technologies. Fishing strategies, control of information, and social organization of marine exploitation in subsistence and modern industrial contexts. Theory of common property resources and the role of social science in commercial fisheries management.
Attribute/Distribution: SS

ANTH 312 The Anthropological Signature of the Past 4 Credits
Covers the basic tenets of different anthropological analyses of premodern cultures. Emphasis on the archaeological traces of different social constructions in the past.
Attribute/Distribution: SS

ANTH 320 (GS 320) Global Capitalism 4 Credits
Anthropological approach to the forms and effects of global capitalism. Topics include the structure of contemporary global capitalism, including the growth of multinational corporations, flexible corporate strategies, overseas manufacturing, and global branding and marketing; the impact of global capitalism on the environment and on the lives of people in “Third World” countries; consumer culture and the diversity of non-Western consumption practices; alternative capitalist systems.
Attribute/Distribution: SS

ANTH 324 (AAS 324, GS 324) Globalization and Development in Africa 4 Credits
Examines the challenges Africa presents to expectations of modernization and development. Have African societies been left behind by globalization, shut out from it, or do they reflect an unexpected side of globalization processes? What is Africa’s place in the neoliberal world order? What role does “African culture” play in generating or blocking social change? How can anthropology illuminate prospects for change on what has long been regarded as the “dark continent”?"?
Attribute/Distribution: SS

ANTH 325 Economic Anthropology 4 Credits
Cross-cultural perspectives on the ways people produce, distribute, and consume goods; how these systems are organized; and how they are connected with other aspects of society, particularly political and ideological systems.
Prerequisites: ANTH 001 or ANTH 011 or SOC 005 or SOC 021 or PSYC 021 or SOC 001
Attribute/Distribution: SS

ANTH 330 Food For Thought 4 Credits
Symbolic and cultural analyses of foods and cuisines. Examines what people eat, who prepares it, what it means, and the social and religious uses of foods historically and cross-culturally.
Attribute/Distribution: SS
ANTH 335 (REL 335) Religion, Witchcraft And Shamanism 4 Credits
Addresses broad questions about supernatural beliefs as systems of meaning and as practical and moral guides, with a focus on theoretical explanations for supernatural beliefs and the function of religious specialists in the social organization of cultures.
Attribute/Distribution: SS

ANTH 337 (ASIA 337, REL 337) Buddhism and Society 4 Credits
The course approaches Buddhism as a lived tradition rather than as a textural tradition. We examine how Buddhist practices are integrated into local traditions and how religious practices become part of the larger social, political, and value systems. Societies examined include Thailand, Nepal, Japan, China, and the U. S. Students will develop a comparative framework that includes Theravada, Tibetan, and Zen Buddhism.
Attribute/Distribution: SS

ANTH 339 Seminar In Anthropology 4 Credits
Topics in anthropology. Varying semester to semester: human evolution, politics and law, introduction to linguistics, human use of space, anthropology of deviance.
Repeat Status: Course may be repeated.
Prerequisites: ANTH 001 or ANTH 011 or SOC 005 or SOC 021 or PSYC 021 or SOC 001
Attribute/Distribution: SS

ANTH 340 Archaeological Theory 4 Credits
Explores important issues in the interpretation of archaeological material. Issues include variable utility of anthropological analogies, unevenness of data, reconstructions of past cultures, processual and post-processual approaches. Students will write a sample NSF proposal.
Attribute/Distribution: SS

ANTH 352 (ES 352) Environmental Archaeology 4 Credits
This course reviews the various categories of archaeological data used to examine the nature of past human-environmental relationships. We will explore how archaeologists use data to recognize anthropogenic and natural environmental changes, as well as cultural adaptations to local environments.
Attribute/Distribution: SS

ANTH 370 (HIST 370) Historical Archeology 3-4 Credits
This course examines the unique nature of historical archaeology of post contact America. Topics include reconstructing the past through the archaeological and historical record, exhibiting past culture, and capturing the real or imagined past. Course includes fieldwork and visits to famous historical archaeological sites.
Attribute/Distribution: SS

ANTH 371 Special Topics 1-4 Credits
Advanced work through supervised readings. Consent of department chair required.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS

ANTH 376 Culture and the Individual 4 Credits
Concepts and methods of studying relations between the individual and the sociocultural milieu. Culture and personality language and thought, cross-cultural studies of cognition.
Attribute/Distribution: SS

ANTH 377 Archaeology Of Death 4 Credits
Examines what we can determine about the past from human remains. Class will study health, age, and disease from the analysis of human bone, the cultural aspects of burial and funerals, and take part in a field project in Nisky Hill Cemetery in Bethlehem.
Attribute/Distribution: SS

ANTH 378 (LAS 378) Blood, Pyramids, and the Tree of Life 4 Credits
This course explores the ways of life of the Maya people. We will take a close look at their religion, their foods, their family life, music, medicine, festivals, etc. An important part of this class explores the long tradition of the Maya, making connections between the modern Maya and the Maya of their past.
Attribute/Distribution: SS

ANTH 389 Honors Project 1-8 Credits
ANTH 393 Supervised Research 1-4 Credits
Conducting anthropological research under the supervision of a faculty member. Consent of department chair required.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS

ANTH 394 Field School 1-8 Credits
Field school in archaeology or ethnography. Maximum of eight credits for a single season or field experience.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS

ANTH 395 Internship 1-4 Credits
Supervised experience involving nonpaid work in a setting relevant to anthropology. Open only to department majors.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS

ANTH 399 Senior Thesis 2-4 Credits
Research during senior year culminating in senior thesis. Required for anthropology majors seeking departmental honors. Consent of department chair required.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS

Sociology and Anthropology Courses

SOAN 041 (WGSS 041) Human Sexuality 4 Credits
Sexuality and gender roles across the life cycle, including human reproduction, decision-making, and the societal regulation of sexual behavior.
Attribute/Distribution: ND

SOAN 042 (WGSS 042) Sexual Minorities 4 Credits
How minority sexual identities have been the subject of speculation, misunderstanding, and sometimes violent attempts at correction or elimination. Sexual orientation, gender role, including transvestism and “drag”, transsexualism, sexism, heterosexism, and homophobia. Emphasis on critical thinking, guest speakers, and discussions.
Attribute/Distribution: SS

SOAN 111 Research Methods and Data Analysis 4 Credits
Research skills in anthropology, sociology and social psychology. Problem formulation; research design; methods and measures; analysis and interpretation of data. Emphasis on the use of statistics in the research process.
Attribute/Distribution: SS

SOAN 112 Development Of Social Theory 4 Credits
This course introduces some of the most influential theoretical ideas in sociology. It focuses on understanding the differences among several classical theoretical traditions and their strengths and weaknesses in analyzing societies. It also helps students learn to apply social theory to contemporary sociological research and problems, learning the ways theory can be used to answer questions and problems societies face today.
Attribute/Distribution: SS

SOAN 381 Development of Social Theory 4 Credits
Comparative study of social theory.
Attribute/Distribution: SS

Sociology Courses

SOC 001 Introduction to Sociology 4 Credits
Patterns of social interaction, group behavior and attitudes provide a focus on the relationship of the individual to society. Social structure and social change within the institutions of society provide a focus on the relationship of society to the individual. The influences of social class, gender and race are explored at each level of analyses. Theories, methods and research results provide micro and macro models for understanding society.
Attribute/Distribution: SS

SOC 100 Seminar in Sociology 1-4 Credits
Topics in sociology.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS
SOC 103 (AAS 103) Race and Ethnicity in the Contemporary U.S.
4 Credits
examines race and ethnicity from a sociological perspective. Focus on the role of the major racial and ethnic communities in modern American society. Explores the roles of race and ethnicity in identity, social relations, and social inequality. Topics include race and ethnic communities, minority/majority groups, assimilation, prejudice and discrimination, identity, and the social construction of the concept of "race.".
Attribute/Distribution: SS

SOC 104 (POLS 104) Political Sociology 4 Credits
An introduction to political sociology through an examination of the major sociological questions concerning power, politics, and the state. Covers questions concerning state formation, nationalism, social movements, globalization, political culture and participation, and civil society.
Attribute/Distribution: SS

SOC 105 Social Origins Of Terrorism 4 Credits
Examines the social, religious, and political foundations of terrorism by studying the roots of terrorism historically and cross-nationally. We will look at the differing kinds of terrorism, including political terrorism in the Middle East, antiabortion terrorism in the United States, ecoterrorism, and religious and state terrorism throughout the world. Students will have a chance to better understand the beliefs of terrorists, conditions that produce and sustain terrorism, and the origins of political violence more generally.
Attribute/Distribution: SS

SOC 106 Race and Ethnicity in the Americas 4 Credits
How is it possible that someone who is officially considered black in the United States, can embody different racial identities throughout current Latin America? Even more, how is it possible that people consider white nowadays were not officially so in early twentieth-century US (although they were viewed as white in the Latin American context at the same time period)? This course offers a historical comparative analysis of the nature and dynamics of race between the United States and Latin America.
Attribute/Distribution: SS

SOC 110 (WGSS 110) Women's Work in Global Perspective 4 Credits
This course brings to the forefront the intersections of race, class, gender, and nation with women's employment around the world. We will examine women's paid and unpaid work in the U.S., Europe, Asia, Latin America, and Africa in an effort to understand the striking persistence of gender inequality over time and across the world. Topics of study include: work and family relations, women's domestic labor, factory work, and agribusiness. In addition, we will explore the ways in which women have organized for changes in work and in their communities in order to conceive of possibilities for the future of women's work.
Attribute/Distribution: SS

SOC 114 (ASIA 114) Social Issues in Contemporary China 4 Credits
Dramatic economic, cultural and social changes are underway in China today and have aroused much debate among social scientists. East and West. The following social issues are critical for understanding China's development trajectory: inequality and poverty; rapid demographic shifts; provision of health care services; provision of education services; and becoming an "information society." We will explore how these issues intersect with old hierarchies in China, urban-rural differences, and gender differences.
Attribute/Distribution: SS

SOC 115 A Nation of Immigrants: The American Experience 4 Credits
The course provides an introduction to contemporary immigration, conceptualizing it as a social and economic process, as well as a human experience that is simultaneously liberating and limiting. Through immigration we will analyze processes of assimilation and resistance, the construction of cultural boundaries, the development of modern nation-states, as well as the role race plays in current debates about immigrants. The course advances a critical perspective by questioning how immigration is framed in the West, particularly in the Unites States.
Attribute/Distribution: SS

SOC 116 (GS 116, JST 116) Jewish Community and Identity 4 Credits
A century ago, large Jewish communities existed throughout the world, including North Africa, Europe, the Middle East, and South America. Today, over 80% of all Jews live in North America or Israel. This course focuses on these historical changes in Jewish communities and the transformation of Jewish identities and social life in recent years, particularly in the U.S. and in Israel.
Attribute/Distribution: SS

SOC 125 Social Psychology of Small Groups 4 Credits
Theories and empirical research regarding interpersonal behavior in small groups. Classroom exercises and group simulations.
Attribute/Distribution: SS

SOC 128 (WGSS 128) Race, Gender, and Work 4 Credits
Race, Gender and Work is a class designed to help students understand racial and gender inequalities as they relate specifically to work and employment. We explore the origins and histories of inequalities, the ways in which inequalities persist and/or change today, and what steps might be taken toward creating a more equal society.
Attribute/Distribution: SS

SOC 130 Sociology of Sports 4 Credits
This course provides an encompassing explanation of the process of globalization in the twentieth century through exploring the diffusion of sports, inquiring whether the sports has been connected to multiple forms of Empires, i.e. colonialism and imperialism. To do so, we will use sports to explore social and racial tensions, analyze mechanism of resistance, re-conceptualize the boundaries of social, economic and political spheres, examine the adoption of cultural practices, as well as understanding the construction of modern nation-states.
Attribute/Distribution: SS

SOC 135 (COMM 135, JOUR 135) Human Communication 4 Credits
Processes and functions of human communication in relationships and groups.
Attribute/Distribution: SS

SOC 138 (WGSS 138) Afro-Latino Social Movements in Latin America & the Caribbean 4 Credits
This course focuses on Afro-Latinos who make up nearly 70% of the population of the Americas. Despite the large amount of people of African descent living in the Americas, Afro-Latinos are an understudied population who face significant amounts of racial discrimination in their countries. Who are Afro-Latinos? Where do they live? How are they challenging the racism that they face? These are questions we will tackle in this course.
Attribute/Distribution: SS

SOC 144 (AAS 144) Global Hip Hop and Social Change 4 Credits
Hip Hop has become a global phenomenon. We will analyze how and why socially Conscious Hip Hop, as a tool for social change, has expanded to Latin America, Africa, and the Middle East.
Attribute/Distribution: SS

SOC 152 (HMS 152) Alcohol, Science, and Society 4 Credits
Alcohol use and abuse, its historical function in society, moral entrepreneurship, status struggles and conflict over alcohol. Current problems with attention to special population groups and strategies for prevention of alcohol abuse.
Attribute/Distribution: SS

SOC 155 (AAS 155, LAS 155) Afro-Latino Social Movements in Latin America 4 Credits
This course focuses on Afro-Latinos who make up nearly 70% of the population of the Americas. Despite the large amount of people of African descent living in the Americas, Afro-Latinos are an understudied population who face significant amounts of racial discrimination in their countries. Who are Afro-Latinos? Where do they live? How are they challenging the racism that they face? These are questions we will tackle in this course.
Attribute/Distribution: SS

SOC 160 (HMS 160) Medicine and Society 4 Credits
Sociological perspectives on health, illness, and medical care. Focus on social epidemiology, social psychology of illness, socialization of health professionals, patient-professional relationships, medical care organization and policies.
Attribute/Distribution: SS
SOC 162 (HMS 162) AIDS and Society 4 Credits
Impact of the AIDS epidemic on individuals and on social institutions (medicine, religion, education, politics, etc.); social and health policy responses; international experience; effect of public attitudes and policy on people affected directly by AIDS.
Attribute/Distribution: SS

SOC 163 (AAS 163) Sociology of Hip Hop Culture 4 Credits
Hip Hop culture is a complex form of artistic practices reflecting and impacting the environments in which they were produced. Through readings, music and video, this class will uncover the origins of Hip Hop by examining the musical history of the Afro-diaspora in the 20th century. Further study will reveal how the young Bronx, NY underclass in the 1970s fused elements of past musical styles with their own personal and political expression that sparked a worldwide phenomenon and culture industry.
Attribute/Distribution: SS

SOC 165 Contemporary Social Problems 4 Credits
Studies of major problems facing contemporary society.
Attribute/Distribution: SS

SOC 166 (AAS 166) Wealth and Poverty in the United States 4 Credits
Examines the sociology of wealth and poverty affluence and disadvantage, "rags and riches" in American Society. Focus is a critical analysis of the wealth gap, its causes, consequences, and social context. We will consider the roles of wealth and poverty in determining life chances and structuring opportunity, as well as their roles in the perpetuation of social inequality across generations. We will address contemporary debates surrounding public policy, tax laws, antipoverty programs and other reform efforts aimed at decreasing the gap between the "Haves" and the "Have-Nots".
Attribute/Distribution: SS

SOC 171 (REL 171) Religion And Society 4 Credits
An introduction to the sociology of religion. Covers classical and contemporary approaches to defining and studying the role of religion in society. Emphasis on understanding religious beliefs and practices in the United States, the sources and contours of religious change, and the effects of religion on individuals and society. Specific topics include religious fundamentalism, religious conversion, religious practices and authority, secularization, religion in public life, religion in social change, religious terrorism, and the ways in which religion impacts our personal health, educational attainment, and family life.
Attribute/Distribution: SS

SOC 177 (AAS 177, LAS 177) Cuba: Race, Revolution and Culture 4 Credits
This course analyzes the role of race & "culture" in the Afro Cuban struggle for equality. By focusing on the arts: particularly music, film & literature, this course will analyze the development of race during Cuba's colonial period; the Afro Cuban challenge to the "race blind" political and cultural movements of the Cuban Republic. We will then wrap up the semester by addressing the significance of contemporary cultural movements that challenge the social issues currently facing Afro Cubans.
Attribute/Distribution: SS

SOC 300 Apprentice Teaching 1-4 Credits

SOC 302 The Sociology Of Cyberspace 4 Credits
An examination of social life on the Internet and the World Wide Web. Topics may include sociocultural and psychological aspects of communication in cyber-environments (e.g., email, chat rooms, news groups, MUDS, etc.), interpersonal relationships and group development, the nature of community, the politics of cyberspace (control and democracy), privacy and ethics, and economic dimensions. Examination of past and current case studies.
Attribute/Distribution: SS

SOC 310 (AAS 310, WGSS 310) Gender, Race and Sexuality: The Social Construction of Differences 4 Credits
Students will engage with current debates about the meaning and use of racial and sexual classification systems in society. We will examine the historical and sociological contexts in which specific theories of racial and sexual differences emerged in the U.S. We will also explore the ways in which changes in the images have implications on the role of race, gender, and sexual identity plays in our understanding of the relationship between difference and inequality.
Prerequisites: SOC 103 or SSP 103
Attribute/Distribution: SS

SOC 313 (AAS 313) Social Movements 4 Credits
Explores the origins, dynamics, and consequences of social movements through both sociological theory and empirical case studies. Covers questions of what constitutes a social movement, where and when social movements arise, who joins a social movement, and how social movements are able to contribute to change. Answers to these questions highlight issues of social movement recruitment and leadership, interactions between movements and the media, the state, and the broader public, ideology, strategies and tactics, and the factors contributing to the success and failure of social movements. Course readings drawn from case studies on civil rights, women's rights, gay rights, the environment, American Indians, abortion, globalization, antiapartheid, democratization, peace, and Islamic fundamentalism. Must have completed one 100-level SSP course.
Attribute/Distribution: SS

SOC 316 (HMS 316) Social Epidemiology 4 Credits
Social epidemiology is the study of the distribution and social determinants of health and disease in human populations. This course introduces the basic principles of epidemiological study design, analysis and interpretation, covering topics such as how a disease spreads across populations and how public health interventions can help control or reduce the spread of disease. This course also reviews epidemiology as a social science by reviewing the social causes and consequences of health.
Attribute/Distribution: SS

SOC 317 Seminar in Globalization and Social Issues 4 Credits
Advanced seminar that focuses on research and discussion of specialized topics in globalization and social issues. Subjects vary by semester. Junior or senior standing and departmental permission required.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS

SOC 319 (GS 319) The Political Economy of Globalization 4 Credits
This course studies the relationship among economic, political and cultural forces in an era of globalization. Focus is on how global capitalism, the world market and local economics shape and are shaped by social, cultural and historical forces. Topics include political and cultural determinants of trade and investment; culture and the global economy; global capitalism, especially studied through the lens of culture; globalization and patterns of economic growth; cross-cultural study of consumerism; and poverty and inequality.
Attribute/Distribution: SS

SOC 321 (ES 321) Information Ecology 4 Credits
Information theory, critical social theory, and ecological principles are combined to model how information organizes human ecosystems. These concepts are applied to environmental policy analysis using case studies.

SOC 322 (GS 322, HMS 322) Global Health Issues 4 Credits
Sociological dimensions of health, illness, and healing as they appear in different parts of the world. Focus on patterns of disease and mortality around the world; the relative importance of 'traditional' and 'modern' beliefs and practices with regard to disease and treatment in different societies; the organization of national health care systems in different countries; and the role of international organizations and social movements in promoting health.
Attribute/Distribution: SS
SOC 366 Sociology of Aging 4 Credits
Residential patterns, social policies and services for the aged. Alternative political strategies, health programs, living arrangements and workplace choices considered. The changing roles of the elderly in American and other societies, and the special problems they face. Impact of changing age structure.
Attribute/Distribution: SS

SOC 370 (ES 370, GS 370) Globalization and the Environment 4 Credits
This course investigates globalization and the environment, including the ways in which globalization has influenced society-nature relationships, as well as how environmental conditions influence the globalization processes. A key focus will be on the rapidly evolving global economic and political systems that characterize global development dynamics. Resource use, particular attention is paid to the role of multi-national corporations, international trade, and finance patterns and agreements. Questions related to consumption, population, global climate change, toxic wastes, and food production/distribution represent key themes.
Attribute/Distribution: SS

SOC 371 Special Topics 1-4 Credits
Advanced work through supervised readings. Consent of department chair required.
Repeat Status: Course may be repeated.
Attribute/Distribution: SS

SOC 373 Seminar In Sociology 4 Credits
Intensive consideration of selected topics in contemporary theory or research in sociology. The subject matter varies from semester to semester.
Repeat Status: Course may be repeated.
Prerequisites: ANTH 011 or SOC 005 or SOC 021 or PSYC 021 or SOC 001
Attribute/Distribution: SS

SOC 374 Social Stratification: Race, Class, Gender 3 Credits
This course is an introduction to social stratification. Examines social inequality as an organizing principle in complex societies. Explores the intersection of the "great divides" of race, class, and gender. Through readings from classical sociological theory to cutting-edge literature we embark on a critical analysis of the causes and consequences of social stratification and social mobility in the United States and in a global context.
Prerequisites: ANTH 011 or SOC 001
Attribute/Distribution: SS

SOC 375 (REL 375) The Christian Right In America 4 Credits
What do we know about the Christian Right? Who are they? What do they believe? Where do they come from? Seminar explores answers to such questions through a focus on the history of the Christian Right as well as its ideologies and beliefs, the people who are a part of it, and its evolving relationship to the American political system.
Attribute/Distribution: SS

SOC 379 Race And Class In America 4 Credits
This course focuses on the ways in which race and class intersect in the social, economic, and political structures of American society. Through sociological literature, fiction, nonfiction, film, and other media we will explore the place of race and class in American society. We will examine how race and class operate on a personal, "micro" level, while at the same time operating on a large scale, "macro" level.
Attribute/Distribution: SS

SOC 389 Honors Project 1-6 Credits
Repeat Status: Course may be repeated.

SOC 391 Evaluation Research 3 Credits
Application of social research methods of evaluation of the effectiveness of social programs. Measurement, research design, criteria of effectiveness and decision making. Consent of department chair.
Prerequisites: SR 111
Attribute/Distribution: SS
SOC 416 3 Credits
Social epidemiology is the study of the distribution and social determinants of health and disease in human populations. This course introduces the basic principles of epidemiological study design, analysis and interpretation, covering topics such as how a disease spreads across populations and how public health interventions can help control or reduce the spread of disease. This course also reviews epidemiology as a social science by reviewing the social causes and consequences of health.

SOC 418 (WGSS 418) Gendered Experience of Globalization 3 Credits
Women and men experience globalization differently and globalization affects women in different cultural and national contexts. Gender stratification has been intensified by the transnational flow of goods and people, provides students with a survey of new development in feminist theories on globalization and on gender stratification and development, and links these theoretical frameworks to empirical research about gender issues that have become more prominent with globalization.

SOC 419 Global Food Systems 3 Credits
Where does our food come from? How does it get to our tables? Why are there famines in some parts of the world and obesity epidemics in other parts of the world? This course will investigate these questions by focusing on food systems – the chains of social action that link food producers to food consumers. We will also explore a range of alternatives to global food systems that emphasize food democracy, security, and sustainability.

Attribute/Distribution: SS

SOC 420 Global Migration 3 Credits
International migration is transforming societies at both the global and national levels, and in both origin and destination areas. Why do people move? What are the consequences of these movements? We will investigate the political and economic explanations for international migration and explore how each act of migration contributes to the transnationalization of social relations, alters existing livelihoods, transforms economic production and social support arrangements, and recreates racial, ethnic, and national identities.

SOC 421 (ES 421) Information Ecology 3 Credits
Information theory, critical social theory, and ecological principles are combined to model how information organizes human ecosystems. These concepts are applied to environmental policy analysis using case studies.

SOC 422 Sociology of the Body 3 Credits
This course examines the body not as a biological entity but as a product of complex social forces. We will study how our bodies are connected to social structures, such as class, gender and race. In doing so, students will realize how our bodies are simultaneously expressions of the self as well as powerful social factors. To explore these topics we will analyze the work of thinkers such as Marx, Elias, Goffman, Foucault, Bourdieu, and Butler.

Attribute/Distribution: SS

SOC 441 (WGSS 441) Gender and Health 3 Credits
Relationships of sex differences and gender norms to disease and longevity in the US and around the world. Influence of medical systems on men’s and women’s lives and the impact of gender-based consumer health movements on health and medical care. Focus on specific topics, e.g., medicalization and commercialization of women’s bodies, the politics of reproductive choices, masculinity and health, and gender and mental health.

SOC 443 Race, Ethnicity, and Health 3 Credits
People who belong to racial and ethnic minority groups are exposed to more health risks, have disproportionately high levels of sickness and excess deaths, and have limited access to good quality healthcare. This course provides students with theoretical and empirical insights into the intersection of race, ethnicity, and health in the U.S. Historical and contemporary patterns in U.S. demography, race relations, residential segregation, environmental justice, and social stratification will be explored in the context of health and health care.

SOC 445 Urban Education: Inequality and Public Policy 1-4 Credits
Social inequality is found throughout American Society but problems of inequality related to education have perhaps received more attention than those of any other contemporary social institution. Researchers, scholars, journalists, social critics, and observers have studied, written, and talked about educational inequality to an enormous extent. Social service organizations, activists, policymakers, legal professionals, and government officials have focused massive reform efforts and political agendas to tackle inequality in education. Many sociologists have long viewed education not just as an arena of inequality but as the solution to the widespread inequalities they see reflected in society. Urban education has been an especially complex and controversial subject of scrutiny in recent scholarly and popular debates. This course will focus with a sociological perspective on urban education, inequality, and public policy in the contemporary United States. The first portion of the course examines research and literature relevant to the contemporary social problems of urban education and inequality. The second portion of the course will explore the role of public policy in perpetuating educational inequality, and as a potentially promising solution to it.

SOC 461 Seminar In Sociology 1-4 Credits
Topics vary.

SOC 465 (WGSS 465) Inequalities at Work 3 Credits
Primary focus is on race, gender, and class as axes of disadvantage and privilege in work and employment. We will explore both theories and empirical studies of inequality as well as their social, political, and practical ramifications for the workplace.

Attribute/Distribution: SS

SOC 471 Special Topics 1-3 Credits
Intensive study in an area of sociology that is appropriate to the interests and needs of staff and students.

SOC 472 Special Topics 1-3 Credits
Continuation of SSP 471.

SOC 473 Social Basis Of Human Behavior 3 Credits
Development of human behavior from a social psychological perspective. Emphasis placed on the impact of society upon school-age children and adolescents.

SOC 476 Issues In Health Policy Analysis 3 Credits
Sociological analyses of health care and health care policy issues of current concern in American and other societies. Application of analytic frameworks to several major issues such as organization and financing of services, effects of aging populations on needs, impact of new diseases and of new technologies. Students will analyze selected health care problems faced by local communities.

SOC 490 Master’s Thesis 1-6 Credits

Special Education

The Special Education program offers two degrees, a Master’s Degree in Education in Special Education (M.Ed) and a Doctor of Philosophy Degree in Special Education (Ph.D.).

Students have options within the Master’s degree program to pursue Pennsylvania state teacher certification. These options include:
- Dual certification in special education (PreK-8) and elementary education (PreK-4);
- Dual certification in special education (7-12) and secondary education (7-12);
- Certification in elementary/middle level special education (PreK-8), and
- Certification in secondary special education (7-12).

For individuals already certified in special education, students may enroll in a post-certification Master’s in Special Education degree program to build upon their professional expertise. The special education program also offers options for Pennsylvania state teacher certification in special education, without earning a master’s degree.

All teacher certification programs are fully accredited by the Pennsylvania Department of Education.

Students who complete the Master’s degree and/or certification programs are fully qualified to teach special education in school settings
within the grade band of their certification. Teacher graduates may assume a variety of roles as teachers in self-contained classrooms, co-teachers in inclusive classrooms, itinerant support or consultants, and transition coordinators. Some graduates choose to work in community settings, providing behavioral support or services to non-school age individuals with disabilities.

Students who complete the Ph.D. program are fully prepared to conduct research and teach in college or university settings. Alternatively, some graduates assume leadership positions, directing school, district, or state-level programs or participating in state or national educational policy or teacher training initiatives.

The Special Education program emphasizes the use and development of evidence-based and other innovative practices that make meaningful differences in the lives of individuals with disabilities. Working collaboratively the Teaching, Learning, and Technology program, our master’s students learn a variety of effective practices to prevent disabilities and to support students with disabilities in inclusive settings. Students are also trained in intensive academic and behavioral interventions. The Ph.D. program is individualized and emphasizes the development of professional competencies in research, teacher training, and dissemination. Two unique features of our program are our small Ph.D. cohorts, which allow for personalized faculty-student mentoring, and cross-collaboration with other programs within the college (for example, School Psychology; Educational Leadership; and Teaching, Learning and Technology).

Special Education faculty members are continuously immersed in research and service projects that bring nationally recognized innovations to schools and community settings that support individuals with disabilities. Students may have the opportunity to work with faculty on projects supported by competitive university, state, foundation and federal grants and contracts. Recent projects/programs include:

- Providing behavioral and academic interventions for young children with or at risk for disabilities in preschool classrooms,
- Evaluating peer-mediated interventions to improve the social-communication skills of high school students with autism, and
- Demonstrating an individualized transition program of support for adolescents with intensive learning and behavioral needs.

For additional information about the program, please visit: http://coe.lehigh.edu/academics/disciplines/sped

**Professors.** Linda M. Bambara, EdD (Vanderbilt University); Lee Kern, PhD (University of South Florida); Gary M. Sasso, PhD (University of Kansas)

**Associate Professor.** Brenna K. Wood, PhD (University of Arizona)

**Assistant Professor.** Minyi Shih Dennis, PhD (University Texas, Austin)

Lehigh undergraduates may enroll in either of the College of Education's 5-year teacher certification areas: Elementary Education (grade levels PreK through 4) and Secondary Education (grade levels 7 through 12). A Minor in Education is offered through the College of Arts and Sciences.

For information on the 5-year programs, see below. For information on the Education Minor, see the College of Arts and Sciences 'Minor Programs in the College'.

**5-YEAR MASTER OF EDUCATION IN ELEMENTARY EDUCATION AND PREK-4 TEACHER CERTIFICATION**

The College of Education offers a five-year degree program that is designed to allow students to earn both a bachelor’s degree and a master’s degree in five years instead of the traditional six. The combined degree program leads to either a B.A. or B.S. degree in an academic discipline from the College of Arts and Sciences, the P.C. Rossin College of Engineering and Applied Sciences, or the College of Business and Economics, and an M.Ed. degree in Elementary Education. In addition, students also earn eligibility for an Instructional I teaching certificate from the Pennsylvania Department of Education (PDE) in grades PreK-4.

**PROGRAM OF STUDY FOR PREK-4 CERTIFICATION:**

B.A. or B.S. plus Master of Education (M.Ed.) in Elementary Education and PA Certification eligibility. This 42-credit (minimum) master’s program prepares students for certification as PreK-4 teachers. Students complete coursework in three categories:

**Core Course Work (21 credit hours)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPED 332</td>
<td>Education and Inclusion of Individuals with Special Needs in K-12</td>
<td>3</td>
</tr>
<tr>
<td>TLT 380</td>
<td>Child Development and Cognition</td>
<td>3</td>
</tr>
<tr>
<td>TLT 404</td>
<td>Diversity, Families, and School Collaborations in K-12</td>
<td>3</td>
</tr>
<tr>
<td>TLT 405</td>
<td>Principles and Applications of K-12 Assessment</td>
<td>3</td>
</tr>
<tr>
<td>TLT 407</td>
<td>Instructional Design for K-12 Classes</td>
<td>3</td>
</tr>
<tr>
<td>TLT 409</td>
<td>K-12 Classroom Environment and Management</td>
<td>3</td>
</tr>
<tr>
<td>TLT 411</td>
<td>Early Childhood Education</td>
<td>3</td>
</tr>
</tbody>
</table>

**Development of Professional Skills (18 credit hours)**

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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT 412</td>
<td>Social Studies in PreK through 4th Grade</td>
<td>3</td>
</tr>
<tr>
<td>TLT 420</td>
<td>Reading and Literacy in PreK through 4th Grade</td>
<td>3</td>
</tr>
<tr>
<td>TLT 422</td>
<td>Language Arts in PreK through 4th Grade</td>
<td>3</td>
</tr>
<tr>
<td>TLT 426</td>
<td>Science in PreK through 4th Grade</td>
<td>3</td>
</tr>
<tr>
<td>TLT 428</td>
<td>Mathematics and Numeracy in PreK through 4th Grade</td>
<td>3</td>
</tr>
<tr>
<td>SPED 465</td>
<td>Advanced Inclusionary Practices in K-12</td>
<td>3</td>
</tr>
</tbody>
</table>

**Extended Field Experience (3 credit hours)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT 444</td>
<td>General Education Student Teaching and Seminar</td>
<td>1-6</td>
</tr>
</tbody>
</table>

In order to be eligible for PreK-4 certification, by the time a student finishes the program he or she must have demonstrated competence in the core content areas for that certification. At time of acceptance, each student will be informed of any additional content-area coursework he or she will be required to complete in order to demonstrate competence in the PreK-4 core content areas. The student is responsible for completing this coursework prior to applying for PreK-4 certification. The credits for this coursework are not included in the master's degree.

**Distribution of coursework across undergraduate and graduate study:**

- **Sophomore Year** (3 credit hours)
  - Junior Year (3 credit hours)
  - Senior Year (12 credit hours)
  - College of Education - Summer (12 credits)
  - College of Education - Fall (9 credits)
  - College of Education - Spring (6 credits)

Students in the 5-year program will take 18 credits pre-bachelor’s and an additional 27 credits post-bachelor's. However, the University requires that master’s degrees carry at least 30 credits minimum. This means students in the 5-year program must have at least 3 credits “left over” from their bachelor’s program to move across to the College of Education to put toward their master's degree.

**5-YEAR MASTER OF EDUCATION IN SECONDARY EDUCATION AND 7-12 TEACHER CERTIFICATION**

The College of Education offers a five-year degree program that is designed to allow students to earn both a bachelor’s degree and a master’s degree in five years instead of the traditional six.

The combined degree program leads to (1) a B.A/B.S. degree in an academic discipline from the College of Arts and Sciences, the P.C. Rossin College of Engineering and Applied Sciences, or the College of Business and Economics, and (2) an M.Ed. degree in Secondary Education. In addition, students also earn eligibility for Instructional I
teacher certification from the Pennsylvania Department of Education (PDE) in one of the 8 subject areas below:

- Biology 7-12
- Chemistry 7-12
- Earth and Space Science 7-12
- English 7-12
- General Science 7-12
- Mathematics 7-12
- Physics 7-12
- Social Studies 7-12

**PROGRAM OF STUDY:**

B.A. or B.S. plus Master of Education (M.Ed., 33 credits minimum) and Pennsylvania teacher certification eligibility. In addition to meeting the requirements for the bachelor's degree, students must satisfy the Pennsylvania Department of Education guidelines for demonstrated content-area competence (see below).

Students complete coursework in three categories:

**Core Coursework (15 credits)**

<table>
<thead>
<tr>
<th>Course Code</th>
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<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPED 332</td>
<td>Education and Inclusion of Individuals with Special Needs in K-12</td>
<td>3</td>
</tr>
<tr>
<td>TLT 404</td>
<td>Diversity, Families, and School Collaborations in K-12</td>
<td>3</td>
</tr>
<tr>
<td>TLT 405</td>
<td>Principles and Applications of K-12 Assessment</td>
<td>3</td>
</tr>
<tr>
<td>TLT 407</td>
<td>Instructional Design for K-12 Classrooms</td>
<td>3</td>
</tr>
<tr>
<td>TLT 409</td>
<td>K-12 Classroom Environment and Management</td>
<td>3</td>
</tr>
</tbody>
</table>

**Development of Professional Skills (12 credits)**

Content-area teaching methods course with approval of adviser (one of the following):

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT 431</td>
<td>Social Studies in Middle Level and High School Education</td>
<td>3</td>
</tr>
<tr>
<td>TLT 434</td>
<td>English in Middle Level and High School Education</td>
<td>3</td>
</tr>
<tr>
<td>TLT 436</td>
<td>Science in Middle Level and High School Education</td>
<td>3</td>
</tr>
<tr>
<td>TLT 438</td>
<td>Mathematics in Middle Level and High School Education</td>
<td>3</td>
</tr>
<tr>
<td>Plus:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TLT 432</td>
<td>Reading and Critical Thinking in Middle Level and High School Education</td>
<td>3</td>
</tr>
<tr>
<td>SPED 465</td>
<td>Advanced Inclusionary Practices in K-12</td>
<td>3</td>
</tr>
<tr>
<td>TLT XXX</td>
<td>Elective with adviser approval</td>
<td>3</td>
</tr>
</tbody>
</table>

**Extended Field Experiences (6 credits)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>TLT 440</td>
<td>Pre-professional Seminar</td>
<td>3</td>
</tr>
<tr>
<td>TLT 444</td>
<td>General Education Student Teaching and Seminar</td>
<td>1-6</td>
</tr>
</tbody>
</table>

In order to be eligible for secondary certification, by the time a student finishes the program he or she must have demonstrated competence in the subject matter area of that certification. Each student upon admission meets with the content-area specialist in the field in which that student seeks secondary certification. The content-area specialist, who is a faculty member in the College of Arts and Sciences, reviews the student’s transcripts and compares that student’s coursework with the content-area guide sheet approved by the Pennsylvania Department of Education (PDE). Following this audit, the content-area specialist will identify what additional coursework in the content-area is needed, if any. The student is responsible for completing this coursework prior to applying for secondary certification. The credits for this course work are not included in the M.Ed. degree.

Students in the secondary teacher-preparation program are expected to have completed almost all their content area coursework prior to going out to student teach. This is important because student teachers need to have mastery of their content in order to fulfill their responsibilities to their students and to derive maximum benefit from the student teaching experience.

**Distribution of coursework across undergraduate and graduate study:**

- Sophomore Year (3 credit hours)
- Junior Year (6 credit hours)
- Senior Year (6 credit hours)

**College of Education - Summer (6 credits)**

**College of Education - Fall (9 credits)**

Students in this program unable to accrue enough credits outside their undergraduate degree programs may need to take additional credits after beginning graduate study in order to reach the 33-credit minimum. Students in this program who wish to obtain the Master of Arts (M.A.) degree rather than the M.Ed. degree may petition to change to that degree after admission to graduate study. The M.A. degree requires 42 credits instead of 33 credits and has specific content-area expertise requirements. See the M.A. degree description for its requirements.

**Doctor of Philosophy in Special Education**

This 60 credit post-master's degree program is individualized and emphasizes applied research, faculty-student mentoring, and the development of professional competencies such as writing for publication, college teaching, grant writing, and program administration.

**Doctoral Core (12 credits)**

<table>
<thead>
<tr>
<th>Course Code</th>
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<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>SCHP 496</td>
<td>Doctoral Seminar in School Psychology</td>
<td>3</td>
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<tr>
<td>and/or</td>
<td></td>
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<tr>
<td>SPED 490</td>
<td>Doctoral Seminar in Special Education</td>
<td>3</td>
</tr>
</tbody>
</table>

**Research Core (18 credits)**

Required:

- EDUC 410  Univariate Statistical Models 3
- EDUC 411  Multivariate Statistical Models 3

Other:

- EDUC 408  Introduction to Statistics 3
- EDUC 409  Analysis of Experimental Data 3
- EDUC 461  Single-Subject Research Design 3
- SCHP 473  Advanced Research Methods in Applied Psychology 1-3
- SPED 495  Independent Study in Special Education 1-6

Other courses with approval of adviser.

**Special Education Major Core (15 credits)**

Choose from special education courses or independent studies in special interest areas with approval of adviser.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>EDUC 471</td>
<td>Diversity and Multicultural Perspectives</td>
<td>3</td>
</tr>
</tbody>
</table>

Other courses with approval of adviser.

**Related Areas (9 credits)**

Required:

- EDUC 411  Multivariate Statistical Models 3

Other courses with approval of adviser.

**Apprenticeship (6 credits)**

Supervised mentored experiences such as college teaching, student teaching supervision, writing for publication, participation in research projects, presentations at national conferences, grant writing, or educational leadership in schools and community.

**Master of Education in Special Education**

The Master of Education (M.Ed.) degree in Special Education is designed for the college graduate who holds instructional certification in special education and who is interested in pursuing advanced studies in special education. The mission of this special education master’s program is to enhance the skills of highly qualified special educators who are not only skilled practitioners, but also leaders in establishing...
effective teaching and learning environments for individuals with disabilities in their schools and communities.

Core Course Work (15 credits)

SPED 404 Diversity, Families, and School Collaborations in K-12 3
SPED 429 Professional Seminar 3
SPED 432 Positive Behavior Support 3
SPED 452 Assessment in Special Education 3
SPED 465 Advanced Inclusionary Practices in K-12 3

Area of Study (3 credits; must choose one of the following; courses not chosen here may be taken as Electives, below)

SPED 411 Early Childhood Education 3
SPED 418 Alternative Curricular Approaches 3
SPED 419 Academic Interventions: PreK-8 3
SPED 421 Academic Interventions: Secondary Level 3

Electives (12 credits; the one course chosen above under Area of Study may not also be counted toward fulfilling Electives credits)

EDL 432 Special Education Law 3
EDL 479 School Law and Ethics 3
SCHP 412 Consultation Procedures 2
SCHP 426 Advanced School and Family Interventions 3
SPED 330 Special Topics in Special Education 1-3
SPED 338 Emotional and Behavioral Disorders of Children 3
SPED 402 Applied Behavior Analysis 3
SPED 411 Early Childhood Education 3
SPED 418 Alternative Curricular Approaches 3
SPED 419 Academic Interventions: PreK-8 3
SPED 421 Academic Interventions: Secondary Level 3
SPED 423 Transition to Post-school Life 3
SPED 430 Advanced Seminar in Special Education 3
SPED 440 Early Academic Intervention 3

Other electives as approved by adviser

Courses

SPED 330 Special Topics in Special Education 1-3 Credits
Current issues in the education of individuals with special needs. Titles vary.
Repeat Status: Course may be repeated.

SPED 332 Education and Inclusion of Individuals with Special Needs in K-12 3 Credits
Overview of social, developmental, legal, and educational issues and practices related to the special education of individuals with disabilities. Covers social, environmental, and physiological etiology; development; identification; learning characteristics; and needs of individuals identified for special education. Emphasizes meeting diverse needs of students in general education classrooms through evidence-based practices and adaptations matched to learner needs. Addresses legal rights of students and their families, as well as legal responsibilities of teachers as required by IDEA and other related legislation.

SPED 338 Emotional and Behavioral Disorders of Children 3 Credits
Definition, classification, etiology, treatment, and historical perspective of children and adolescent disorders.

SPED 402 (SCHP 402) Applied Behavior Analysis 3 Credits
Theory and application of behavior modification methods in classroom and clinical settings. Topics include behavior analysis, outcome research, task utilization, and single case research.

SPED 404 (TLT 404) Diversity, Families, and School Collaborations in K-12 3 Credits
Cultural and linguistic diversity as critical variables in educational equity for all learners, including ELL. Explores home-school partnerships, family and professional collaboration, and teacher self-awareness. Implementing culturally sensitive and responsive classroom practices as well as forming collaborative relationships with families that respect diversity of family contexts. Collaborative, multidisciplinary learning to support, optimize, and advocate for student's educational needs and connect to community services and resources available to individuals and families. Addresses family mental health issues and wraparound services.

SPED 405 (TLT 405) Principles and Applications of K-12 Assessment 3 Credits
Assessment applied to learning in classroom learning environments, including universal screening and progress monitoring. Discusses assessment approaches, ways to implement assessment, and use of assessment tools to monitor all students, including ELL and students with disabilities. Use of data-management and grading systems. Addresses diagnostic assessments for student placement and analysis of assessment data to tailor instruction to diverse student needs. Emphasis on research-based practices of assessment to inform instructional decision-making consistent with the RtII framework.

SPED 409 (TLT 409) K-12 Classroom Environment and Management 3 Credits
Designing inclusive classroom environments that maximize learning. Emphasis on fostering a community of learners using connections among classroom arrangement, classroom management, and cognitive development to create positive learning outcomes for all students, including ELL learners and students with disabilities. Addresses the tiered model of prevention and positive behavior support, including the role of functional assessment and individual positive behavior support plans in classroom management. Highlights the ways a positive climate for learning involves establishing and maintaining partnerships with families.

SPED 411 (TLT 411) Early Childhood Education 3 Credits
Introduction to development of early childhood education in the U.S. Emphasizes evidence-based methods and materials to assist young children in the learning process, including arrangement of indoor/ outdoor space, developmentally appropriate practices, and the design of instruction to foster young children’s emotional, social, language, cognitive, physical, and creative development. Includes embedded instruction and adaptations for students with identified disabilities, children at risk for developing disabilities, and children with culturally and linguistically diverse backgrounds, and family collaboration within the instructional planning process.

SPED 418 Alternative Curricular Approaches 3 Credits
Curricular and instructional methods for students with pervasive support needs (e.g., intellectual disabilities, autism) who follow an alternative or modified curriculum. Methods for developing an individualized curriculum, embedding instruction and accessing the general education curriculum, systematic instruction, and instruction for full participation in school, home, and community settings are covered. Strategies for facilitating emergent social and communication skills, teaching augmentative and alternative communication, and use of assistive technologies to enhance self-directed learning are included.

SPED 419 Academic Interventions: PreK-8 3 Credits
Methods course designed to address the needs of students with disabilities to increase knowledge of instruction of comprehensive pre-literacy and literacy skills and their components. Additionally, pre- reading, reading, language arts, mathematics, and content area reading literacy skills in primary and elementary settings will be addressed. Emphasis on instructional planning, differentiated instructional strategies, appropriate assessments modifications, and adaptations needed for use with individuals with disabilities through a conceptual foundation in the components of reading and the integration of research validated interventions.
SPED 420 Field Experience: Special Education Certification 1-3 Credits
Intensive practice in the application of principles of teaching in a supervised experience in the schools for students who already hold another content area certification (e.g., elementary, middle school, secondary). Consent of the program.

SPED 421 Academic Interventions: Secondary Level 3 Credits
Methods course designed to increase knowledge of core components of reading in secondary settings, language arts, mathematics, and content area literacy skills for students with disabilities and those who are culturally and/or linguistically diverse. Emphasis on instructional planning, differentiated instructional strategies, appropriate assessments, modifications, and adaptations needed for use with individuals with disabilities through a conceptual foundation in the components of reading and the integration of research validated interventions.

SPED 423 Transition to Post-school Life 3 Credits
Best instructional practices for preparing students for post-school adult life: employment, post-secondary education, and community participation in inclusive settings. Topics include transition planning, person-centered and work-based assessments, family and interagency collaboration, innovative post-school and inschool transition services, and self-determination. Evidence-based practices to promote positive student outcomes are emphasized.

SPED 429 Professional Seminar 3 Credits
Master’s seminar on current issues in the area of special education and research design. Must have 18 graduate credits in special education.

SPED 430 Advanced Seminar in Special Education 3 Credits
Advanced issues relating to the field of special education. Titles will vary. Repeat Status: Course may be repeated.

SPED 432 Positive Behavior Support 3 Credits
Design of comprehensive, multi-component behavior support plans for individuals with a variety of disabilities who engage in problem behavior. Topics include functional assessment, antecedent and setting event interventions, replacement behaviors, consequence and crisis procedures, lifestyle interventions, and teaming strategies. Assessment focuses on the link between curriculum, academic performance, and behavior problems. Promotes consideration of diverse populations for understanding behavioral differences. Describes strategies for ongoing monitoring and maintenance of behavior reductions.

SPED 434 Applied Research Practicum 1-3 Credits
Designing and conducting research projects in applied settings.

SPED 434 Early Academic Intervention 3 Credits
Explores the potential effectiveness of interventions to prevent academic failure of children at risk for learning difficulties. Emphasis on research-based interventions in the areas of beginning reading, language and vocabulary, writing and spelling, awareness of print and exposure to print, and mathematics (number sense).

SPED 442 (TLT 442) General Education and Special Education Student Teaching and Seminar 1-6 Credits
Intensive practice in the application of principles of teaching for both general and special education settings in a supervised internship in the schools (for dual certification). Regular meetings among student teachers for critical analysis and discussion of classroom instructional practices, as illustrated by the student teachers’ experiences in the schools. Practical mentoring on professionalism, applying differentiated instructional models in a real-world setting, and aligning instruction with standards. Consent of program director required.

SPED 448 Practicum/Seminar in Positive Behavior Specialist 1 3 Credits
Introductory supervised field work with emphasis on conducting functional assessments, designing positive behavior support plans, and teaming with families and professionals. Requires one-hour weekly meetings with faculty and other practicum students. This course is restricted to students enrolled in the Positive Behavior Specialist program.

SPED 450 Practicum/Seminar in Positive Behavior Specialist 2 3 Credits
Advanced field work with emphasis on resolving difficult case problems in positive behavior support. Requires one-hour weekly meetings with faculty and other practicum students. This course is restricted to students enrolled in the Positive Behavior Specialist program.

SPED 452 Assessment in Special Education 3 Credits
Identification, administration and interpretation of a variety of assessments used for planning and to determine special education eligibility and to assess social, emotional, behavioral, and academic functioning. Discusses strengths and limitations of various models and assessment, both formal and informal, instruments used to evaluate the need for special education. Describes strategies to enhance the relationship between assessment and service delivery. Addresses assessment practices to identity curricular needs consistent with the RtI II framework.

SPED 465 Advanced Inclusionary Practices in K-12 3 Credits
Advanced techniques grounded in current research-based methods and best practice for educating and assessing students with disabilities, students from diverse backgrounds, and English language learners using a standards-aligned system. Accommodations, modifications, planning for physical and instructional inclusion through embedded strategic instruction, adaptations, and curriculum overlapping. Addresses decision hierarchies for level of instructional adaptation and social inclusion methods through social facilitation techniques. Explores critical factors in developing, implementing, and modifying curriculum using evidence-based practices. Explores collaborative co-planning and co-teaching models.

Prerequisites: SPED 332

SPED 482 Practicum in University Teaching: Special Education 1-4 Credits
Mentored and guided co-teaching focused on the design, organization, pedagogy and assessment of university courses in Special Education. Students in this course will work with a faculty member to apply best practices in university teaching with feedback while co-teaching students in a course in the College of Education. Students taking the course must meet the college standards for participation and be approved by the program director and department chair. May be repeated for credit. Repeat Status: Course may be repeated.

SPED 490 Doctoral Seminar in Special Education 3 Credits
Advanced knowledge of issues and research in the education of individuals with special needs. Topics will vary. Must be admitted for doctoral studies. Repeat Status: Course may be repeated.

SPED 499 Dissertation 1-15 Credits
Repeat Status: Course may be repeated.

Supply Chain Management

Success in today's business environment is driven by competitive advantage and profitability. Customer-focus, value added product differentiation and cost management are the elements associated with industry leaders. The Supply Chain Management undergraduate major at Lehigh University prepares students to understand and manage the processes that distinguish the successful company from its competitors. The Supply Chain Management major equips students with the knowledge, skills and abilities necessary for success in the complex business environment of the 21st Century. This program:

• Provides solid exposure to supply management, logistics, business-to-business, and operations management topics.
• Develops cross-functional team skills by integrating Supply Chain Management students with engineering students in the Integrated Product Development (IPD) program.
• Emphasizes advanced cost analysis, negotiation, quality management and improvement, logistics network modeling and e-business.
• Integrates core business courses with supply chain major courses.
• Provides field study and experiential learning opportunities.

Supply Chain Management graduates will be prepared to enter industry at a level that accelerates their on-the-job learning and development.
Supply Chain Management graduates typically work within five areas, each with its own set of positions and career paths:

- purchasing and supply management
- transportation and logistics
- operations management
- inventory management and control
- supply chain planning

**SUPPLY CHAIN MANAGEMENT PROGRAM**

**Required Major Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCM 309</td>
<td>Supply, Cost, and Risk Management</td>
<td>3</td>
</tr>
<tr>
<td>SCM 354</td>
<td>Integrated Logistics and Transportation Management</td>
<td>3</td>
</tr>
<tr>
<td>BUS 211</td>
<td>Negotiations and Conflict Management</td>
<td>3</td>
</tr>
<tr>
<td>SCM 340</td>
<td>Demand and Supply Chain Planning</td>
<td>3</td>
</tr>
<tr>
<td>SCM 342</td>
<td>e-Business Enterprise Applications</td>
<td>3</td>
</tr>
</tbody>
</table>

**Optional**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCM 373</td>
<td>Supply Chain Management Internship</td>
<td>1-3</td>
</tr>
</tbody>
</table>

**Total Credits**: 19-21

**SUPPLY CHAIN MANAGEMENT MINOR**

The Supply Chain Management minor is designed to offer students in other disciplines an opportunity to learn about supply chain topics and issues. The College of Business and Economics offers a Supply Chain Management minor to any student that has completed the following:

**Prerequisites**

- ECO 001 Principles of Economics
- ECO 045 Statistical Methods (or applicable statistics from the student’s college)

**Required**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCM 309</td>
<td>Supply, Cost, and Risk Management</td>
<td>3</td>
</tr>
<tr>
<td>SCM 354</td>
<td>Integrated Logistics and Transportation Management</td>
<td>3</td>
</tr>
</tbody>
</table>

Select one of the following: 3

- SCM/MGT 328 Negotiations and Conflict Management
- SCM 342 e-Business Enterprise Applications
- SCM 340 Demand and Supply Chain Planning

**Total Credits**: 9

**Courses**

**SCM 186 Supply Chain Operations Management 3 Credits**

Introduction to managing global supply chains and operations within the context of an integrated value chain. Topics include supply chain management, total quality management, project management, demand forecasting, supply management, lean operations, aggregate planning, capacity planning, inventory management, distribution and transportation management, and performance measurement.

**Prerequisites**: (MATH 021 or MATH 076 or MATH 097 or MATH 081) and (ECO 045 or ECO 145 or MATH 231)

**Attribute/Distribution**: ND

**SCM 300 Apprentice Teaching 1-3 Credits**

This class presents a framework for achieving sustainable competitive advantage through progressive supply management leadership and approaches. It presents the need for supply leadership, the organizational enablers that must be in place, and the strategies and approaches that leading organizations pursue to achieve competitive advantage in price and cost, quality, delivery, cycle time, technology, flexibility, and end customer responsiveness. Special attention is given to a wide range of price, cost and risk management techniques.

**Prerequisites**: SCM 186 or MGT 186

**SCM 328 (MGT 328) Negotiations and Conflict Management 3 Credits**

This course covers the theory and processes of negotiation in a variety of settings including face-to-face, virtual and cross-cultural business environments. Students will learn negotiating skills by preparing and simulating a broad mixture of negotiations, ranging from one-on-one, to three-person, to multiparty and team negotiations. They will learn to analyze outcomes and strategies during the debriefing sessions and will have an opportunity to compare results of their negotiations to the results of other people in class.

**SCM 340 Demand and Supply Chain Planning 3 Credits**

Students will learn how businesses work with other businesses to build relationships and integrate demand and supply planning activities across the supply chain to deliver value to customers. They will learn about tools and technologies enabling integration, and the critical drivers and key metrics of supply chain performance. Current readings, case studies, simulations and written assignments will be used.

**Prerequisites**: MGT 186 or SCM 186

**SCM 342 (BIS 342) e-Business Enterprise Applications 3 Credits**

Introduction to the implications of key information technologies used within and across businesses to conduct e-business. The course covers the functionality of various enterprise applications and their integration: customer relationship management, enterprise resource planning, supply chain management, supplier relationship management, data warehousing and mining, business intelligence, and product lifecycle management.

**Prerequisites**: BIS 111

**SCM 354 Integrated Logistics and Transportation Management 3 Credits**

A combined lecture, discussion, and experiential course designed to provide students (1) exposure to the fundamentals of logistics and transportation and (2) the opportunity to work in teams to manage a company’s supply chain within a strategic supply chain simulation. Students will gain hands-on-experience integrating supply chain management concepts to optimize business performance outcomes. Topics addressed include integrated logistics, transportation, warehouse management and global logistics.

**SCM 371 Directed Readings 1-3 Credits**

Readings in various fields of supply chain management designed for the student who has a special interest in some field of supply chain management not covered by the regularly scheduled courses. Consent of the department chair.

**Repeat Status**: Course may be repeated.

**SCM 372 Special Topics 1-3 Credits**

Special problems and issues in supply chain management for which no regularly scheduled course work exists. When offered as a group study, coverage varies according to interests of instructor and students. Consent of the department chair.

**Repeat Status**: Course may be repeated.

**SCM 373 Supply Chain Management Internship 1-3 Credits**

A sponsoring faculty member shall direct readings, projects and other assignments including a comprehensive final report in conjunction with an industry sponsored internship. The work experience itself, whether paid or unpaid, is not the basis for academic credit. Intellectual development in the context of a field study learning experience comparable to Bus 211 (Engr 211), Integrated Product Development Projects, and SCM 372, Special Topics, will be the determining factor in awarding academic credit. This course cannot be used to satisfy requirements of the Supply Chain Management major. Consent of the department chair. Must have junior standing in the College of Business and Economics and Supply Chain Management declaration.

**Repeat Status**: Course may be repeated.
### Sustainable Development

**Program Director:** Mark Orrs, Professor of Practice (Columbia University)

**Email:** mark.orrs@lehigh.edu  #  Phone: 610-758-2533

**Website:** www.lehigh.edu/sdp

Supported by the Office of Interdisciplinary Programs, 610-758-3996; incasip@lehigh.edu

*Williams Hall, 31 Williams Drive*

**Core Faculty**

David Casagrande, Ph.D. (Department of Sociology and Anthropology); Stephen Cutcliffe, Ph.D. (Department of History); John Gatewood, Ph.D. (Department of Sociology and Anthropology); Kristen Jellison, Ph.D. (Department of Civil and Environmental Engineering); Donald Morris, Ph.D. (Department of Earth and Environmental Sciences); Mark Orrs, Ph.D. (Department of Political Science); Todd Watkins, Ph.D. (Department of Economics and Executive Director, Martindale Center for the Study of Private Enterprise and Microfinance Program); and Rick Weisman, Ph.D. (Department of Civil and Environmental Engineering)

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**Students of any discipline who are interested in helping solve the triple bottom line challenge of their generation: economic well-being, environmental protection, and social inclusion, are invited to join with like-minded students to collaborate in devising and implementing solutions to real-world challenges of Sustainable Development (SDEV).**

**MINOR IN SUSTAINABLE DEVELOPMENT**

The minor in SDEV consists of a minimum of at least 15 hours of study that includes a combination of core courses and approved electives. To declare a minor in Sustainable Development, students must complete a minor declaration form.

**Core Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDEV 010 &amp; SDEV 201</td>
<td>Challenges of Sustainable Development and Sustainable Development Solutions, I</td>
</tr>
<tr>
<td>SDEV 010 &amp; SDEV 202</td>
<td>Challenges of Sustainable Development and Sustainable Development Solutions, II</td>
</tr>
</tbody>
</table>

**or**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDEV 010 &amp; SDEV 203</td>
<td>Challenges of Sustainable Development and Research in Sustainable Development</td>
</tr>
</tbody>
</table>

**Additional Core Electives**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDEV 122</td>
<td>Sustainable Dev:CR Experience</td>
</tr>
<tr>
<td>ECO 203</td>
<td>Microfinance: Financial Inclusion for the Poor</td>
</tr>
<tr>
<td>ANTH 305</td>
<td>Anthropology Of Fishing</td>
</tr>
<tr>
<td>SDEV/ENTP/IR 307</td>
<td>International Social Entrepreneurship</td>
</tr>
<tr>
<td>SDEV/ES 310</td>
<td>Foundations of Sustainable Development Practice</td>
</tr>
<tr>
<td>ANTH/GS/AAS 324</td>
<td>Globalization and Development in Africa</td>
</tr>
<tr>
<td>SOC/GS 328</td>
<td>Global Food Systems</td>
</tr>
</tbody>
</table>

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**SDEV 201 Sustainable Development Solutions, I, 3 Credits**

Projects practicum in which cross-disciplinary teams of 5-6 students focus on understanding the context of a particular NGO amidst the broader social, economic, and scientific challenges to sustainable development. Analytic techniques for designing, implementing and evaluating projects. Nuts and bolts of development practice. Teams work on needs assessment related to their NGO’s proposed goals and devise innovative solutions for implementing development projects. On-the-ground field experience, whether international or domestic, is required. Fee may apply. Oral presentations and written reports.

**Prerequisites:** SDEV 010

**Attribute/Distribution:** SS

**SDEV 202 Sustainable Development Solutions, II, 2-4 Credits**

Continuation and extension of projects begun in SDEV 201. Refine implementation strategies and develop project evaluation protocol. Oral presentations and written reports.

**Prerequisites:** SDEV 201

**Attribute/Distribution:** SS

**SDEV 203 Research in Sustainable Development, 2-4 Credits**

Students will work on sustainable development research projects not involving field work. Consent of instructor required.

**Repeat Status:** Course may be repeated.

**Prerequisites:** SDEV 010

**Attribute/Distribution:** SS

**SDEV 372 Independent Study in Sustainable Development, 1-4 Credits**

**Total Credits:** 15

1 Additional course electives may be substituted in consultation with the Program Director.

**Courses**

**SDEV 010 Challenges of Sustainable Development, 4 Credits**

History and principles of sustainable development, including their application to projects in both rich and poor countries. Survey of current environmental, social and economic challenges to sustainable development. Philosophy and ethics of external intervention for poverty alleviation and green development, especially in poor societies. Integrated approaches to sustainable development practice, including the inter-relationship of the health sciences, natural sciences, social sciences and management.

**Attribute/Distribution:** SS

**SDEV 122 Sustainable Dev:CR Experience, 3 Credits**

Investigation of the concept of sustainable development as currently being practiced in Costa Rica. Case studies in diverse areas (e.g. agriculture, bio-prospecting, ecotourism, energy, and land use) demonstrate how current approaches to sustainable development are influenced by the history and ecology of Costa Rica, as well as the structure of its political, social, and economic systems. Attention to theories of sustainable development and of consumption help to frame the Costa Rican experience. Students maintain individual “sustainability” journals based on their experiences from which they draw for team-based research and writing projects. The course is offered through Lehigh Abroad and consists of 5 evening classes during the fall semester and required course travel to Costa Rica between the fall and winter semesters (approximately 18 days). Final course projects are due early in the spring semester. Course participation will require additional fees as described by Lehigh Abroad (airfare and program fee).

**Prerequisites:** SDEV 010

**Attribute/Distribution:** SS

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**SDEV 423 Supply Chain Operations Management, 2 Credits**

This course provides an essential understanding of managing global supply chains and operations within the context of an integrated value chain. Topics addressed include the fundamentals of supply chain management; supply chain risk management; quality management; demand and supply chain planning, including forecasting, capacity planning, aggregate planning, and scheduling; the components of a lean supply chain; inventory and working capital management; distribution and transportation management; and performance measurement. Special emphasis is given to managing supply chains from a financial perspective.
SDEV 307 (ENTP 307, IR 307) International Social Entrepreneurship

4 Credits

International social entrepreneurship aims to change the world through innovation in solving social problems. Focus on the nexus between social entrepreneurship and development practice, especially in relation to NGOs. Emphasis on acquiring tools and conceptual frameworks to launch new social ventures through real hands-on international fieldwork and team-oriented learning by doing. Exposure to best practices of how to affect meaningful social change in poor countries, to generate and evaluate innovative ideas to develop them into concrete on-the-ground startups.

Attribute/Distribution: SS

SDEV 310 (ES 310) Foundations of Sustainable Development Practice 4 Credits

The broad goal of this course is to introduce students to the foundations of key sectoral and thematic knowledge for important challenges to sustainable development: food and nutritional security, social service delivery, energy policy, water resource management, urbanization, infrastructure, human rights, biodiversity, adaption to climate change, mitigating GHGs, sustainable business, good governance, and more. Through the Global Classroom we will do this together virtually with academic partners from around the world.

Attribute/Distribution: SS

SDEV 372 Independent Study in Sustainable Development 1-4 Credits

Opportunity for students to pursue individual sustainable development projects or continue work begun in SDEV 201/202. May not count towards minor’s credit requirements. Consent of department required.

Prerequisites: SDEV 010

Attribute/Distribution: HU, SS

Teaching, Learning, and Technology

The Teaching, Learning and Technology (TLT) program offers six master’s degrees and one graduate certificate, divided into two areas: teacher education and instructional technology. The program also offers a doctoral degree.

The master’s degrees in teacher education are Master of Education in Elementary Education and PreK-4 Teacher Certification, Master of Education (or Master of Arts) in Secondary Education and Teacher Certification, and Master of Education (or Master of Arts) in Teaching and Learning. Undergraduate students at Lehigh may also enroll in a five-year program for a Master of Education in Elementary Education and PreK-4 Certification or Master of Education in Secondary Education and Teacher Certification, in addition to their undergraduate degree. Teacher education students may elect to complete additional coursework to earn certification in Special Education, as well as Elementary Education or their Secondary Education field. All teacher certification programs have been approved by the Pennsylvania Department of Education, making graduates eligible for initial certification in Pennsylvania.

In instructional technology TLT offers a Master of Science in Instructional Technology and a Lehigh graduate certificate in Technology Use in the Schools. This certificate is endorsed by the International Society for Technology in Education (ISTE).

Finally, the program offers a Doctor of Philosophy in Teaching, Learning, and Technology, which spans both fields of teacher education and instructional technology.

The TLT program prepares professional educators through a combination of graduate-level education and certification experiences. The program highlights research-based, inquiry-oriented, and technology-enabled strategies to reach all learners. We emphasize collaborative and equitable approaches to instruction and learning. TLT graduates are not only highly skilled practitioners, but also reflective scholars and leaders in their professional communities.

Upon completion, TLT graduates become teachers in PreK-12 schools; curriculum coordinators, coaches, and educational technology specialists in both formal and informal education settings; instructional designers and/or learning designers; or professors in higher education institutions.

Distinctive current TLT projects include the Environmental Literacy and Inquiry curricula that uses geospatial data and tools to study land use, energy, tectonics, and climate change, and Read It Again- PreK! Over the academic year and during kindergarten, this latter project improves reading education for children with disabilities enrolled in early childhood special education, as well as for their typically developing classmates.

For more information about teacher education:
http://coe.lehigh.edu/academics/disciplines/teachered

For more information about instructional technology:
http://coe.lehigh.edu/academics/disciplines/itech

Professors. Alec M. Bodzin, PhD (North Carolina State University); Ward M. Cates, EdD (Duke University)

Associate Professors. Helen Lynn Columba-Piervallo, EdD (University of Louisville); Thomas Chalmers Hammond, PhD (University of Virginia)

Assistant Professors. Sara Kangas, PhD (Temple University); Laura Brook E. Sawyer, PhD (University of Virginia)

Professor Of Practice. Scott Roy Garrigan, EdD (Lehigh University)

Emeritus. Warren R. Heydenberk, PhD (University of Northern Colorado)

Lehigh undergraduates may enroll in either of the College of Education’s 5-year teacher certification areas: Elementary Education (grade levels preK through 4) and Secondary Education (grade levels 7 through 12). A Minor in Education is offered through the College of Arts and Sciences. For information on the 5-year programs, see below. For information on the Education Minor, see the College of Arts and Sciences ‘Minor Programs in the College’.

5-YEAR MASTER OF EDUCATION IN ELEMENTARY EDUCATION AND PREK-4 TEACHER CERTIFICATION

The College of Education offers a five-year degree program that is designed to allow students to earn both a bachelor’s degree and a master’s degree in five years instead of the traditional six. The combined degree program leads to either a B.A. or B.S degree in an academic discipline from the College of Arts and Sciences, the P.C. Rossin College of Engineering and Applied Sciences, or the College of Business and Economics, and an M.Ed. degree in Elementary Education. In addition, students also earn eligibility for an Instructional I teaching certificate from the Pennsylvania Department of Education (PDE) in grades PreK-4.

PROGRAM OF STUDY FOR PREK-4 CERTIFICATION:

B.A. or B.S. plus Master of Education (M.Ed.) in Elementary Education and PA Certification eligibility. This 42-credit (minimum) master’s program prepares students for certification as PreK-4 teachers. Students complete coursework in three categories:

Core Course Work (21 credit hours)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPED 332</td>
<td>Education and Inclusion of Individuals with Special Needs in K-12</td>
<td>3</td>
</tr>
<tr>
<td>TLT 380</td>
<td>Child Development and Cognition</td>
<td>3</td>
</tr>
<tr>
<td>TLT 404</td>
<td>Diversity, Families, and School Collaborations in K-12</td>
<td>3</td>
</tr>
<tr>
<td>TLT 405</td>
<td>Principles and Applications of K-12 Assessment</td>
<td>3</td>
</tr>
<tr>
<td>TLT 407</td>
<td>Instructional Design for K-12 Classrooms</td>
<td>3</td>
</tr>
<tr>
<td>TLT 409</td>
<td>K-12 Classroom Environment and Management</td>
<td>3</td>
</tr>
<tr>
<td>TLT 411</td>
<td>Early Childhood Education</td>
<td>3</td>
</tr>
</tbody>
</table>

Development of Professional Skills (18 credit hours)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT 412</td>
<td>Social Studies in PreK through 4th Grade</td>
<td>3</td>
</tr>
<tr>
<td>TLT 420</td>
<td>Reading and Literacy in PreK through 4th Grade</td>
<td>3</td>
</tr>
<tr>
<td>TLT 422</td>
<td>Language Arts in PreK through 4th Grade</td>
<td>3</td>
</tr>
<tr>
<td>TLT 426</td>
<td>Science in PreK through 4th Grade</td>
<td>3</td>
</tr>
</tbody>
</table>
In order to be eligible for PreK-4 certification, by the time a student finishes the program he or she must have demonstrated competence in the core content areas for that certification. At time of acceptance, each student will be informed of any additional content-area coursework he or she will be required to complete in order to demonstrate competence in the PreK-4 core content areas. The student is responsible for completing this coursework prior to applying for PreK-4 certification. The credits for this coursework are not included in the master’s degree.

Distribution of coursework across undergraduate and graduate study:

Sophomore Year (3 credit hours)
Junior Year (3 credit hours)
Senior Year (12 credit hours)
College of Education - Summer (12 credits)
College of Education - Fall (9 credits)
College of Education - Spring (6 credits)

Students in the 5-year program will take 18 credits pre-bachelor’s and an additional 27 credits post-bachelor’s. However, the University requires that master’s degrees carry at least 30 credits minimum. This means students in the 5-year program must have at least 3 credits “left over” from their bachelor’s program to move across to the College of Education to put toward their master’s degree.

5-YEAR MASTER OF EDUCATION IN SECONDARY EDUCATION AND 7-12 TEACHER CERTIFICATION

The College of Education offers a five-year degree program that is designed to allow students to earn both a bachelor’s degree and a master’s degree in five years instead of the traditional six.

The combined degree program leads to (1) a B.A./B.S. degree in an academic discipline from the College of Arts and Sciences, the P.C. Rossin College of Engineering and Applied Sciences, or the College of Business and Economics, and (2) an M.Ed. degree in Secondary Education. In addition, students also earn eligibility for Instructional I teacher certification from the Pennsylvania Department of Education (PDE) in one of the 8 subject areas below:

- Biology 7-12
- Chemistry 7-12
- Earth and Space Science 7-12
- English 7-12
- General Science 7-12
- Mathematics 7-12
- Physics 7-12
- Social Studies 7-12

PROGRAM OF STUDY:

B.A. or B.S. plus Master of Education (M.Ed., 33 credits minimum) and Pennsylvania teacher certification eligibility. In addition to meeting the requirements for the bachelor’s degree, students must satisfy the Pennsylvania Department of Education guidelines for demonstrated content-area competence (see below).

Students complete coursework in three categories:

**Core Coursework (15 credits)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPED 332</td>
<td>Education and Inclusion of Individuals with Special Needs in K-12</td>
<td>3</td>
</tr>
<tr>
<td>TLT 404</td>
<td>Diversity, Families, and School Collaborations in K-12</td>
<td>3</td>
</tr>
<tr>
<td>TLT 405</td>
<td>Principles and Applications of K-12 Assessment</td>
<td>3</td>
</tr>
</tbody>
</table>

**Extended Field Experience (3 credit hours)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT 444</td>
<td>General Education Student Teaching and Seminar</td>
<td>1-6</td>
</tr>
</tbody>
</table>

**Development of Professional Skills (12 credits)**

Content-area teaching methods course with approval of adviser (one of the following):

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT 431</td>
<td>Social Studies in Middle and High School Education</td>
<td>3</td>
</tr>
<tr>
<td>TLT 434</td>
<td>English in Middle Level and High School Education</td>
<td>3</td>
</tr>
<tr>
<td>TLT 436</td>
<td>Science in Middle Level and High School Education</td>
<td>3</td>
</tr>
<tr>
<td>TLT 438</td>
<td>Mathematics in Middle Level and High School Education</td>
<td>3</td>
</tr>
</tbody>
</table>

**Plus:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT 432</td>
<td>Reading and Critical Thinking in Middle Level and High School Education</td>
<td>3</td>
</tr>
<tr>
<td>SPED 465</td>
<td>Advanced Inclusionary Practices in K-12</td>
<td>3</td>
</tr>
</tbody>
</table>

**Extended Field Experiences (6 credits)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT 440</td>
<td>Pre-professional Seminar</td>
<td>3</td>
</tr>
<tr>
<td>TLT 444</td>
<td>General Education Student Teaching and Seminar</td>
<td>1-6</td>
</tr>
</tbody>
</table>

In order to be eligible for secondary certification, by the time a student finishes the program he or she must have demonstrated competence in the subject matter area of that certification. Each student upon admission meets with the content-area specialist in the field in which that student seeks secondary certification. The content-area specialist, who is a faculty member in the College of Arts and Sciences, reviews the student’s transcripts and compares that student’s coursework with the content-area guide sheet approved by the Pennsylvania Department of Education (PDE). Following this audit, the content-area specialist will identify what additional coursework in the content-area is needed, if any. The student is responsible for completing this coursework prior to applying for secondary certification. The credits for this course work are not included in the M.Ed. degree.

Students in the secondary teacher-preparation program are expected to have completed almost all their content area coursework prior to going out to student teach. This is important because student teachers need to have mastery of their content in order to fulfill their responsibilities to their students and to derive maximum benefit from the student teaching experience.

Distribution of coursework across undergraduate and graduate study:

Sophomore Year (3 credit hours)
Junior Year (6 credit hours)
Senior Year (6 credit hours)
College of Education - Summer (6 credits)
College of Education - Fall (9 credits)
College of Education - Spring (3 credits)

Students in this program unable to accrue enough credits outside their undergraduate degree programs may need to take additional credits after beginning graduate study in order to reach the 33-credit minimum. Students in this program who wish to obtain the Master of Arts (M.A.) degree rather than the M.Ed. degree may petition to change to that degree after admission to graduate study. The M.A. degree requires 42 credits instead of 33 credits and has specific content-area expertise requirements. See the M.A. degree description for its requirements.

**Master of Arts in Teaching and Learning**

The 30-credit master’s in Teaching and Learning degree program comprises a 15-credit core (5 courses) and 15 credits of electives. The goal of the post-certification master’s in Teaching and Learning is to provide professionally oriented practicing classroom teachers...
an in-depth understanding of classroom learning environments and experience in classroom-based research methods. These classroom
teachers will enhance their pedagogical knowledge and skills, the design
of classroom learning environments, and develop innovative curricula
and learning activities. For the Master of Arts degree, 12 credits of
content-area courses must be taken outside the College of Education.

Core Coursework (15 credits)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDUC 403</td>
<td>Research 3</td>
</tr>
<tr>
<td>EDUC 471</td>
<td>Diversity and Multicultural Perspectives 3</td>
</tr>
<tr>
<td>TLT 401</td>
<td>Overview of Teaching and Learning 3</td>
</tr>
<tr>
<td>TLT 403</td>
<td>Instructional Design 3</td>
</tr>
<tr>
<td>TLT 480</td>
<td>Curriculum Theory and Design 3</td>
</tr>
</tbody>
</table>

Electives: Teaching Field Content (15 credits)

For the M.A.: Must include 12 credits of content-area courses taken
outside the College of Education (300 level and above).

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDUC 419</td>
<td>Second Language Acquisition (SLA) Theory 3</td>
</tr>
<tr>
<td>EDUC 421</td>
<td>Intercultural Communication 3</td>
</tr>
<tr>
<td>EDUC 422</td>
<td>Theory and Practice for Second Language Learning 3</td>
</tr>
<tr>
<td>EDUC 423</td>
<td>Second Language Assessment 3</td>
</tr>
<tr>
<td>TLT 367</td>
<td>Environmental Education 3</td>
</tr>
<tr>
<td>TLT 368</td>
<td>Teaching and Learning with Geospatial Tools 3</td>
</tr>
<tr>
<td>TLT 494</td>
<td>Culminating Research Project 3</td>
</tr>
<tr>
<td>Other electives as approved by advisor</td>
<td>0-3</td>
</tr>
</tbody>
</table>

Master of Education in Teaching and Learning

The 30-credit master’s in Teaching and Learning degree program
comprises a 15-credit core (5 courses) and 15 credits of electives.

The goal of the post-certification master’s in Teaching and Learning
is to provide professionally oriented practicing classroom teachers
an in-depth understanding of classroom learning environments and experience in classroom-based research methods. These classroom
teachers will enhance their pedagogical knowledge and skills, the design
of classroom learning environments, and develop innovative curricula
and learning activities.

Core Coursework (15 credits)

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<td>TLT 480</td>
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</tr>
</tbody>
</table>

Electives (15 credits, select courses from the tracks below)

Track 1: Technology in School Settings

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT 458</td>
<td>Introduction to Multimedia Programming and Resource Development for Learning 3</td>
</tr>
<tr>
<td>TLT 460</td>
<td>Advanced Multimedia Programming and Resource Development for Learning 3</td>
</tr>
<tr>
<td>TLT 462</td>
<td>Special Topics in Development of Instructional Resources and Technologies for Learning 1-3</td>
</tr>
<tr>
<td>TLT 470</td>
<td>Technology for Teaching and Learning 3</td>
</tr>
<tr>
<td>TLT 476</td>
<td>Assessment of Instructional Technologies 3</td>
</tr>
</tbody>
</table>

Other electives as approved by advisor | 0-3 |

Track 2: Globalization in Education

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIE 400</td>
<td>Comparative and International Education 3</td>
</tr>
<tr>
<td>CIE 401</td>
<td>Globalization &amp; Contextualization 3</td>
</tr>
<tr>
<td>CIE 403</td>
<td>Globalization and Curriculum Implications 3</td>
</tr>
<tr>
<td>CIE 404</td>
<td>Issues and Institutions in International Educational Development 3</td>
</tr>
<tr>
<td>CIE 405</td>
<td>Experiencing the United Nations: Gender and Education in International Development 3</td>
</tr>
<tr>
<td>CIE 406</td>
<td>International Education Policy 3</td>
</tr>
<tr>
<td>CIE 407</td>
<td>Grant Writing and Fund Raising in International Education Development 3</td>
</tr>
<tr>
<td>CIE 414</td>
<td>Globalization and Post-Colonialism in Education 3</td>
</tr>
<tr>
<td>CIE 471</td>
<td>Globalization and Education Equity 3</td>
</tr>
<tr>
<td>Other electives as approved by advisor</td>
<td>0-3</td>
</tr>
</tbody>
</table>

Track 3: Teaching Field Content

<table>
<thead>
<tr>
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<tr>
<td>TLT 368</td>
<td>Teaching and Learning with Geospatial Tools 3</td>
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<tr>
<td>TLT 494</td>
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</tr>
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<td>Other electives as approved by advisor</td>
<td>0-3</td>
</tr>
</tbody>
</table>

Master of Science in Instructional Technology

A thirty-credit masters degree offered through the Teaching, Learning,
and Technology program. The program is aimed at those interested
in the use of technology in education, particularly preK-12 and post secondary settings.

The 30-credit Master of Science in Instructional Technology program focuses on the planning and use of instructional technology in preK-12 and post secondary settings and non-formal learning environments (such as museums and science centers). The program is targeted toward individuals from varied backgrounds who wish to help educators or learn themselves to design, develop, and incorporate technology applications more effectively in diverse educational settings including preK-12, post secondary education, and informal learning environments. This is an appropriate degree for those who teach in the classroom and online, technology specialists, informal educators, and others interested in effectively using information and communications technologies to enhance instruction.

The program is designed to help develop skills that can be used to create new curriculum and learning activities to meet the demands of a changing technological society and the needs of new generations of students. As such, graduates may be designing online courses, enhance existing curriculum with emerging technologies, or may work as technology specialists, assisting with the integration of technology in academic and informal learning environments. The Instructional Technology graduate program is intended for both current professionals in the education field as well as those who are seeking an advanced degree to upgrade their skills and knowledge base related to technology.

Other electives as approved by advisor | 0-3 |

Track: Core Requirements (3 credits)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDUC 471</td>
<td>Diversity and Multicultural Perspectives 3</td>
</tr>
</tbody>
</table>

Program Core Requirements (15 credits)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT 401</td>
<td>Overview of Teaching and Learning 3</td>
</tr>
</tbody>
</table>
The doctorate in Teaching, Learning, and Technology (TLT) is a 48-credit, post-graduate program. The TLT Ph.D. program employs a scientist/practitioner model of learning. That is, research is not separate from application or practice. Our doctoral students collaborate closely with faculty to generate new theories and classification systems, innovative curricula, technology-integrated learning environments, and a wide range of creative methods of teaching and learning in a global world highly interconnected by technology.

In keeping with the scientist/practitioner model, our doctoral students learn through innovative approaches, including research-based strategies for curriculum delivery, synchronous and asynchronous environments, and a wide range of other technology-enhanced designs and approaches for learning. Students take about 42 credits of coursework in addition to their qualifying examination preparation, coursework, college teaching, grant writing, and the like (i.e., 30 or more credits completed, including 12 credits in Foundations, 3 credits in Research, and 15 credits from other courses listed and/or directed research) but are unable to progress through the culminating research projects of a doctoral degree. There is no thesis requirement for this master of science; it is a coursework-only masters. Awarding of such degree shall depend upon the student meeting all relevant university and College of Education requirements for master's degrees.

**Master of Science in Teaching, Learning, and Technology**

The master of science in Teaching, Learning, and Technology is a 30-credit master's program. The TLT M.S. is available to students who are NOT completing their doctoral degree. This MS is provided solely for those students who have completed the core coursework (i.e., 30 or more credits completed, including 12 credits in Foundations, 3 credits in Research, and 15 credits from other courses listed and/or directed research) but are unable to progress through the culminating research projects of a doctoral degree. There is no thesis requirement for this master of science; it is a coursework-only masters. Awarding of such degree shall depend upon the student meeting all relevant university and College of Education requirements for master's degrees.

**Doctor of Philosophy in Teaching, Learning, and Technology**

A 48-credit, post-doctoral degree offered through the Teaching, Learning, and Technology program.

In keeping with the scientist/practitioner model, our doctoral students learn through innovative approaches, including research-based strategies for curriculum delivery, synchronous and asynchronous environments, and a wide range of other technology-enhanced designs and approaches for learning. Students take about 42 credits of coursework in addition to their qualifying examination preparation, doctoral research project, and dissertation project. Coursework is individualized according to the concentration students decide to pursue. Also, many of the course assignments are project-based, which will allow students to apply concepts they are learning to their particular area of interest. In addition, the choice of research topic and projects is also up to the student -- in consultation with his/her faculty adviser and within the broader context of the field, of course.

**Foundations (12 credits)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDUC 471</td>
<td>Diversity and Multicultural Perspectives</td>
<td>3</td>
</tr>
<tr>
<td>TLT 401</td>
<td>Overview of Teaching and Learning</td>
<td>3</td>
</tr>
<tr>
<td>TLT 402</td>
<td>Critical Reading and Writing</td>
<td>3</td>
</tr>
</tbody>
</table>

**Research (12 credits)**

**Required:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDUC 403</td>
<td>Research</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 408</td>
<td>Introduction to Statistics</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 409</td>
<td>Analysis of Experimental Data</td>
<td>3</td>
</tr>
</tbody>
</table>

**Electives (select at least one):**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDUC 405</td>
<td>Qualitative Research Methods</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 410</td>
<td>Univariate Statistical Models</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 411</td>
<td>Multivariate Statistical Models</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 412</td>
<td>Advanced Applications of Psychometric Principles</td>
<td>3</td>
</tr>
</tbody>
</table>

**Other statistical research course in TLT, COE, or A&S as approved by adviser.**

**Professional Cognate (12 credits)**

**Required:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT 480</td>
<td>Curriculum Theory and Design</td>
<td>3</td>
</tr>
</tbody>
</table>

**Electives:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDUC 491</td>
<td>Advanced Seminars: (with subtitle)</td>
<td>1-6</td>
</tr>
<tr>
<td>EDUC 493</td>
<td>Internship: (with subtitle)</td>
<td>1-6</td>
</tr>
<tr>
<td>EDUC 496</td>
<td>Doctoral Research Seminar</td>
<td>3</td>
</tr>
</tbody>
</table>

**Professional Sub-Specialty (6 credits)**

These credits are intended to advance the students’ research agenda or career goals (such as a enhanced subject matter knowledge, mentored field/practical experiences with outreach programs, specialized coursework, college teaching, grant writing, and the like) with adviser approval.

**Courses**

**TLT 367 (ES 367) Environmental Education 3 Credits**

Introductory environmental education course designed to prepare students to implement environmental education opportunities in formal and non-formal education settings. Topics include history and philosophy of environmental education, environmental laws and regulations, GIS, environmental issues and decision making, curriculum integration and environmental education teaching methodologies. This is a Web enhanced containing both online and fieldwork components.
TLT 368 (ES 368) Teaching and Learning with Geospatial Tools 3 Credits
Exploration of geospatial tools, including but not limited to global positioning systems (GPS), geographic information systems (GIS), and related visualization tools (e.g. Google Earth). Application of these tools and techniques to instructional settings, including appropriate pedagogy and assessment.

TLT 380 Child Development and Cognition 3 Credits
Introduction to physical, motor, perceptual, cognitive, language, emotional, social, and gender development of young children and adolescents. Developmental history, theories, and research, as well as the effect of culture, family, peers, media, and schooling on the individual and groups. Students investigate typical and atypical development and explore the implications of individual differences for teaching and learning, with an emphasis on evidence-based instructional practices designed to optimize the growth and development of all learners. Explores mental health issues and at-risk students.

TLT 391 Workshops 1-3 Credits
Cooperative study of current educational problems. Provides elementary, secondary, and special education teachers an opportunity to work at their own teaching levels and in their own fields. Limited to six credits during a summer session but the student may register for more than one workshop provided there is no duplication in subject matter.

Repeat Status: Course may be repeated.

TLT 394 Special Topics in Education: 1-3 Credits
Examination of a topic of research or professional interest in education. Subtitle will vary. May be repeated for credit as subtitle varies.

Repeat Status: Course may be repeated.

TLT 401 Overview of Teaching and Learning 3 Credits
Foundations and key concepts in learning and instructional theory. Cognition and brain-based research with a focus on innovations in teaching and learning.

TLT 402 Critical Reading and Writing 3 Credits
Using literature to build persuasive written arguments. Searching and identifying promising sources, distilling research findings, synthesizing literature to support an argument, and organizing written materials to enhance persuasiveness. Suited to those writing qualifying projects, dissertation proposals, dissertations, funding proposals, conference proposals, and journal articles.

TLT 403 Instructional Design 3 Credits
Social, cognitive, and environmental factors in designing for teaching and learning. Systems theory applied to learning settings. Special emphasis on motivational theories and technological affordances.

Prerequisites: TLT 401

Can be taken Concurrently: TLT 401

TLT 404 (SPED 404) Diversity, Families, and School Collaborations in K-12 3 Credits
Cultural and linguistic diversity as critical variables in educational equity for all learners, including ELL. Explores home-school partnerships, family and professional collaboration, and teacher self-awareness. Implementing culturally sensitive and responsive classroom practices as well as forming collaborative relationships with families that respect diversity of family contexts. Collaborative, multidisciplinary teaming to support, optimize, and advocate for student’s educational needs and connect to community services and resources available to individuals and families. Addresses family mental health issues and wraparound services.

TLT 405 (SPED 405) Principles and Applications of K-12 Assessment 3 Credits
Assessment applied to learning in classroom learning environments, including universal screening and progress monitoring. Discusses assessment approaches, ways to implement assessment, and use of assessment tools to monitor all students, including ELL and students with disabilities. Use of data-management and grading systems. Addresses diagnostic assessments for student placement and analysis of assessment data to tailor instruction to diverse student needs. Emphasis on research-based practices of assessment to inform instructional decision-making consistent with the RtII framework.

TLT 407 Instructional Design for K-12 Classrooms 3 Credits
Introduces the systematic design of instruction following the Response to Instruction and Intervention (RtII) and Universal Design for Learning models. Explores theories of learning and instructional applications as a part of technology-based and standards-aligned classroom education grounded in the use of a quality, research-based core curriculum and effective instructional practices to meet the needs of all learners. Addresses appropriate use of instructional technologies for universal learning. Students will plan, design, and develop student-centered, standards-aligned, technology-supported instruction and appropriate learner assessments.

TLT 409 (SPED 409) K-12 Classroom Environment and Management 3 Credits
Designing inclusive classroom environments that maximize learning. Emphasis on fostering a community of learners using connections among classroom arrangement, classroom management, and cognitive development to create positive learning outcomes for all students, including ELL learners and students with disabilities. Addresses the tiered model of prevention and positive behavior support, including the role of functional assessment and individual positive behavior support plans in classroom management. Highlights the ways a positive climate for learning involves establishing and maintaining partnerships with families.

TLT 410 The Writing Process 3 Credits
Developmental characteristics of children’s writing and relationships among writing, spelling and reading. Predictors of writing achievement, teaching strategies and activities, and evaluation schemes will be emphasized, K-12.

TLT 411 (SPED 411) Early Childhood Education 3 Credits
Introduction to development of early childhood education in the U.S. Emphasizes evidence-based methods and materials to assist young children in the learning process, including arrangement of indoor/outdoor space, developmentally appropriate practices, and the design of instruction to foster young children’s emotional, social, language, cognitive, physical, and creative development. Includes embedded instruction and adaptations for students with identified disabilities, children at risk for developing disabilities, and children with culturally and linguistically diverse backgrounds, and family collaboration within the instructional planning process.

TLT 412 Social Studies in PreK through 4th Grade 3 Credits
Overview of Pennsylvania’s PreK-4 Standards for social studies, including: Pennsylvania history, United States history, economics, civics and government, citizenship, political science/government, and geography. Development, implementation and evidence-based assessment of preK-grade 4 social studies curricula. Effective teaching techniques such as lesson planning, inclusive practices, integrating instructional technologies into instruction, reflecting on teaching, and the latest research-based teaching and assessment methods. Emphasis on alignment of instruction with standards.

TLT 420 Reading and Literacy in PreK through 4th Grade 3 Credits
Methods of teaching reading and literacy in preK-4, including critical components of early literacy. Selection of appropriate materials, instructional strategies, techniques, and formative and summative assessments. Best practices in reading instruction in a standards-aligned curriculum, explicit strategies for teaching vocabulary and comprehension, and using evidence-based practices to teach reading to learners at all levels of proficiency. Helping learners make the transition from learning to read to reading to learn. Working with families and non-school support services to enhance reading development.

TLT 422 Language Arts in PreK through 4th Grade 3 Credits
Principles of language learning and the development of communication skills from preK-4. Implications of developmental differences and experiences in non-school settings on student readiness and skills. Helping parents support their children’s language skills development. Methods of teaching listening, speaking, and writing, including spelling, punctuation, grammar, and handwriting. Selection of appropriate standards-aligned materials, textbooks, assessments, and evidence-based approaches to teach the language arts to learners from a variety of backgrounds and across a range of abilities.
TLT 424 Children’s Literature in Elementary Education 3 Credits
Role of literature in the instructional program of the elementary schools.
Use of trade books for individualized instruction in reading, language arts, mathematics, science, and social studies.

TLT 426 Science in PreK through 4th Grade 3 Credits
Overview of inquiry-based activities and investigations to promote science learning in PreK-grade 4 classrooms. Emphasis on Pennsylvania’s PreK-4 Standards for Science and Technology and Environment and Ecology standards and aligning instruction with standards. Activities include planning effective lessons, trying out new methods of teaching, reflective practice, instructional methods, and integrating instructional technologies into science learning. Evidence-based assessment types are highlighted within instructional contexts.

TLT 428 Mathematics and Numeracy in PreK through 4th Grade 3 Credits
Trends, theories, activities and manipulative materials for teaching early numeracy and elementary mathematics. Pre-school development and in-school skills and concepts, including sets, systems of numeration, experience with numbers, number operations and concepts, numerals, measurement, early algebra, and elements of geometry. Implications of developmental differences and early non-school experiences on learner readiness and skills. Helping parents support their children’s mathematics conceptual development. Research-based practices and inclusionary approaches to teach mathematics to learners from a variety of backgrounds and across ability levels.

TLT 431 Social Studies in Middle Level and High School Education 3 Credits
Middle and high school curriculum, content, teaching strategies, and instructional materials for the social studies. Emphasis on organizing content, using appropriate methods, testing and evaluation, and appropriate integration of technology. Overview of Pennsylvania’s 4-8 and 8-12 standards for social studies and related standards from the National Council for the Social Studies and other national organizations. Explores relevant research, courses of study, textbooks, and teacher-made materials. Addresses inclusive evidence-based and standards-aligned instructional approaches and techniques, including co-teaching.

TLT 432 Reading and Critical Thinking in Middle Level and High School Education 3 Credits
Development of reading in the secondary content areas (English/language arts, mathematics, science, social studies). Highlights effective teaching strategies in critical areas, such as higher order reading and study skills. Addresses analysis of evidence based methods and current research for improving the reading development and analytical skills of all students.

TLT 434 English in Middle Level and High School Education 3 Credits
Curricula, philosophy, methods, strategies, and materials for the teaching of middle and high school English. Literature, genres, and the nature of text and text differences. Critical analysis and drawing inferences from narrative text and poetry. Techniques for teaching and enhancing writing various styles. Applications of technology and assessment principles. Addresses inclusive evidence-based and standards-aligned instructional approaches and techniques, including co-teaching.

TLT 436 Science in Middle Level and High School Education 3 Credits
Overview of inquiry-based activities and investigations to promote science learning in secondary science classrooms. Emphasis on aligning instruction with Pennsylvania’s Standards for Science and Technology and Environment and Ecology standards. Activities include planning effective lessons, trying out new methods of teaching, inclusionary methods, reflective practice, and integrating instructional technologies into science learning. Evidence-based assessment types highlighted within instructional contexts.

TLT 438 Mathematics in Middle Level and High School Education 3 Credits
Standards-based and technology-intensive curricula, instructional activities, and manipulative aids for mathematics in middle level and high schools. This course models and explores an investigative and hands-on approach to secondary mathematics instruction. Particular attention given to learning theories, curriculum issues, and recommendations arising from state, national, and international assessments. Research-based practices and inclusionary approaches to teach mathematics to learners from a variety of backgrounds and across a range of abilities. Addresses standards-aligned instructional approaches and techniques, including co-teaching.

TLT 440 Pre-professional Seminar 3 Credits
Study, directed observation of, and initial practice in the various phases of teaching in secondary schools. Guided opportunities to try out strategies to facilitate the inclusion of special education students, differentiated instructional practices, and standards-aligned and evidence-based instructional approaches in actual school settings. Consent of program coordinator required.

TLT 442 (SPED 442) General Education and Special Education Student Teaching and Seminar 1-6 Credits
Intensive practice in the application of principles of teaching for both general and special education settings in a supervised internship in the schools (for dual certification). Regular meetings among student teachers for critical analysis and discussion of classroom instructional practices, as illustrated by the student teachers’ experiences in the schools. Practical mentoring on professionalism, applying differentiated instructional models in real-world setting, and aligning instruction with standards. Consent of program director required.

TLT 444 General Education Student Teaching and Seminar 1-6 Credits
Intensive practice in the application of principles of teaching for general education settings in a supervised internship in the schools. Regular meetings among student teachers for critical analysis and discussion of classroom instructional practices, as illustrated by the student teachers’ experiences in the schools. Practical mentoring on professionalism, applying differentiated instructional models in real-world setting, and aligning instruction with standards. Consent of program director required.

TLT 454 Applied Instructional and Interface Design Principles 3 Credits
Exploration and application of design models for learning. Special emphasis on the application of perception theory, communication theory, and learning theory to the design of media for teaching and learning.

Prerequisites: TLT 403

TLT 456 Instructional Design and Development Studio 3 Credits
Studio-based, authentic and collaborative design experiences led by a faculty mentor. Students work in teams to complete substantial multimedia design and development projects.

Prerequisites: TLT 454 and TLT 460

TLT 458 Introduction to Multimedia Programming and Resource Development for Learning 3 Credits
Introduction to programming and resource development tools used in the creation of interactive multimedia teaching and learning materials.

TLT 460 Advanced Multimedia Programming and Resource Development for Learning 3 Credits
Advanced exploration of programming and resource development tools used in the creation of interactive teaching and learning materials.

Prerequisites: TLT 456

TLT 462 Special Topics in Development of Instructional Resources and Technologies for Learning 1-3 Credits
We know the use of technology in education will continue to increase. This course extrapolates current research to envision the innovations we can expect in a planning horizon of 2 to 5 years. We will study schools and systems that use emerging technologies today that could be widely adopted tomorrow. The course focuses equally on technology and pedagogy.

Repeat Status: Course may be repeated.
The technical entrepreneurship program (TE) helps students develop the entrepreneurial mindset needed to create, refine and commercialize new products and services, whether in an established company or a start-up. Students enrolled in TE courses learn by experiencing the idea-to-venture process in an education environment that is hard-wired to support the development of novel, innovative, and commercially-robust technologies. The TE programs are based on our 20 years of experience with Lehigh’s award-winning Integrated Product Development (IPD) program. In 2012 IPD was recognized by the National Academy of Engineering for providing real-world entrepreneurial experiences to our students. In 2015 the IPD named courses were replaced by TE 211 and TE 212.

**TE Undergraduate Program**

At the undergraduate level the technical entrepreneurship program offers introductory skill building courses, such as TE 250: Creativity Methods, and TE 304: Software Ventures, as well as capstone projects courses such as TE 211/212: Capstone Design Projects I/II. While the capstone projects courses satisfy ABET requirement for many engineering majors, TE 211/212 are open to all junior level students from any undergraduate major.

**UNDERGRADUATE TE COURSES**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tr>
<td>TE 211</td>
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<td>Capstone Design Projects-1</td>
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<tr>
<td>TE 212</td>
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<td>Capstone Design Projects-2</td>
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<td>TE/ENTP 250</td>
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<tr>
<td>Systematic Creativity Techniques</td>
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<tr>
<td>TE/ENTP 304</td>
<td>3</td>
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<tr>
<td>Software Ventures</td>
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**Graduate TE Program: See Masters of Engineering in Technical Entrepreneurship**

**Courses**

**TE 211 Capstone Design Projects-1 3 Credits**

Students work in cross disciplinary teams on conceptual design projects with realistic constraints including marketing, financial and economic planning, and economic and technical feasibility including industrial, business and engineering standards for new products. Teams typically work on projects from industry or entrepreneurial start-ups. Oral presentations and written reports.

**Prerequisites:** TE 211

**Attribute/Distribution:** ND

**TE 250 (ENTP 250) Systematic Creativity Techniques 3 Credits**

ENTP 250/TE 250 -- Systematic creativity methods including anthropological research, painstorming, bisociation, the Kano model, trimming technique, DeBono’s Six Hats technique, biomimicry, lateral benchmarking, Blue Ocean Strategy, & the art of tinkering, along with other innovation methods. This course includes hands-on labs, individual & team projects, & the creation of a creativity portfolio. Open to students in any college and major. (ND).

**Attribute/Distribution:** ND

**TE 301 Creativity and Systematic Innovation Methods 3 Credits**

Creativity methods, anthropological research, painstorming, bisociation, the Kano model, axiomatic design, the trimming technique, parameter analysis, decomposition, nonlinear design, Taguchi’s method, DeBono’s Six Hats technique, biomimicry, TRIZ, lateral benchmarking, Blue Ocean Strategy, the art of tinkering and other innovation methods. Hands-on labs, individual and team projects.

**TE 302 Methods in Visual Thinking 2 Credits**

Visualisation techniques, visual thinking and envisioning information as taught by Edward Tufte and others, multimedia tools and methods. Appropriate use of technology as applied to new product development, no programming required.

**TE 303 Methods in Prototyping, Modeling and Testing 2 Credits**

Generation of mock-ups and looks-like prototypes, electro-mechanical-optical bread-boards design, fabricate, build and test multiple generations of prototypes, computer modeling methods, shop methods, testing, sensors and data collection.
TE 304 (CSB 304, ENTP 304) Software Ventures 3 Credits
Designed from the perspective of a functional leader, this course provides students with a holistic perspective of developing a successful software venture in an interdisciplinary and experiential environment. Students will develop a software-oriented idea concurrent with module delivery that will contain best practices, case studies, and subject matter experts. Examination will include business model fundamentals, customer discovery, translating requirements to a minimum viable product, agile development, user acquisition, and traction. Prior programming experience preferred, but not required. Open to any major.
Prerequisites: ENGR 010 or CSE 002 or BIS 111

TE 401 Integrated Product Development (IPD) Process-1 3 Credits
An integrated and interdisciplinary approach to engineering design, concurrent engineering design, decision making, risk, cost, material and manufacturing process selection, platform and modular design, mass customization, quality, planning and scheduling, business issues, teamwork, group dynamics, creativity and innovation. Case studies and semester-long team projects.
Prerequisites: TE 301 and TE 407

TE 402 Integrated Product Development (IPD) Process-2 3 Credits
Continuation of TE 401, the parallel development of the product, the development of the marketing and manufacturing system, manufacturing and marketing launch, sales, service and customer support. Case studies and semester-long team projects.
Prerequisites: TE 401

TE 403 Entrepreneurial Startup Process-1 3 Credits
Key aspects surrounding company startups, including feasibility analysis, business model development and evaluation, formation of new venture teams, financial forecasts, sources of financing, Readings, financial templates, live case studies and guest entrepreneurs.
Prerequisites: TE 301 and TE 407

TE 404 Entrepreneurial Startup Process-2 3 Credits
Continuation of TE 403, integration of key business components to form and launch your venture: industry analysis, marketing plan and sales strategy, mobilization of the new venture team; operations, including space, legal and insurance consideration; and financial management. Selected topics related to respective venture types (i.e. social entrepreneurship, family business, franchising, immigrant entrepreneurs). Lectures, workshops and guest entrepreneurs.
Prerequisites: TE 403

TE 405 Entrepreneurial Startup Projects-1 2 Credits
Applying the concepts and processes developed in TE 403. Developing your business platform including business model, start-up team, and financial plan to launch and grow your venture.
Prerequisites: TE 403 and TE 302 and TE 303

TE 406 Entrepreneurial Startup Projects-2 3 Credits
Applying the concepts off entrepreneurial startup process, building upon the business model, entrepreneurial team and financing plan developed in TE 405. Developing a comprehensive business plan and investor’s pitch, finalize the steps necessary to launch the company and start operations.
Prerequisites: TE 404 and TE 405

TE 407 Intellectual Property (IP) Creation and Management 2 Credits
Intellectual property issues: confidentiality, nondisclosure, agreement not to compete, founders agreements, patents, copyrights, trademarks, trade secrets both domestic and international.
Prerequisites: TE 302 and TE 303 and TE 403

TE 461 Integrated Product Development (IPD) Projects-1 2 Credits
Technical and economic feasibility study of new products. Selection and content of the project is determined by the faculty project adviser in consultation with the student, progress and final reports, oral and posters presentations. Consent of the program director and faculty project adviser required.
Prerequisites: TE 401 and TE 302 and TE 303

TE 462 Integrated Product Development (IPD) Projects-2 2 Credits
Detailed design specification, fabrication, building and testing prototype new products and plan for production, selection and content of the project is determined by the faculty project advisor in consultation with individual students or student teams. Progress and final reports, oral and poster presentations. Consent of program director and faculty project advisor required.
Prerequisites: TE 461 and TE 402

Theatre

To study theatre is to examine its many internal disciplines. Acting and directing combine with design, technical theatre, dramatic literature and theatre history to form the body of our art. Students may pursue general theatre studies or focus on particular areas such as performance, design or history and literature. They may major in theatre, minor in theatre or participate strictly in our production program. Students may even complete a minor in theatre from outside the College of Arts and Sciences.

The bachelor of arts degree in theatre is granted after at least 48 credit hours of study. Because we believe that undergraduate theatre education should be broad based with an emphasis on diversity of experience, students are encouraged to take a variety of courses outside the major. Many students complete double majors. Those with the talents and aspirations for a career in theatre have gone to graduate schools offering intense, pre-professional training. Other majors who have not pursued a theatrical career have gone from our program directly into careers in business, social services, sales. Theatre study is an excellent preparation for vocations in which self presentation is important, such as law. The problem solving, analytical and interpersonal skills gained from this discipline are applicable across a wide range of careers. An understanding and appreciation of the complex art of the theatre will enrich a lifetime.

The department’s active production program is curricular and promotes collaborative projects involving students, faculty, staff and guest artists. Our large performance facility is the Diamond Theater, a 300-seat thrust theatre housed in the Zoellner Arts Center. The core of our work in this space is dedicated to productions featuring primarily student actors directed by faculty or guest artists. When possible, a highly qualified student may direct or design in this space. In addition to our own productions, we regularly invite outside professional performers and ensembles to work with us and perform. We also operate a lab theatre (Fowler Black Box Theater) for student and faculty experimentation. The availability of valuable hands-on experience and the very close working relationships developed between students and faculty uniquely characterize the department of theatre. The department enjoys a special relationship with Bethlehem’s professional theatre company, Touchstone Theatre. Performance and administrative internships with the company are available to qualified students and the department and Touchstone often collaborate on workshops and seminars.

Students interested in designing a major or minor in theatre should consult with the department chairperson. Experienced theatre students with questions regarding accurate placement in any theatre course should, likewise, consult with the chairperson.

Lehigh University is an accredited institution of the National Association of Schools of Theatre.

Professors. Erica Hoelscher, MFA (Northwestern University); Pam Pepper, MFA (Ohio University); Augustine Ripa, Jr., MFA (Northwestern University)

Associate Professor. Kashi K. Johnson, MFA (University of Pittsburgh)

Assistant Professors. Melpomene Katakalo, MFA (University of California San Diego); William Lowry, MFA (University of North Carolina Greensboro); Darius Williams, PhD (Ohio State University)

Emeritus. Jeffrey R. Milet, MFA (Yale University)

THEATRE MAJOR

Through the selection of appropriate electives, students may concentrate their major in one of these areas:

• Acting/Directing
• Design/Technical Theatre
The major in theatre consists of 48 hours distributed as follows:

**Coursework required of all majors, 24 hrs:**

- **THTR 060** Dramatic Action, 4 Credits
- **THTR 087** Design for the Theatre, 4 Credits
- **THTR 127** The Development of Theatre and Drama I, 4 Credits
- **THTR 128** The Development of Theatre and Drama II, 4 Credits
- Thtr Acting (any appropriate level), 4 Credits

AND

- Two courses from the following:
  - **THTR 020** Stagecraft I, 2 Credits
  - **THTR 025** Costume Construction I, 2 Credits
  - **THTR 027** Lighting Technology and Production I, 2 Credits

**Production Requirement, 8 hrs**

Four courses from the following:

- **THTR 021** Stagecraft II, 2 Credits
- **THTR 022** Stage Properties and Decoration, 2 Credits
- **THTR 023** Basic Scene Painting, 2 Credits
- **THTR 026** Costume Construction II, 2 Credits
- **THTR 028** Lighting Technology and Production II, 2 Credits
- **THTR 030** Sound Technology and Production I, 2 Credits
- **THTR 031** Sound Technology and Production II, 2 Credits
- **THTR 035** Performance, 2 Credits
- **THTR 045** Stage Management, 2 Credits
- **THTR 067** Stage Crew, 2 Credits
- **THTR 068** Costume Crew, 2 Credits
- **THTR 069** Lighting Crew, 2 Credits
- **THTR 175** Special Projects, 2 Credits

Advanced courses may be substituted.

**Electives, 16 hrs.**

Four courses carefully selected with an advisor, emphasizing depth or breadth of study.

**Recommended electives from other departments**

The departments of art and architecture, English, modern languages and literature, music and others all offer courses of value to a theatre major or minor. Consult with your advisor about enriching your academic career outside the theatre department.

**THEATRE MINOR**

The minor in theatre consists of at least 22 hours of course work selected in consultation with a departmental advisor. This includes at least five 3-4 credit courses, (18-20 hours) and two semesters in theatre productions totaling at least 4 credits. The minor in theatre must include some academic diversity beyond a single curricular area.

**DEPARTMENTAL HONORS**

The exceptional student may elect to pursue departmental honors in the senior year. This student must have a GPA of 3.3 in all theatre courses presented for the major. No later than the fall of the senior year the student, with faculty supervision, elects a special project in a particular area of theatre. This may take the form of preparing to direct a play, researching a role to be performed, preparing a design presentation or researching in an area of theatre scholarship in preparation for the writing of a substantial report. In the next semester, usually the spring of the senior year, the report or project would be executed. The student would enroll in two, four-credit independent study courses, one each senior semester.

**THE ACTING SEQUENCE**

Students with little or no prior acting experience should elect **THTR 011**, Introduction to Acting, as their first course. Students with some prior acting experience should consult with the department chairperson for accurate placement and waiver of the THTR 011 prerequisite.

**Courses**

- **THTR 001** Introduction To Theatre 4 Credits
  - Foundations of theatre: historical, literary and practical.
  - **Attribute/Distribution:** HU

- **THTR 011** Introduction To Acting 4 Credits
  - Preparation for scene study and characterization.
  - **Attribute/Distribution:** HU

- **THTR 020** Stagecraft I 2 Credits
  - Introduction to the art of scenic construction and technical theatre. Scenic construction materials, techniques, tools, rigging and safety. Practical experience in executing scenery for the stage.
  - **Attribute/Distribution:** HU

- **THTR 021** Stagecraft II 2 Credits
  - A continuation of **THTR 20** – Stagecraft I. Specialty tools, materials, methods and problem-solving. Practical experience in executing scenery for the stage.
  - **Prerequisites:** THTR 020
  - **Attribute/Distribution:** HU

- **THTR 022** Stage Properties and Decoration 2 Credits
  - Creating props and decor for the stage. Production assignment as assistant property master.
  - **Attribute/Distribution:** HU

- **THTR 023** Basic Scene Painting 2 Credits
  - Painting for the stage. Production assignments painting with scenic artist.
  - **Attribute/Distribution:** HU

- **THTR 025** Costume Construction I 2 Credits
  - Introduction to the art of costume construction. Costume construction materials, techniques, tools and safety. Practical experience in executing costumes for the stage.
  - **Attribute/Distribution:** HU

- **THTR 026** Costume Construction II 2 Credits
  - Continuation of **THTR 25** - Costume Construction I, including pattern drafting, fitting, crafts and accessories. Materials, methods and problem solving. Practical experience in executing costumes for the stage.
  - **Prerequisites:** THTR 025
  - **Attribute/Distribution:** HU

- **THTR 027** Lighting Technology and Production I 2 Credits
  - Introduction to the art of lighting technology and production. Lighting techniques, tools and safety. Practical experience in executing lighting for the stage.
  - **Attribute/Distribution:** HU

- **THTR 028** Lighting Technology and Production II 2 Credits
  - Specialty equipment, methods and problem solving. Practical experience in programming the lighting console for production. Assignment as light board operator on a production.
  - **Attribute/Distribution:** HU

- **THTR 030** Sound Technology and Production I 0,2 Credits
  - Introduction to the art and technology of sound reinforcement. Audio theory, methods and practice. Practical experience in executing audio technical support for the stage.
  - **Attribute/Distribution:** HU

- **THTR 031** Sound Technology and Production II 0,2 Credits
  - Advanced techniques of sound technology and production. Speciality equipment, methods and problem solving. Practical experience in systems engineering, design implementation and trouble shooting. Assignment as sound engineer on production.
  - **Prerequisites:** THTR 030
  - **Attribute/Distribution:** HU

- **THTR 035** Performance 2 Credits
  - Performing in a department-approved production.
  - **Repeat Status:** Course may be repeated.
  - **Attribute/Distribution:** HU

- **THTR 045** Stage Management 2 Credits
  - Organization, scheduling, coordination of various production specialties. Production assignment as assistant stage manager.
  - **Attribute/Distribution:** HU
THTR 054 (CLSS 054, ENGL 054) Greek Tragedy 4 Credits
Aspects of Greek theater and plays of Aeschylus, Sophocles, and Euripides in their social and intellectual contexts.
Attribute/Distribution: HU

THTR 056 Jazz Dance 2 Credits
Jazz dance styles and combinations. Fee required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

THTR 057 Modern Dance 2 Credits
Modern dance styles and combinations. Fee required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

THTR 058 (CLSS 058, ENGL 058) Greek and Roman Comedy 4 Credits
Study of comedy as a social form through plays of Aristophanes, Menander, Plautus, and Terence.
Attribute/Distribution: HU

THTR 059 (AAS 059) West African Dance 2 Credits
This course will explore the dance movement and rhythms of West Africa. Students will learn African-based dance technique, characteristics, and the fundamental connection between the drums and the dance. Although some videos will be viewed, this is primarily a studio course; students should come prepared to move.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

THTR 060 (ENGL 060) Dramatic Action 4 Credits
How plays are put together; how they work and what they accomplish. Examination of how plot, character, aural and visual elements of production combine to form a unified work across genre, styles and periods. Recommended as a foundation for further studies in design, literature, or performance.
Attribute/Distribution: HU

THTR 062 (AAS 062) Black Theatre 4 Credits
Attribute/Distribution: HU

THTR 065 Introduction to Playwriting 4 Credits
An introduction to writing for the stage, with an emphasis on creating characters, maintaining tone, shaping metaphor, and using the resources available to theatre artists to a writer's best advantage. This course combines in-class exercises with seminar-style discussion of the student's work.
Attribute/Distribution: HU

THTR 066 (AAS 066) Hip Hop Dance 2 Credits
Techniques, vocabulary, and history behind the various elements of the Hip Hop Movement. Focus upon the cultural influence of Hip Hop dance styles, and the overall social influence of the Hip Hop Movement.
Attribute/Distribution: HU

THTR 067 Stage Crew 2 Credits
Production run crew assignment.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

THTR 068 Costume Crew 0.2 Credits
Production run crew assignment in wardrobe, hair and makeup.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

THTR 069 Lighting Crew 2 Credits
Production run crew assignment as master electrician. Instructor permission required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

THTR 077 Ballet 2 Credits
Classical ballet for beginners and those who have had some training. Fee required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

THTR 087 Design for the Theatre 4 Credits
Introduction to the process of creating integrated designs in theatre production. The study and practice of the principles of visual representation, historical and conceptual research and the study of theatrical styles.
Attribute/Distribution: HU

THTR 111 (DES 111) Sound Design 2 Credits
Techniques, materials, and methods of designing sound for theatrical production.
Attribute/Distribution: HU

THTR 127 (ENGL 127) The Development of Theatre and Drama I: Rituals to Romantics 4 Credits
Survey of theatre and dramatic literature from ritual origins to the 18th century.
Attribute/Distribution: HU

THTR 128 (ENGL 128) The Development of Theatre and Drama II 4 Credits
Survey of theatre and dramatic literature from the 19th century to the present day.
Attribute/Distribution: HU

THTR 129 (DES 129, WGSS 129) History of Fashion and Style 4 Credits
Dress and culture in the Western Hemisphere from pre-history to today. The evolution of silhouette, garment forms and technology. The relationship of fashion to politics, art and behavior. Cultural and environmental influences on human adornment.
Attribute/Distribution: HU

THTR 130 Drafting For The Theatre 4 Credits
Theatre drafting techniques and conventions. Material, methods and theory in stage graphics. Model building techniques and practice. An introduction to computer drafting.
Attribute/Distribution: HU

THTR 132 (AAS 132) Hip Hop Theatre 4 Credits
Introduction to the creation and performance of Hip Hop theatre. Exploration of the history and culture of Hip Hop through original written material, live performance, music, film, video and web based content. Public performances. Must audition. Consent of instructor required.
Attribute/Distribution: HU

THTR 135 Playwriting II 4 Credits
For students interested in continuing and deepening their writing for the stage. Instructor approval required.
Attribute/Distribution: HU

THTR 140 (AAS 140) African American Theatre 4 Credits
Studies in African American theatre: literary, practical and historical.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

THTR 144 Directing 4 Credits
Introduction to the theatrical director's art. Research, rehearsal techniques, scene work. Acting experience as determined by the department or consent of chair.
Repeat Status: Course may be repeated.
Prerequisites: (THTR 060)
Attribute/Distribution: HU

THTR 145 Advanced Stage Management 1-4 Credits
Advanced application, practice, and leadership development of stage management role and skills: production assignment as stage manager.

THTR 147 Acting Modern Realism 4 Credits
Characterization and scene study in modern realistic drama e.g. Ibsen, Chekov, O’Neill, Hellman, Miller and Williams. Consent of instructor.
Prerequisites: THTR 011
Attribute/Distribution: HU

THTR 148 Acting Contemporary Drama 4 Credits
Characterization and scene study in modern contemporary drama. Consent of the instructor.
Prerequisites: THTR 011
Attribute/Distribution: HU
THTR 152 Stage Make-up 4 Credits
Theatrical make-up techniques for the actor and designer.
Attribute/Distribution: HU

THTR 154 (DES 154) Scene Painting 4 Credits
Study and practice of basic and advanced methods of painting for the theatre. Includes basic elements and principles of design, color theory, the influence of light, atmosphere and aesthetics for the theatre.
Attribute/Distribution: HU

THTR 155 (DES 155) Model Building and Rendering 4 Credits
The art and practice of model building and rendering for the stage. Special techniques including scale furniture, soldering, acrylic painting and hand drafting.

THTR 161 (ARCH 161) Performing Arts Venue Design and Technology 4 Credits
Designing theatres. Theatre equipment systems and acoustics. Function and form.
Attribute/Distribution: HU

THTR 166 (ENGL 166) The Playwright as Traveler 4 Credits
This class will read and analyze plays and critical essays to discern how playwrights navigate the tricky ethical and artistic enterprise that is travel. The material is challenging and will require students to utilize analytic tools culled from various disciplines including political economy, literary criticism, feminism and queer studies. We will focus on aesthetic devices that either foreground or obscure questions of politics, power, race, gender and class. Concepts such as ideology, orientalism, interpellation and hegemony will be covered.
Attribute/Distribution: HU

THTR 175 Special Projects 1-4 Credits
Theatrical topics of current or special interest.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

THTR 181 Theater Management 3 Credits
Concepts, techniques and practices related to managing the theatrical enterprise.
Attribute/Distribution: HU

THTR 185 Production Seminar 1-4 Credits
Practicum in various approaches to theatre production, e.g. performance ensemble. Must audition, or consent of the chairperson required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

THTR 186 (DES 186) Lighting Design 4 Credits
An introduction to the art and practice of lighting design for the theatre. Script analysis, research, and the interplay of lighting technology and design. Students will develop a sense of the dramatic while creating a portfolio of lighting designs.
Attribute/Distribution: HU

THTR 188 (DES 188) Scenic Design 4 Credits
An introduction to the art and practice of scenic design for the theatre. Script analysis, research, drafting and modeling techniques. Students will develop a sense of the dramatic while creating a portfolio of scenic designs.
Attribute/Distribution: HU

THTR 189 (DES 189) Costume Design 4 Credits
An introduction to the art and practice of costume design for the theatre. Script analysis, research, and rendering techniques. Students will develop a sense of the dramatic while creating a portfolio of costume designs.
Attribute/Distribution: HU

THTR 222 (ENGL 222) Readings in Non-Realism 4 Credits
Through close readings and analysis of a variety of non-realistic play scripts, this class catalogs what a grammar of non-realism might look like. Students will conduct close readings of non-realistic scripts that make use of the grammar available to the writer writing for the stage.
Attribute/Distribution: HU

THTR 236 Acting Presentational Styles 4 Credits
Elements of characterization and scene study in presentational dramatic literature from classical through post-modern periods. Must have completed 100-level acting course, or consent of chairperson required.
Prerequisites: THTR 147 or THTR 148
Attribute/Distribution: HU

THTR 244 Acting Shakespeare 4 Credits
Monologue scene study and ensemble work from Shakespeare’s dramatic and poetic canon. Must have completed a 100-level acting course or consent of chairperson required.
Attribute/Distribution: HU

THTR 245 Advanced Directing 4 Credits
Continuation of Theatre 144. The director’s voice. Supervised practical experience.
Prerequisites: (THTR 144)
Attribute/Distribution: HU

THTR 253 Scene Painting II 4 Credits
Applied advanced scene painting methods for the theatre. Shop management for the scenic artist. Collaboration with designers and stage technology.

THTR 255 (ENGL 255) The Collectively Devised Text 4 Credits
This class explores theater as a vehicle for civic engagement. Theater artists as varied as Moises Kaufman, the Civilians, Cornerstone, Culture Clash and Caryl Churchill have worked on scripts that were devised either in whole or in part collectively. Students will outline a plan for choosing a theme, identifying stakeholders, generating text and either writing or shepherding a full-length script to completion. Instructor approval required.
Attribute/Distribution: HU

THTR 260 Design Practicum 1-4 Credits
Scenic, costume, lighting or sound design for the theatre. Realized design production assignments and portfolio building. Collaboration, process and presentation. Consent of department required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

THTR 275 Internship 1-4 Credits
Professionally supervised work in theatres and theatrical organizations in the areas of performance, design, technical theatre, theatre administration and management. Consent of department chair required.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

THTR 300 Apprentice Teaching 1-4 Credits
Repeat Status: Course may be repeated.

THTR 315 Senior Study 0 Credits
Seminar for senior theatre majors. Enhancement of current theatre studies while preparing for further theatre studies or activity.
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

THTR 328 (ENGL 328) Shakespeare 3,4 Credits
An introduction to Shakespearean drama including comedies, histories, tragedies, and romances. Emphasis on textual study, cultural contexts, and performance strategies.
Attribute/Distribution: HU

THTR 351 Advanced Special Projects 1-8 Credits
Independent study in theatre. Consent of department chair required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

THTR 387 (DES 387) Scenography II 4 Credits
Advanced projects in theatrical design. Portfolio readiness and resume preparation.
Prerequisites: THTR 087 or DES 087
Can be taken Concurrently: THTR 087, DES 087
Attribute/Distribution: HU

THTR 389 Honors Project 1-8 Credits
Repeat Status: Course may be repeated.
Women, Gender, and Sexuality Studies

Program Director: Monica R. Miller, Ph.D (Chicago Theological Seminary)
Email: mrm213@lehigh.edu  Phone: 610-758-3364
Website: http://wgs.cas2.lehigh.edu/
Supported by the Office of Interdisciplinary Programs, 610-758-3996; incasip@lehigh.edu
Williams Hall, 31 Williams Drive

Core Faculty
Kelly Austin, Ph.D. (Department of Sociology and Anthropology); Hugo Ceron-Anaya, Ph.D. (Department of Sociology and Anthropology); Marie-Hélène Chabut, Ph.D. (Department of Modern Languages and Literatures); Brooke DeSipio, Ph.D. (Gender Violence Education and Support); Robin Dillon, Ph.D. (Department of Philosophy); Suzanne Edwards, Ph.D. (Department of English); Jodi Eichler-Levine, Ph.D. (Department of Religion Studies, Jewish Studies); Mary Folz, Ph.D. (Department of English); Chelsea Fullerton, M.Ed. (Pride Center); Kashi Johnson, MFA (Department of Theatre); Rita Jones, Ph.D. (Women's Center); Jackie Krasas, Ph.D. (Department of Sociology and Anthropology); Danielle Lindemann, Ph.D. (Department of Sociology and Anthropology); Monica R. Miller, Ph.D. (Department of Religion Studies, Africana Studies); Vera Stegman, Ph.D. (Department of Modern Languages and Literatures); Nobuko Yamasaki, Ph.D. (Department of Modern Languages and Literatures); Yuping Zhang, Ph.D. (Department of Sociology and Anthropology)

Women, Gender, and Sexuality Studies (WGSS) at Lehigh University is an interdisciplinary field of academic inquiry that critically examines gender and sexuality from an intersectional model that takes into account the manner in which class, race, and power co-constitutively shape and impact gendered and sexed identity construction. In the best tradition of a liberal arts education, Women, Gender, and Sexuality Studies encourages thinking that is critical and constructive, multifaceted and intersectional in order to redesign knowledge, and gain a better understanding of how identities shape and are shaped by the social world in which we live. Offering an undergraduate major and minor, a Graduate Certificate, and a host of faculty and student-focused events and resources, WGSS works to be a space of professional growth, intellectual development and maturity, and a knowledge leader on campus, in the surrounding Lehigh Valley, and abroad.

UNDERGRADUATE MAJOR IN WOMEN, GENDER, AND SEXUALITY STUDIES
The Women, Gender, and Sexuality Studies BA will provide students an in depth education in an interdisciplinary field of academic inquiry that critically examines the diverse realities of women’s lives and the ways in which gender and power differentials shape human lives and human societies. WGSS pursues a fundamental critique of knowledge by challenging the basic assumptions, methods of inquiry, theoretical frameworks, and knowledge claims of traditional fields of inquiry that have thought it unimportant to study women, gender, or sexuality. WGSS seeks to create new paradigms of knowledge and inquiry, to develop more truthful and comprehensive understandings of humans and our world, and to explore nonexistent alternatives for more richly human lives and more fully human social orders.

Women, Gender, and Sexuality (WGSS) is an invaluable asset as part of a double major. The major will have a core curriculum, a concentration (social sciences or humanities), electives, and a senior experience.

Major Core Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>WGSS 001</td>
<td>Women &amp; Men in Society (SS)</td>
<td>4</td>
</tr>
<tr>
<td>WGSS 350</td>
<td>Seminar in Feminist Theory (ND)</td>
<td>4</td>
</tr>
<tr>
<td>Global/Diversity (select one of the following)</td>
<td>1</td>
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<tr>
<td>WGSS/SOC 042</td>
<td>Sexual Minorities (SS)</td>
<td>4</td>
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<tr>
<td>WGSS/ASIA/MLL 073</td>
<td>Film, Fiction, and Gender in Modern China (HU)</td>
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<tr>
<td>WGSS/SOC 110</td>
<td>Women’s Work in Global Perspectives (SS)</td>
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<tr>
<td>WGSS/ANTH 123</td>
<td>Anthropology of Gender (SS)</td>
<td></td>
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<tr>
<td>WGSS/SOC 128</td>
<td>Race, Gender and Work (SS)</td>
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<tr>
<td>WGSS/REL 138</td>
<td>Women in Jewish History (HU)</td>
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<tr>
<td>WGSS/AAS 145</td>
<td>African American Women Writers (HU)</td>
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<tr>
<td>WGSS/AAS/SOC 310</td>
<td>Gender, Race and Sexuality: The Social Construction of Differences (SS)</td>
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<tr>
<td>WGSS/SPAN/LS 326</td>
<td>Tradition and Resistance: Women Writers of Latin America (HU)</td>
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<tr>
<td>WGSS/FREN 327</td>
<td>Women Writing in French (HU)</td>
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<tr>
<td>WGSS/POLS/GS 342</td>
<td>Gender and Third World Development (SS)</td>
<td></td>
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<tr>
<td>WGSS/SOC 365</td>
<td>Inequalities at Work (SS)</td>
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</tbody>
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Major Concentration

Students must concentrate in Social Science (SS) or Humanities (HU)
- Select two courses in SS or HU
- Select one of the following:
- One SS course if HU concentration
- One HU course if SS concentration

Major Electives

Select any combination of SS and HU courses
- Select one of the following:
- WGSS 271 | Independent Reading and Research (HU/SS) |
- WGSS 330 | Internship in Women, Gender and Sexuality Studies (SS) |
- WGSS 373 | Internship in Women’s Center (SS) |
- WGSS 399 | Senior Thesis (ND) |

Total Credits: 34-36

1. Cannot be double-counted in categories.
2. HU or SS courses must carry the WGSS course designation or be approved by the program director.
3. Additional ND courses may fulfill HU or SS requirements with program director approval. These courses may include SOAN 041 Human Sexuality, WGSS 091 Special Topics, WGSS 191 Special Topics, WGSS 272 Special Topics, WGSS 291 Special Topics, WGSS 371 Special Topics, WGSS 381 Special Topics, WGSS 382 Special Topics, WGSS 391 Special Topics, WGSS 392 Special Topics and ARTS 250 Communications, Cultures, Behaviors and Attitudes

HONORS IN WOMEN, GENDER, AND SEXUALITY STUDIES
In order to receive honors in Women, Gender, and Sexuality Studies, the student must attain a 3.5 grade-point average in courses presented for the major and a 3.2 grade-point average overall, and must take WGSS 399 Senior Thesis and write a thesis during their senior year.

UNDERGRADUATE MINOR IN WOMEN, GENDER, AND SEXUALITY STUDIES
The minor in WGSS engages students in the study of three interrelated subjects. The first is an examination of the cultural, historical, and social experiences and contributions of women. The second is an exploration of gender (the social construction of differential identity for males and females) and of the ways in which gender distinctions shape human
CONCEPTUAL FRAMEWORK

The minor in WGSS consists of a minimum of 18 credit hours. Students pursuing the minor are required to take the introductory course (WGSS 001) and one upper-level course from among those concerned with the theory and practice of women, gender, and sexuality studies. Courses completed must include at least one course in the arts and humanities and one course in the natural and social sciences. Students arrange their program in consultation with the program director.

UNDERGRADUATE MINOR

WGSS 001 Women & Men in Society 4
Select 2 credits from following:

WGSS 271 Independent Reading and Research 2
WGSS 330 Internship in Women, Gender and Sexuality Studies 2
WGSS 373 Internship in Women's Center 2

Select one 300-level course 4
Select two electives or new course as approved 4

Total Credits 18

1 One course must be HU and one course must be SS

GRADUATE CERTIFICATE IN WOMEN, GENDER, AND SEXUALITY STUDIES

The Graduate Certificate in WGSS is designed as a complement to a disciplinary graduate program or as a standalone post-baccalaureate course of study. The Certificate is a small, flexible program that provides students with breadth and the challenge of working outside their home discipline in concentrated interdisciplinary study of women and gender. In recognition of contemporary educational and employment contexts that are increasingly diverse and international, the WGSS Program offers the graduate certificate as a means to enrich academic, personal, and employment horizons. A certificate in WGSS will be especially beneficial to those who wish to incorporate a broader perspective into their teaching (either in secondary or higher education), and qualifies them for positions that require such expertise. Additionally, individuals interested in fields such as social policy, human resources, and business will also gain from understanding how gender operates at individual, organizational, and institutional levels. Students will work closely with outstanding faculty from diverse disciplinary backgrounds.

Basic Requirements

WGSS 450 Seminar in Feminist Theory 3
Select three additional courses 1,2 9

Total Credits 12

1 2 courses outside home department (for matriculating students)
2 No more than 6 credits at the 300-level

Admissions

Students in degree programs must be in good standing in their programs and are encouraged to apply early in their course of studies. Non-degree students must hold a bachelor's degree or equivalent with a 3.0 GPA.

COURSE DESCRIPTIONS

In addition to these courses, new courses may be offered annually. Students should check with the director for an updated list.

Courses

WGSS 001 Women & Men in Society 4 Credits

The course introduces students to key concepts, theoretical frameworks, and interdisciplinary research in the field of Women's and Gender Studies. Examines how gender interacts with race, age, class, sexuality, etc., to shape human consciousness and determine the social organization of human society. The course may include topics such as: gender and work; sexuality and reproduction; women's health; media constructions of gender and race; gender, law, and public policy.

Attribute/Distribution: SS

WGSS 041 (SOAN 041) Human Sexuality 4 Credits

Sexuality and gender roles across the life cycle, including human reproduction, decision-making, and the societal regulation of sexual behavior.

Attribute/Distribution: ND

WGSS 042 (SOAN 042) Sexual Minorities 4 Credits

How minority sexual identities have been the subject of speculation, misunderstanding, and sometimes violent attempts at correction or elimination. Sexual orientation, gender role, including transvestism and "drag", transsexualism, sexism, heterosexism, and homophobia. Emphasis on critical thinking, guest speakers, and discussions.

Attribute/Distribution: SS

WGSS 073 (ASIA 073, MLL 073) Film, Fiction, and Gender in Modern China 4 Credits

Study of the struggle for an individual "modern" identity out of traditionally defined roles for men and women as depicted by Chinese writers and filmmakers. Class, texts, and films in English. Students interested in setting up a corollary Chinese language component for credit as CHIN 371 or CHIN 251, may discuss this possibility with the professor.

Attribute/Distribution: HU

WGSS 091 Special Topics 1-4 Credits

Intensive study of a topic of special interest not covered in other courses. May be cross-listed with relevant offerings in major department or other programs. Consent of program director required.

Repeat Status: Course may be repeated.

WGSS 104 (ENGL 104) Special Topics in Gender Studies 4 Credits

This course will involve extended study in a sub-area of English language culture, and literature with a focus on gender, sexuality, and/or race/ethnicity. Prereq: 6 hours of freshman English.

Repeat Status: Course may be repeated.

Attribute/Distribution: HU

WGSS 110 (SOC 110) Women's Work in Global Perspectives 4 Credits

This course brings to the forefront the intersections of race, class, gender, and nation with women's employment around the world. We will examine women's paid and unpaid work in the U.S., Europe, Asia, Latin America, and Africa, in effort to understand the striking persistence of gender inequality over time and across the world. Topics of study include: work and family relations, women's domestic labor, factory work, and agribusiness. In addition we will explore the ways in which women have organized for changes in work and in their communities in order to conceive of possibilities for the future of women's work.

Attribute/Distribution: SS

WGSS 117 (HIST 117, STS 117) Pioneering Women: Women in Science, Medicine and Engineering 4 Credits

This course analyses the careers of professional women in science, medicine and engineering, principally in the United States. It examines historical barriers to training and entry into these professions; cultural stereotypes that shape women’s options; women’s participation in innovation in their fields; their concern for work/life balance; and their contribution to clients and patients, both male and female. It focuses on three locations of professional work: the laboratory, the clinic, and the job site.

Attribute/Distribution: SS
WGSS 121 (ART 121) Women in Art 4 Credits
A history of women artists from Renaissance to present day, with emphasis on artists of the 20th and 21st century from a global perspective. We explore attitudes toward women artists and their work as well as the changing role of women in art world. There may be required visits to museums and/or artists’ studios.
Attribute/Distribution: HU

WGSS 123 (ANTH 123) Anthropology of Gender 4 Credits
Comparative study of the meanings and social roles associated with gender. Psychological, symbolic, and cultural approaches.
Attribute/Distribution: SS

WGSS 124 (HIST 124) Women in America 4 Credits
Roles of women in American society from colonial to present times: attitudes toward women, female sexuality, women’s work, and feminism.
Attribute/Distribution: SS

WGSS 128 (SOC 128) Race, Gender and Work 4 Credits
Race, Gender and Work is a class designed to help students understand racial and gender inequalities as they relate specifically to work and employment. We explore the origins and histories of inequalities, the ways in which inequalities persist and/or change today, and what steps might be taken toward creating a more equal society.
Attribute/Distribution: SS

WGSS 138 (JST 138, REL 138) Sex, Gender, Jews 4 Credits
How do Jews of all genders tell their stories? What are the varied Jewish approaches to sexuality? How have feminist movements affected Jewish rituals? In this course, we will consider how religion, gender, sexuality, race, and class intersect in the lives of Jews, with a particular focus on North America. Topics will include: Jewish women’s memoirs; the voices of LGBTQJews; recent innovations in Jewish ritual and leadership; Jewish masculinities; and the gendering of Jewish children’s literature, among others.
Attribute/Distribution: HU

WGSS 145 (AAS 145) African American Women Writers 4 Credits
Literature by African American women writers with a focus on the experiences and images of black women in the U.S. Explores the written portraits and voices of 20th century black female novelists and poets, including Hurston, Petry, Morrison, Angelou, and Walker.
Attribute/Distribution: HU

WGSS 146 (PHIL 146) Philosophy of Sex and Gender 4 Credits
An examination of concepts, values, and assumptions relevant to gender and sex(uality) in our diverse society, investigating how they affect our lives in both concrete and symbolic ways. Intersections among gender, sex(uality), race, class, religion, ethnicity, etc., will be explored. Special attention will be paid to how gendered assumptions color our understandings of experiences of embodiment and emotion, reasoning and decision-making, knowledge production, and public and private relationships and activities.
Attribute/Distribution: HU

WGSS 179 (POLS 179) Politics of Women 4 Credits
Selected social and political issues relating to the role of women in American society. Focuses on such questions as economics equality, poverty, and work roles, the older woman, gender gap, political leadership, reproduction technology, and sexual violence.
Attribute/Distribution: SS

WGSS 182 (REL 182) Sex and Gender in the Bible 4 Credits
The Bible is often invoked—and often simplistically—as an authoritative source in contemporary discussions about the role of women and what kinds of human sexual expression is acceptable. This course will examine how sex and gender are constructed in different biblical periods and biblical books. We will see that things are not nearly as simple as they are often made out to be.
Attribute/Distribution: HU

WGSS 184 (REL 184) Religion, Gender, and Power 4 Credits
Gender differences as one of the basic legitimations for the unequal distribution of power in Western society. Feminist critiques of the basic social structures, cultural forms, and hierarchies of power within religious communities, and the ways in which religious groups have responded.
Attribute/Distribution: HU

WGSS 191 Special Topics 1-4 Credits
Intensive study of a topic of special interest not covered in other courses. May be cross-listed with relevant offerings in major department or other programs. Consent of program director required.
Repeat Status: Course may be repeated.

WGSS 226 (PHIL 226) Feminism and Philosophy 4 Credits
Analysis of the nature, sources and consequences of the oppression and exploitation of women, and justification of strategies for liberation. Topics include women’s nature and human nature, sexism, femininity, sexuality, reproduction, mothering. Must have completed one HU designated course in Philosophy or one course in Women, Gender, and Sexuality Studies.
Attribute/Distribution: HU

WGSS 232 (ENTP 232) Gender Issues in Entrepreneurship 4 Credits
Explores role of women entrepreneurs in society & economic development; impacts of women’s entrepreneurship in different economic and cultural contexts; research on why women still represent a minority or entrepreneurs; gender differences in patterns of entrepreneurship; related policy challenges. Also addresses pragmatic and personal life choices facing women entrepreneurs, including identifying key characteristics of entrepreneurial opportunities and mapping those against values, skills, ethics and definitions of success; and planning for professional and personal development.
Attribute/Distribution: SS

WGSS 271 Independent Reading and Research 1-4 Credits
Independent study of selected topics designated and executed in close collaboration with a member of Women, Gender, and Sexuality Studies faculty. Students taking this course as a requirement for the minor must elect at least the three-credit option. May be repeated for elective credit. Consent of program director required.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU, SS

WGSS 272 Special Topics 1-4 Credits
Intensive study of a topic of special interest not covered in other courses. May be cross-listed with relevant offerings in major department or other programs. Consent of program director required.
Repeat Status: Course may be repeated.

WGSS 275 (LAS 275, SPAN 275) Introduction to Hispanic Women Writers 4 Credits
The objective of this class is to introduce students to Hispanic contemporary female authors from Latin America, Spain, and the United States through the analysis of all literary genres (novel, short story, poetry, essay, and drama). This class provides students with a solid introduction to Hispanic women's writing from the last years of the Nineteenth Century to the present, as well as to feminist literary theory.
Attribute/Distribution: HU

WGSS 291 Special Topics 1-4 Credits
Intensive study of a topic of special interest not covered in other courses. May be cross-listed with relevant offerings in major department or other programs. Consent of program director required.
Repeat Status: Course may be repeated.

WGSS 300 Apprentice Teaching 1-4 Credits
Supervised participation in various aspects of the teaching of a course. Transcript will identify department in which apprentice teaching was performed. Consent of department chairperson and permission of the Dean. The transcript will reflect the subject area in which the teaching was done.
Repeat Status: Course may be repeated.
WGSS 303 (GERM 303, MLL 303) Grimm's Fairy Tales: Folklore, Feminism, Film 4 Credits
This intercultural history of the Grimm's fairy tales investigates how folktale types and gender stereotypes developed and became models for children and adults. The course covers the literary fairy tale in Germany, Europe and America. "Little Red Riding Hood", "Cinderella", or "Sleeping Beauty" exist not only in the Grimm's collection but in many forms of world literature/film. Modern authors have rewritten fairy tales in feminist ways, promoting social change. Taught in English. German language students may receive a German component.
Attribute/Distribution: HU

WGSS 304 (ENGL 304) Special Topics in Gender Studies II 3,4 Credits
This course will involve extended study in a sub-area of English language, culture, and literature with a focus on gender, sexuality, and/ or race/ethnicity.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

WGSS 310 (AAS 310, SOC 310) Gender, Race and Sexuality: The Social Construction of Differences 4 Credits
Students will engage with current debates about the meaning and use of racial and sexual classification systems in society. We will examine the historical and sociological contexts in which specific theories of racial and sexual differences emerged in the U.S. We will also explore the ways in which changes in the images have implications on the role racial, gender, and sexual identity plays in our understanding of the relationship between difference and inequality.
Prerequisites: SOC 103 or SSP 103
Attribute/Distribution: SS

WGSS 311 (ENGL 311) Gender and Literature 3-4 Credits
Exploration of constructions of gender and sexuality in literature from different historical periods, traditions, and nationalities. How do female and male writers envision what it means to be a "woman" or to be a "man" at various moments in history and from various places around the world? How do gendered (and sexed) identities been shaped in various constraining and empowering ways in the literary imagination? What specifically gendered issues (such as love and violence) have been represented in literature? Content changes each semester.
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

WGSS 318 (PSYC 318) Seminar in Gender and Psychology 4 Credits
Gender as shaped by psychological and social psychological processes. Socialization, communication and power, gender stereotypes, methodological issues in sex differences research. Consent of department required.
Prerequisites: PSYC 210
Can be taken Concurrently: PSYC 210
Attribute/Distribution: SS

WGSS 325 (HIST 325, SOC 325) History of Sexuality and the Family in the U.S. 3-4 Credits
Changing conceptions of sexuality and the role of women, men, and children in the family and society from the colonial to the post-World War II era. Emphasis on the significance of socioeconomic class and cultural background. Topics include family structure, birth control, legal constraints, marriage, divorce, and prostitution.
Attribute/Distribution: SS

WGSS 326 (LAS 326, SPAN 326) Tradition and Resistance: Women Writers of Latin America 4 Credits
Study of poetry and narrative works by Latin American women writers. Authors include Rosario Ferré, Rosario Castellanos, Elena Poniatowska, Cristina Peri Rossi, among others.
Prerequisites: SPAN 152
Attribute/Distribution: HU

WGSS 327 (FREN 327) Women Writing in French 4 Credits
Reading and discussion of works written by women in French. The emphasis is on 19th and 20th Century writers, such as G. Sand, Colette S. de Beauvoir, M. Duras, Andrée Chédid.
Attribute/Distribution: HU

WGSS 330 Internship in Women, Gender and Sexuality Studies 1-4 Credits
Supervised work in women's organizations or settings, combined with an analysis, in the form of a major paper, of the experience using the critical perspectives gained in WGSS courses. Placements arranged to suit individual interests and career goals; can include social service agencies, women's advocacy groups, political organizations, etc. Consent of program director required.
Repeat Status: Course may be repeated.
Prerequisites: WGSS 001
Attribute/Distribution: SS

WGSS 331 (GS 331, SOC 331) Gendered Experience of Globalization 4 Credits
Women and men experience globalization differently and globalization affects women in different cultural and national contexts. Gender stratification has been intensified by the transnational flow of goods and people. Provides students with a survey of new development in feminist theories on globalization and on gender stratification and development, and links these theoretical frameworks to empirical research about gender issues that have become more prominent with globalization.
Attribute/Distribution: SS

WGSS 334 (HMS 334, PSYC 334) The Psychology of Body Image and Eating Disorders 4 Credits
This course addresses the psychosocial aspects of the development of healthy and unhealthy body image and eating disorders. The roles of personality traits/individual factors, family and interpersonal functioning, and cultural factors will be examined, as will the impact of representations of body image in mass media. Public health and psychological interventions for prevention and treatment will be explored. Personal accounts/memoirs, clinical case presentations, and documentary and dramatic films will be incorporated in the presentation of topics.
Attribute/Distribution: SS

WGSS 341 (HMS 341, SOC 341) Gender and Health 4 Credits
Relationships of sex differences and gender norms to disease and longevity in the U.S. and around the world. Influence of medical systems on men's and women's lives and the impact of gender-based consumer health movements on health and medical care. Focus on specific topics, e.g. medicalization and commercialization of women's bodies, the politics of reproductive choices, masculinity and health, and gender and mental health.
Attribute/Distribution: SS

WGSS 342 (GS 342, POLS 342) Gender and Third World Development 3-4 Credits
Focus on gender implications of contemporary strategies for Third World economic growth, neo-liberalism. How do economic theories affect 'real people'? How do economic theories affect men vs. women? What is the role of people who want to 'help'? Some background in economic theories and/or Third World politics desired, but not required.
Prerequisites: POLS 001 or WGSS 001
Attribute/Distribution: SS

WGSS 346 (LAS 346, SPAN 346) Contemporary Hispanic Women Writers: The Novelists 4 Credits
This course explores the works of Hispanic women writers who have been oppositional to hegemonic cultural politics during the Twentieth Century in Latin America and Spain. Within their particular contexts, we examine issues these writers define as important in their work, their literary and political impact, use of literature to empower minority positions, and their narratives' effects on the changing literary canon. Selected topics include: historical interpretations, exile, forms of violence and repression, expressions of desire, and sexuality.
Attribute/Distribution: HU

WGSS 350 Seminar in Feminist Theory 4 Credits
An upper-level seminar serving as a capstone experience that challenges students to systematize insights gained from introductory and elective courses through the more deeply analytical lens of feminist theory. Consent of program director.
Prerequisites: WGSS 001
Attribute/Distribution: ND
WGSS 351 (SOC 351) Gender and Social Change 4 Credits
Changes in gender roles from social psychological and structural perspectives. Comparative analyses of men and women (including people of color) in the social structure; their attitudes and orientations toward work, family, education, and politics. 
Attribute/Distribution: SS

WGSS 364 (SOC 364) Sociology of the Family 3,4 Credits
Sociological analysis of families in the United States, including investigations of historical and contemporary patterns. Issues addressed include parenting, combining work and family, divorce and remarriage, family policies. 
Prerequisites: ANTH 011 or SOC 001 or SOC 005 or SOC 021 or PSYC 021
Attribute/Distribution: SS

WGSS 365 (SOC 365) Inequalities at Work 4 Credits
Primary focus is on race, gender, and class as axes of disadvantage and privilege in work and employment. We will explore both theories and empirical studies of inequality as well as their social, political, and practical ramifications for the workplace. The course will be conducted seminar-style and the class will rely heavily on student participation. 
Attribute/Distribution: SS

WGSS 371 Special Topics 1-4 Credits
Intensive study of a topic of special interest not covered in other courses. May be cross-listed with relevant offerings in major department or other programs. Consent of program director required. 
Repeat Status: Course may be repeated.

WGSS 373 Internship in Women's Center 1-3 Credits
Supervised work in the Women's Center allows students to bring critical perspectives on women and gender into the campus community. Students who wish to fulfill the internship requirement of the WGSS minor must take the Women's Center internship for (3). Consent of program director required. 
Repeat Status: Course may be repeated.
Prerequisites: WGSS 001
Attribute/Distribution: SS

WGSS 376 (AAS 376, COMM 376) New Media, Race and Gender 4 Credits
This class explores the relationship among race, gender and new media. It examines depictions of racial minorities and women online; how users access and use new media across race and gender (including a look at the digital divide); and differences in use of social media websites across race and gender. The goal is for students to understand how existing racial and gender categorizations are not transmitted to the online community and do/do not become extensions of present social hierarchy. 
Attribute/Distribution: SS

WGSS 381 Special Topics 1-4 Credits
Intensive study of a topic of special interest not covered in other courses. May be cross-listed with relevant offerings in major department or other programs. Consent of program director required. 
Repeat Status: Course may be repeated.

WGSS 382 Special Topics 1-4 Credits
Intensive study of a topic of special interest not covered in other courses. May be cross-listed with relevant offerings in major department or other programs. Consent of program director required. 
Repeat Status: Course may be repeated.

WGSS 391 Special Topics 1-4 Credits
Intensive study of a topic of special interest not covered in other courses. May be cross-listed with relevant offerings in major department or other programs. Consent of program director required. 
Repeat Status: Course may be repeated.

WGSS 392 Special Topics 1-4 Credits
Intensive study of a topic of special interest not covered in other courses. May be cross-listed with relevant offerings in major department or other programs. Consent of program director required. 
Repeat Status: Course may be repeated.

WGSS 399 Senior Thesis 2-4 Credits
Research during senior year culminating in a senior thesis. Consent of program director required. 
Repeat Status: Course may be repeated.
Attribute/Distribution: ND

WGSS 403 (MLL 403) Grimms' Fairy Tales: Folklore, Feminism, Film 3 Credits
This intercultural history of the Grimms' fairy tales investigates how folktale types and gender stereotypes developed and became models for children and adults. The course covers the literary fairy tale in Germany as well as Europe and America. Versions of "Little Red Riding Hood", "Cinderella", or "Sleeping Beauty" exist not only in the Grimms' collection but in films and many forms of world literature. Modern authors have rewritten fairy tales in feminist ways, promoting social change. Taught in English. German language students may receive a German component.

WGSS 405 (CIE 405) Experiencing the United Nations: Gender and Education in International Development 3 Credits
Building on the Lehigh University/United Nations partnership initiative, this course provides a structured practical experience for students to learn about the dynamics of UN and civil society relationships, focusing on the issues of gender and education in international development. Class activities include trips to the UN to attend NGO briefings and other events. Students develop experiences and skills in international development such as policy blogging, brief writing, and education sector analysis.

WGSS 411 (ENGL 411) Gender and Literature 3 Credits
This seminar explores constructions of gender and sexuality in literature from different historical periods, traditions, and nationalities. Content changes each semester. 
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

WGSS 418 (SOC 418) Gendered Experience of Globalization 3 Credits
Women and men experience globalization differently and globalization affects women in different cultural and national contexts. Gender stratification has been intensified by the transnational flow of goods and people, provides students with a survey of new development in feminist theories on globalization and on gender stratification and development, and links these theoretical frameworks to empirical research about gender issues that have become more prominent with globalization.

WGSS 430 Internship in Women, Gender and Sexuality Studies 1-3 Credits
Internship related to women, gender, and sexuality studies. Supervised by WGSS faculty. Consent of program director required.

WGSS 441 (SOC 441) Gender and Health 3 Credits
Relationships of sex differences and gender norms to disease and longevity in the US and around the world. Influence of medical systems on men's and women's lives and the impact of gender-based consumer health movements on health and medical care. Focus on specific topics, e.g. medicalization and commercialization of women's bodies, the politics of reproductive choices, masculinity and health, and gender and mental health.

WGSS 450 Seminar in Feminist Theory 3 Credits
A graduate seminar providing foundational study of multidisciplinary theoretical frameworks of women, gender, and sexuality studies. 
Attribute/Distribution: HU, ND

WGSS 458 (HIST 458) Readings in Gender History 3 Credits
Study in small groups under the guidance of a faculty member on the literature of an issue, period, country or culture within gender history. 
Repeat Status: Course may be repeated.
Attribute/Distribution: HU

WGSS 465 (SOC 465) Inequalities at Work 3 Credits
Primary focus is on race, gender, and class as axes of disadvantage and privilege in work and employment. We will explore both theories and empirical studies of inequality as well as their social, political, and practical ramifications for the workplace. 
Attribute/Distribution: SS
WGSS 484 (PSYC 484) Psychology of Gender 3 Credits
Major theoretical approaches and empirical debates in the psychology of gender, with a focus on the interplay of nature and nurture in producing gender similarities, gender differences and gender variation in personality, social behaviors, cognitive abilities, achievement, sexuality, and mental health. Methodological issues in gender research. Consent of program director required.

WGSS 491 Independent Study 3 Credits
Individually supervised course in area of women, gender, and sexuality studies not ordinarily covered in regularly listed courses. Consent of program director required.
Repeat Status: Course may be repeated.
Lehigh University is independent, nondenominational, and coeducational. Founded in 1865 as a predominantly technical four-year school, the university now has approximately 4,700 undergraduates within its three major units, the College of Arts and Sciences, the College of Business and Economics, and the P. C. Rossin College of Engineering and Applied Science, and approximately 2,100 students enrolled in graduate programs offered through the graduate schools in these colleges and in the College of Education. There are undergraduates from nearly every state and U.S. territory and more than 40 foreign nations.

The university is primarily situated on the Asa Packer Campus on the north slope of South Mountain overlooking Bethlehem, Pennsylvania. Sayre Park, the wooded refugee located toward the top of the mountain, is the setting for many living groups. The residences are reached via winding private roads. Many residential units on campus command a panoramic view of the Lehigh Valley. The Appalachians are visible to the west, with an especially good view from The Lookout on the Packer Campus. Both the tower and dining room in Iacocca Hall on the Mountaintop Campus afford panoramic views of the Lehigh Valley. The campus at its highest point is 971 feet above sea level.

A substantial portion of the upper level of Lehigh’s campus is maintained as a nature preserve. The preserve supports deer, squirrels, chipmunks, raccoons, wild turkeys, and other birds.

Besides the Asa Packer Campus, the university has extensive athletic fields and facilities on the Murray H. Goodman Campus, two miles to the south in Saucon Valley. The university acquired the Mountaintop Campus in 1986; it linked the Packer and Goodman campuses. In 2012, the university received a gift from the Donald B. and Dorothy L. Stabler Foundation: 755 acres in nearby Upper Saucon Township. That brought total land holdings to 2,358 acres, making Lehigh one of the largest private universities in the country.

The board of trustees and university officers have established and enforce policies designed to preserve Lehigh’s natural beauty. It is their contention that the environment in which the young adult university student pursues knowledge can make the total educational experience more meaningful, and that the ideal environment is separate and unique from the distractions of the nonacademic community.

There are approximately 480 full-time members of the faculty, teaching a total of more than 2,000 course titles (not all of which are offered every semester). Among faculty members who are tenured and to whom the university has a permanent commitment, nearly all hold the doctorate degree (typically Ph.D. or Sc.D.).

In total, there are more than 2,000 employees of the university, making it the second-largest employer in the community.

History and Purpose

The principal author of the brief history of Lehigh University that follows, Dr. W. Ross Yates, holds the bachelor of arts and master of arts degrees from the University of Oregon, his native state. He received the doctor of philosophy degree from Yale University and studied in France on a Fulbright Scholarship. He joined the Lehigh staff in 1955 and served as dean of the College of Arts and Science from 1963 to 1972.

When the sound of the last cannon of the Civil War died away, statesmen, educators, and industrial pioneers marshalled the victorious forces of the North and turned their attention to education. They wanted to increase the number of trained scientists, engineers, and other skilled people so they could transform the vast natural resources of the country into a strong and independent national economy.

Asa Packer was one of the industrial pioneers. He built the Lehigh Valley Railroad and controlled a coaling empire in the mountains of eastern Pennsylvania. He knew, as did many others, that a strong national economy depended on more than technical skills. It needed above all people broadly educated in the liberal arts and sciences — people who could combine practical skills with informed judgments and strong moral self-discipline. He kept this in mind when founding and endowing Lehigh University.

The site that Packer chose for his university was a railroad junction across the Lehigh River from Bethlehem, a community founded in 1741 by Moravian missionaries. William Bacon Stevens, Episcopal bishop of the Diocese of Pennsylavnia and the first president of the university’s board of trustees, in 1869 described the origin of the university as follows:

“In the fall of 1864 an interview was requested of me by the Hon. Asa Packer, of Mauch Chunk (now Jim Thorpe), Pa. He came to my house in Philadelphia, and said that he had long contemplated doing something for the benefit of his State, and especially of the Lehigh Valley. From that valley he said he had derived much of the wealth which GOD had given to him, and to the best interests of that valley he wished to devote a portion of it in the founding of some educational institution, for the intellectual and moral improvement of the young men of that region.

“After conversing with him a little while, and drawing out his large and liberal views, I asked him how much money he proposed to set aside for this institution, when he quietly answered that he designed to give $500,000. At the time of this interview no one in this country, it is believed, had offered in a single sum such an endowment for a literary institution. It was the noblest offering which an American had ever laid on the altar of learning, and more than equaled many royal donations which have carried down the names of kings as patrons of European universities.

“Filled with profound emotions at the mention of such a gift for such an object, I asked the noble donor what specific plans he had dreamed in his own mind in reference to it. His reply was, ‘I am not much acquainted with these matters, but you are, and I want you if you will to devise a plan which I can put into effective operation.’ I told him that I would make the attempt. I did so. I drew up the outline sketch of such an institution as I thought would give the largest results for the means used, and submitted it in a few weeks to his inspection.

“He examined it with the practical judgment and business habits with which he deals with all great questions, and adopted the scheme as the basis of his future university.

“The first meeting of the Board of Trustees, selected by Judge Packer, met at the Sun Hotel, in Bethlehem, July 27th, 1865, and began to organize the work before them.”

The trustees followed several principles in setting up the university. One was that of combining scientific and classical education. They considered both to be practical. The principle carried forward an ideal of the great 17th century Moravian educator, John Amos Comenius. A motto taken from the works of Francis Bacon was used to summarize this principle, namely, Homo minister et interpres naturae — man, the servant and interpreter of nature, to use a free translation. That motto lives on at Lehigh, being an element in the university seal.

The trustees chose as first president a man whose education and habits expressed this principle, Henry Coppee. They established five schools, including a school of general literature in addition to four scientific schools of, respectively, civil engineering, mechanical engineering, mining and metallurgy, and analytical chemistry.

Another principle upon which the trustees insisted was that of keeping the size of the student body proportionate to the abilities of the faculty to teach them well. The university would admit only as many freshmen each year as it could be assured of providing with the highest quality of education. In the 19th century the total enrollment never exceeded several hundred students; the size has increased significantly in recent decades, along with the number of faculty members.

The trustees also insisted that Lehigh was to be nondenominational and would have an admission policy based on merit. Competitive examinations were held for applicants for admission. From 1871 to 1891 no tuition was charged, but the national financial crisis at the turn of the century decimated the value of the Lehigh Valley Railroad stock that Packer had given to Lehigh, which was the principal source of income.

At first the student body was entirely male. The contemporary ideological climate would permit nothing else. But around 1916, women were admitted to graduate programs. In 1971, the university opened its
undergraduate program to them as well. Today men and women applicants are considered on an equal basis.

From the first, the students were serious-minded. In 1824, Catherine Drinker Bowen, daughter of president Drinker and later a famous biographer, published a brief history of Lehigh University, in which she commented:

“Ask any college professor which brand of boy he would prefer to teach, the cigarette brand or the flannel shirt variety. Right here we offer ten to one the flannel shirts...Lehigh still holds to the emblem of the flannel shirt—long may it wave! Engineers come to college to work. A writer in the Syracuse Post in 1895 spoke truthfully when he said, ‘From the first, Lehigh’s characteristic has been her earnestness. It is the boast of her graduates, the inspiration of her students. Men go there to learn to take a useful part in the economy of life.’” The university community was constantly infused with new faculty and students determined to renew and rework the original principles in the light of changing times. The students’ ambition and zeal bore fruit; as alumni they carried the university’s educational goals into the work of nation-building. And, having received, they gave to perpetuate Lehigh’s work of service.

Today, Lehigh University still adheres to Asa Packer’s goal of a liberal and scientific education for practical service. Faculty and students work to maintain high quality in instructional programs. Generous support from individuals, foundations, industry, and government help Lehigh to retain high quality of education and faculty while keeping tuition as low as possible. (Tuition covers only a part of the cost of a Lehigh education.)

**Presidents of the University**

The presidents of Lehigh University are described and their achievements cited in the following paragraphs. The years in parentheses are those served in the presidency.

**Henry Coppee** (1866-1875). Coppee served as a railroad engineer in Georgia, a captain in the Army during the Mexican War, and taught at West Point and at the University of Pennsylvania before becoming first president in 1866.

Much building was done on the new university campus. A Moravian church on Packer Avenue was remodeled into Christmas Hall; a house for the president was erected on campus; and Packer Hall, the university center, was built.

Coppee lectured in history, logic, rhetoric, political economy, and Shakespeare.

**John McDowell Leavitt** (1875-1880). Leavitt was an Episcopal clergyman who graduated from Jefferson College and taught at Kenyon College and Ohio University. During his incumbency, the university was divided into two schools, General Literature and Technology. As of 1876, a student could receive two engineering degrees by taking a longer course, and beginning in 1877 the master of arts, doctor of philosophy, and doctor of science degrees were established.

Linderman Library rotunda was completed in 1877. Asa Packer died in May 1879, and Founder’s Day was held in his honor the following October.

**Robert Alexander Lamberton** (1880-1893). Lamberton, a graduate of Dickinson College, practiced law in Harrisburg, Pa., and was a university trustee when asked to become president. During his administration, students and the community witnessed the first Mustard and Cheese dramatic presentation.

A gymnasium (now Coppee Hall) was erected, and Chandler Chemistry Laboratory was built, now known as Chandler-Ullmann Hall. Lehigh was also building its reputation for academic excellence; the mechanical engineering department was established in 1881 and the Lehigh chapter of Phi Beta Kappa was founded in 1887.

**Thomas Messinger Drown** (1895-1904). Drown studied medicine at the University of Pennsylvania and went abroad to study chemistry. Thereafter he was professor of chemistry at Lafayette College. In 1895 he assumed the presidency of Lehigh and was greatly interested in furthering the university’s development as a technical school.

His first years were difficult ones because the Panic of 1893 decimated the university’s stock holdings in the Lehigh Valley Railroad.

Nevertheless, Lehigh managed to grow in enrollment, academics, and in physical plant. Williams Hall was completed. The curriculum leading to a degree in arts and engineering was established, as was the department of zoology and biology. New curricula were adopted in metallurgical engineering, geology, and physics.


**Henry Sturgis Drinker** (1905-1920). Drinker, an 1871 Lehigh graduate, was the only university alumnus ever to become president. In 1907, the alumni endowment fund began, the Lehigh Alumni Bulletin was first published in 1913, and the Alumni Association was incorporated in 1917.

Drinker, besides being a lawyer, was a mechanical engineer and had been largely instrumental in solving the problems of constructing the two-mile-long Musconetcong Tunnel, an engineering feat that made possible a railroad line between Easton, Pa., and New York City. He started a tradition of businesslike management of university affairs.

During Drinker’s years, more buildings were completed: the original section of Fritz Engineering Laboratory, Drown Hall, Coxe Mining Laboratory, Taylor Hall, Taylor Gymnasium and Field House, Taylor Stadium, and Lamberton Hall. Drinker’s interest in horticulture led to the planting of many rare trees and plants.

A teacher’s course and business administration course were begun in 1909 and in 1918 the university was divided into three colleges: liberal arts, business administration, and engineering — the roots of the colleges of today. Army ROTC was established in 1919.

Drinker’s daughter, Catherine Drinker Bowen, went on to become a historical writer of note. Her experiences as the daughter of a Lehigh president and occupant of the President’s House are recorded in *Family Portrait* (Atlantic Little-Brown).

Drinker resigned in 1920 and Natt M. Emery, vice president, served as chief executive officer until 1922.

**Charles Russ Richards** (1922-1935). Richards took office in 1922. During his presidency, the first graduate degrees were awarded to women. Lehigh faced a shortage of students from 1929 to 1936 as a result of the Depression, but the newly established office of admission, as well as university scholarships, fellowships, and deferred tuition payments, helped to ease the shortage.

Changing concepts of education were evident in several newly organized academic offerings: philosophy, music, psychology, journalism, history, and fine arts. The majors system was instituted as were the senior comprehensive examinations in the Arts College. The placement bureau, a public relations office, and a student health service were organized.

The Alumni Memorial Building, a memorial to the Lehigh alumni who served in World War I, was opened in 1925 and Packard Laboratory was completed in 1929. In the same decade, a major addition to Linderman Library also was completed.

**Clement C. Williams** (1935-1944). Williams, a civil engineer, was president during an era of unprecedented alumni support. Undergraduate enrollment rose to an all-time high, passing 2,000 in 1938. Richards and Drinker residential houses, and the Ullmann wing adjoining the Chandler Chemistry Laboratory, were built. Grace Hall, the first arena-type facility of any size on campus, was completed in 1940, the gift of Eugene G. Grace, an 1899 graduate, who headed the board of trustees. A Graduate School implemented the programs in the three colleges. Williams retired in 1944, and the university was without a president for approximately two years.

**Martin Dewey Whitaker** (1946-1960). Dr. Whitaker, who had been director of the Atomic Energy Commission Laboratory at Oak Ridge, Tenn., and had worked in developing the atomic bomb, faced the responsibility of helping the university community readjust to peacetime conditions after World War II.

During his time as president, Lehigh’s assets nearly tripled; the endowment more than doubled to $18 million. Many buildings were renovated, and the Dravo House and McClintic-Marshall House residence halls were built. The faculty increased in number by 75 percent and the first endowed distinguished professorships were established.
The Centennial development program was begun in 1959. It raised more than $22 million for faculty salaries and construction that later included Whitaker Laboratory.

An extensive renovation and enlargement project associated with Packer Hall was undertaken in 1957, and, upon completion in 1958, the building became a university center. Whitaker died in office.

Harvey A. Neville (1961-1964). Dr. Neville was the only faculty member ever elected president. His association with the university began in 1927 as an assistant professor of chemistry. During his three-year term as president, the first phase of the Saucon Valley athletic complex was completed, and Sayre Field was opened atop South Mountain. The Center for Information and Computing Science was established.

Neville, a strong supporter of research who fostered its growth on the campus, died in 1983.

Deming Lewis (1964-1982). Willard Deming Lewis became Lehigh’s 10th president after a distinguished career as a space engineer and research administrator.

Dr. Lewis earned three degrees at Harvard and two from England’s Oxford University, where he was a Rhodes Scholar in advanced mathematics. In 1941, he joined Bell Telephone Laboratories, and in 1962 he became general manager of systems development with Bellcomm Inc., which engineered systems for the Apollo project that placed the first man on the moon.

Lewis, who died in 1989, received 33 U.S. patents on such devices as microwave antennas and filter and digital error detection systems. He helped write the equations describing a stylus sliding through a warped groove.

During Lewis’ tenure as Lehigh president, women were admitted as undergraduate students in 1971. New majors were begun in natural science, biology, social relations, geological sciences, environmental science and resource management, religion studies, computer engineering, computing and information science, applied mathematics, management science, American studies, and other fields. Six research centers and seven institutes were established.

Capital campaigns brought in more than $130 million, and construction was completed on Maginnes Hall, Whitaker Lab, Mart Science and Engineering Library, Sinclair Lab, the Seeley G. Mudd Building, Neville Hall, Rathbone Hall dining room, 13 fraternity houses, the Centennial I and II residential complexes, the Brodhead House residence hall, the Trembley Park student apartments, the Saucon Village Apartments, the Philip Rauch Field House, and the Stabler Athletic and Convocation Center. The restoration of Packer Memorial Church was completed, and Packard Lab was renovated.

The original Physics Laboratory is now named in Lewis’ honor, as is the indoor tennis center.

Peter Likins (1982-1997). Dr. Likins, who earned a B.S. and Ph.D. from Stanford, and an M.S. from the Massachusetts Institute of Technology, became Lehigh’s 11th president in 1982. He sought balanced excellence in undergraduate programs while pursuing focused objectives in graduate study and research.

Under Likins, Lehigh nearly doubled in size with the purchase in 1986 of 742 acres of land and a research complex from Bethlehem Steel Corp. Packer Hall was undertaken in 1957, and, upon completion in 1958, the building became a university center. Also dedicated was the Sherman Fairchild Center for the Physical Sciences, which includes the renovated Physics Building (renamed Lewis Lab), and the adjoining Sherman Fairchild Lab.

Likins’ term also saw the establishment of the Lehigh Valley Center for Jewish Studies at Lehigh, the Center for Advanced Technology for Large Structural Systems, largest of its kind in North America, and centers in integrated circuits, management studies, chemical process modeling and control, and international studies.

Likins, an expert in spacecraft dynamics and control who has written textbooks in engineering mechanics, was one of 13 science advisers to President George H.W. Bush. He came to Lehigh after serving as dean of engineering and provost at Columbia, and left to become president of the University of Arizona.

William C. Hittinger (1997-1998). A former chairman of the university’s board of trustees, Hittinger became interim president after the departure of Peter Likins. A member of the National Academy of Engineering, Hittinger served for 22 years on the board of trustees. He graduated from Lehigh in 1944 with a B.S. in metallurgical engineering, and received an honorary doctor of engineering degree from Lehigh in 1973.

Over a 40-year career in the electronics industry, Hittinger worked for Western Electric Co., National Union Radio Corp., Bell Telephone Laboratories, Bellcomm Inc., General Instrument Corp., and RCA Corp. At Bellcomm, he oversaw systems engineering for NASA’s manned spaceflight program, and at RCA, where he became executive vice president, he was responsible for corporate technology, patents, licensing, international business and marketing development, and corporate technology planning.

Hittinger was a member of President Reagan’s National Security Telecommunications Advisory Committee from 1982-86. He was also a member of the U.S.-Brazil Presidential Committee on Science and Technology and a member of the board of directors for eight companies.

Hittinger served as national president of the Lehigh Alumni Association in 1971-72 and received the prestigious L-in-Life Award in 1979. An ROTC student at Lehigh, he served in the U.S. Army in 1943-46 during World War II, rising to the rank of captain.

During Hittinger’s term as chairman of the board of trustees, Lehigh began construction of the Zoellner Arts Center, completed the Ulrich Student Center, aggressively improved its financial aid for undergraduates, and completed the $300 million Campaign for Preserving The Vision. As president, Hittinger realigned the Iacocca Institute into the College of Business and Economics, oversaw the construction of the new Sayre Park Village residential complex, and helped Lehigh move forward during a time of presidential transition.

Gregory C. Farrington (1998-2006). Dr. Farrington was appointed Lehigh’s 12th president in May 1998 and served the university for eight years before stepping down in June 2006. Proclaiming on many occasions that “the only thing good enough for Lehigh is the best,” Farrington promoted academic excellence, improved facilities, and fostered collaborative relationships between Lehigh and the surrounding community.

Farrington earned his B.S. from Clarkson University and his A.M. and Ph.D. from Harvard, all in chemistry and specializing in solid state electrochemistry. Before joining the University of Pennsylvania’s Department of Materials Science and Engineering in 1979, he was a research chemist for General Electric Company’s Corporate Research and Development Center in New York State. At Penn, he served as dean of the School of Engineering and Applied Science. He holds or shares more than two dozen patents and has written or edited books and book chapters, as well as 100 technical papers.
While at Lehigh, Farrington established the university’s bold and creative Lehigh 2020 Initiative. Launched in October 2000, the $75-million academic venture capital fund focused investment on attracting and retaining the best faculty and students, creating distinctive academic programs, funding critical research fields, and stimulating cross-curricular collaboration. New programs created through the 2020 program include those in bioscience, bioengineering, applied life science, computer science and engineering, information systems and engineering, and bioeconomics.

Along with the reinvigoration of academics and the promotion of interdisciplinary learning, Farrington also literally changed the face of Lehigh’s historic campus. More than 20 major campus enhancement projects were completed during his term, among them the construction of Campus Square, a new Alumni Building Arrival Court and parking garage, and a pedestrian walkway through the heart of the campus green, transforming it into a central gathering place. In addition, Coppee Hall, Lamberton Hall, Maginnes Hall, Wilbur Powerhouse, Grace Hall, the A. Haigh Cundy Varsity House, and Linderman Library were renovated.

Under Farrington’s leadership, Shine Forever: The Campaign for Lehigh generated more than half of its $500 million goal to endow faculty chairs, scholarships, academic programs, and facilities. He also advocated collaborations with the city of Bethlehem, the state and federal governments, industry, and other partners to strengthen the university and spur regional economic development. His commitment to the Lehigh Valley was evident in his participation on various boards as well. He actively participated on the board of trustees of St. Luke’s Hospital & Health Network, the National Museum of Industrial History, and Lehigh Valley Partnership.

Alice P. Gast (2006-2014) became the 13th president of Lehigh University on August 1, 2006. Before coming to Lehigh, Dr. Gast served as the vice president for research and associate provost at the Massachusetts Institute of Technology, where she was also the Robert T. Haslam chair in chemical engineering. Prior to joining MIT in 2001, she spent 16 years as a professor of chemical engineering at Stanford University and at the Stanford Synchrotron Radiation Laboratory. The focus of Dr. Gast’s research career was the study of surface and interfacial phenomena, in particular the behavior of complex fluids. Her areas of research include colloidal aggregation and ordering, protein lipid interactions, and enzyme reactions at surfaces. She is the co-author of Physical Chemistry of Surfaces, a classic textbook on colloid and surface phenomena, and has presented named lectures at several of the nation’s leading research institutions.

Dr. Gast received her B.S. in chemical engineering from the University of Southern California. After earning her Ph.D. in chemical engineering from Princeton University, she spent a postdoctoral year on a NATO fellowship at the Ecole Superieure de Physique et de Chimie Industrielles in Paris. Dr. Gast has served on numerous advisory committees and boards, including the Board of the American Association for the Advancement of Science and the National Research Council Committee for Science, Technology, and the Law. In 2010, Dr. Gast was named to the prestigious post of science envoy by U.S. Secretary of State Hillary Rodham Clinton and the U.S. State Department. In 2012, she was appointed to the board of directors of Chevron Corporation.

Kevin L. Clayton (2014-2015), former vice-chair of the university’s Board of Trustees, became interim president after the departure of Alice Gast. Mr. Clayton retired from the global investment management firm Oaktree Capital Management, L.P., where he had a distinguished 19-year career. He joined Oaktree in 1995 and founded their Marketing and Client Relations Department; he retired as principal and director of the firm.

Clayton earned his B.A. in government from Lehigh in 1984 and his M.B.A. from St. Joseph’s University in 1988. During his time at Lehigh, he served as a four-year class president; as a member of the Newman Association and Alpha Tau Omega; and was elected to Omicron Delta Kappa, the national leadership honor society. He continued his service to Lehigh as a member of the Board of Trustees during the period 1993-1999 and again from 2005-2014. As a member of the Board, Clayton served on the Finance Committee, Endowment Fund Investment Committee, Campus Planning and Operations Committee, Student Affairs Committee, and Advancement Committee. He also served on the Dean’s Advisory Council for the College of Business and Economics.

Clayton and his family have long-standing ties to Lehigh. His late father, William Clayton ’51, was a Lehigh trustee for more than 20 years and was a member of the Executive Committee of the Board. In honor of his parents, Clayton and his wife, Lisa, established the William L. and Carol L. Clayton Endowed Scholarship Fund in 2000. In 2008 they established the Lisa A. and Kevin L. Clayton ’84 Endowed Scholarship Fund to support students enrolled in Lehigh’s South Mountain College. Their contributions also include supporting the Annual Fund, the Athletics Partnership Program, and the Dean’s Strategic Initiative. The Claytons’ son, Patrick ’13, became a member of the third generation of Claytons to earn a Lehigh degree.

John D. Simon (2015-present) was installed as Lehigh’s 14th president during the annual Founder’s Day ceremony on October 2, 2015. Before coming to Lehigh, Dr. Simon was executive vice president and provost at the University of Virginia. Previous to that, he was vice provost of academic affairs at Duke University.

During his tenure at UVA, Dr. Simon spearheaded a number of global initiatives, including the establishment of a new major in global studies and the opening of a physical presence for the university in Asia. He played a leading role in the launch of the university’s cutting-edge Data Science Institute as well as its Advanced Research Institute, and in creating the university’s Endowment for the Arts. He also appointed several deans and oversaw the hiring of several hundred faculty.

At Duke, Dr. Simon guided the university’s strategic planning process and drove initiatives aimed at connecting the humanities, social sciences, and sciences. He was chairman of Duke’s department of chemistry from 1999-2004, and also held appointments in the Duke University Medical Center in both biochemistry and ophthalmology. Dr. Simon received his B.A. in chemistry from Williams College in 1979 and his Ph.D. from Harvard University in 1983. After a postdoctoral fellowship at UCLA, he joined the department of chemistry and biochemistry at the University of California-San Diego in 1985, then moved to Duke as the George B. Geller Professor of Chemistry in 1998.

Dr. Simon has been the recipient of numerous fellowships and awards for his scientific work, including the Presidential Young Investigator Award, Alfred P. Sloan Fellowship, Camille and Henry Dreyfus Teacher-Scholar Award, and the Fresenius Award. He is a fellow of the American Association for the Advancement of Science and the American Physical Society, and has authored or co-authored nearly 250 academic papers and four books.

University Campuses

Lehigh University’s three campuses are located in Bethlehem, Pa., and comprise 1,600 acres.

Asa Packer Campus. Lehigh’s main academic campus, encompassing approximately 360 acres on the north slope of South Mountain overlooking Bethlehem, is a wooded area where most students attend class and live. This contains the original campus of the university.

Murray H. Goodman Campus. During the 1960s, the university acquired extensive acreage in the Saucon Valley just south of South Mountain. Development of one of the nation’s finest collegiate athletic complexes has continued since that time. The 500-acre campus now includes the Murray H. Goodman Stadium and other athletic fields, as well as the 6,000-seat Stabler Athletic and Convocation Center, the Philip Rauch Field House, the Cundey Varsity House, the Lewis Indoor Tennis Facility, and the Ulrich Sports Complex. The campus is named for a major benefactor, Lehigh alumnus Murray H. Goodman, of West Palm Beach, Fla.

Mountaintop Campus. Lehigh bought this campus from Bethlehem Steel Corp. in 1986. It contains 670 acres of woods and a 72-acre research site with 8 buildings, including a landmark tower building visible for miles around. Acquisition of the facilities connected the two older campuses. The Mountaintop Campus houses the College of Education;
the departments of Biological Sciences and Chemical Engineering; programs in biochemistry, biotechnology, bioengineering, ATLSS (Advanced Technology for Large Structural Systems) center, Energy Research Center, the Military Science and Leadership program (Army ROTC) and Ben Franklin TechVentures headquarters and incubator companies. Mountaintop is also home to The Mountaintop Experience, where students work together across disciplines to find creative answers to a variety of difficult questions and challenges.

**University Buildings**

Lehigh has a major collection of 19th century buildings designed by such prominent architects as Addison Hutton (1834-1916), Edward T. Potter (1831-1904), A. W. Leh (1848-1918), and the firm of Furness and Evans (Frank Furness, 1839-1912).

Zoeller Arts Center (1996), designed by Dagit Saylor Architects and located just east of the Rauch Business Center (1990), houses a 1,000-seat music auditorium, a 300-seat theatre, a permanent art gallery and museum store, and the departments of music and theatre. A 350-car parking garage is on the same site.

The university has seen numerous buildings constructed and renovated since 2000 on all three campuses. New Mountaintop construction includes an addition to Iacocca Hall for biological sciences (2003), and ongoing renovations in Building C (since 2013) for the Data X Mountaintop Experience.

New construction on Goodman Campus includes the Mulvihill Golf Learning Center (2007); the Ulrich Sports Complex (2002), the recently constructed Gould Shenfeld Half-Time Building (2015), and most recently, Leadership Field Softball Complex and Legacy Field Baseball Complex (2015). Additions have been made to Cundey Varsity House (2002, 2015), and Stabler Arena (2004).

New buildings on the Asa Packer Campus include a new Police Station at Taylor and E. Packer Streets (2016); the STEPS building for science, technology, environment, policy and society (2010), Lehigh’s first LEED-certified building (Leadership in Energy and Environmental Design) which achieved Gold status in 2011; and the newly renamed Farrington Square (2002) a residential and retail complex and home to Farmer’s Market in the summers. Williams Hall (2015) was completely renovated to become a global hub for students, achieving Silver LEED status. There was also an addition to Sinclair Lab (2005).

New campus enhancements have eliminated vehicular traffic and created landscaped walkways in the historic core of the Asa Packer Campus. A 350-car parking garage pavilion and visitors arrival court (2005) at the west entrance to the Alumni Memorial Building completed the project. Altogether, the three campuses contain more than 160 buildings with more than 4.5 million square feet of floor space.

**Campus Landmarks**

In the following list, the date after the name of each building indicates the year of construction.

**Alumni Memorial Building** (1925). This edifice of Gothic design, housing the Visitor Center, Admissions and other administrative offices, and those of the Alumni Association, represents a memorial to the 1,921 Lehigh alumni who served in World War I and the 46 who died. The building was designed by Theodorus G. Visscher, Class of 1899, and James Lindsey Burley, Class of 1894.

**E. W. Fairchild-Martindale Library and Computing Center** (1985). The high-technology building houses science and engineering holdings, The Media Center, library and technology services staff, and a computer center. Construction was made possible by a major gift from Harry T. Martindale, a 1927 Lehigh graduate, and his wife, Elizabeth, daughter of the late Edmund W. Fairchild, founder of a business publications and communications empire.

**Linderman Library** (1877). The rotunda, designed by Addison Hutton, was built as a gift to the university by founder Asa Packer as a memorial to his daughter, Lucy Packer Linderman. The rotunda is surrounded except on the south by a major addition constructed in 1929. The building houses more than 20,000 rare books and volumes related to the humanities and social science. The Bayer Galleria of Rare Books, made possible by a gift from Curtis F. Bayer ’35, was dedicated in 1985. The building reopened in the spring of 2007 as the intellectual and humanities hub of the university after being closed for renovations for nearly two years. Major new features include more seminar and group study rooms, wireless Internet access throughout, central air conditioning, new furniture and finishes, and a cafe.

**Packer Memorial Church** (1887). The church was the gift of Mary Packer Cummings in memory of her father, founder Asa Packer. It was dedicated on Founder’s Day, October 13, 1887. The building was designed by Addison Hutton; the building is on the National Register of Historic Places.

**President’s House** (1868). This 21-room residence, designed by Edward Potter, is the home of university presidents and is often used for receptions on special university occasions.

**Packer Hall, The University Center** (1888). When construction of the building began in 1885, a railroad was built to transport stone to the site. The building, designed originally by Potter, was extensively renovated and enlarged in 1958. The building was constructed at the expense of the founder, who vetoed a plan to erect it of brick. “It will be built of stone,” Asa Packer responded.

Today the building houses student and faculty dining facilities, a food court, deans’ offices, student activities offices, the Women’s Networking Center, The Center for Academic Success, a bank office, and conference facilities.

**Academic and Research Facilities**

In the following list, the first date after the name of each building indicates the year of construction. The second date indicates the year of a major addition.

**Building C** (1968, ongoing since 2013). Once Bethlehem Steel's 1960s-era industrial-research facility, Building C is now being transformed (high-bay by high-bay since 2013) into a 21st Century learning environment initiative where Lehigh student's pursue creative and innovative answers to challenges and open-ended questions.

**Chandler-Ullmann Hall** (1883, 1938, respectively). These adjoining buildings formerly were the William H. Chandler Chemistry Building (designed by Hutton) and the Harry M. Ullmann Chemistry Laboratory. Chandler served as acting university president, 1904 and 1905, and taught chemistry from 1871 to 1906. Ullmann served as chairman of the chemistry department. The building has been named a National Historic Chemical Landmark by the American Chemical Society. The Department of Art, Architecture and Design and Department of Psychology are located in Chandler-Ullmann.

**Christmas-Saucon Hall** (1865 and 1872, respectively). Christmas Hall is the university's oldest building. When Asa Packer acquired the South Mountain site for the university in 1865, a Moravian church was being constructed. The newly formed university took over the building and completed it for use in recitations and as a dormitory and chapel. The name Christmas Hall was chosen in keeping with Moravian religious tradition. In 1872, Saucon Hall was constructed a few feet to the east of Christmas Hall. The buildings were connected with the construction of a “hyphen” in 1926. The building houses the Department of Mathematics, The University Press, and classrooms, while the ID Card and Gold PLUS offices are located in the annex.

**Coppee Hall** (1883). The building was the original university gymnasium. It is named in honor of Henry Coppee, first president. The building was renovated in 2002 and houses the Weinstock Center for Journalism and Communication.

**Coxe Hall** (1910). Originally a mining laboratory, the structure is named for Eckley B. Coxe, pioneer mining engineer and trustee of the university. The building was recently renovated for the International Students and Scholars and the English as a Second Language programs and the Global Union. It also houses the office of the Vice President for International Affairs.

**Dialogue Center**. This Victorian structure, until recently used by the Newman Association, was converted to a center for dialogue on values and spirituality, and also houses the university chaplain's office.
Drown Hall (1908). The building, designed by Furness and Evans, is a memorial to Thomas M. Drown, president from 1895 to 1904. It is headquarters for the English Department and the Writing and Math Center.

Fritz Engineering Laboratory (1909, 1955). The laboratory is named for John Fritz, pioneer in the steel industry in the United States and a member of the university’s original board of trustees. Fritz provided funds for the original section; a seven-story addition accommodates the university’s testing machine, which is capable of applying a five-million-pound load to tension or compression members up to forty feet in length. The hydraulic testing machine is the largest facility of its kind currently in operation in the world. The laboratory is used primarily by the Department of Civil and Environmental Engineering.

Iacocca Hall (1958, 2003). Known as the tower building for its panoramic views of the Lehigh Valley, as a houses the College of Education, the chemical engineering department, the biological sciences department, The Iacocca Institute, as well as a dining room and food service facilities, plus a teleconferencing classroom.

Imbt Laboratories (1958). This is primarily a high-bay research lab space where the ATLSS project was constructed, and where chemical engineering and Energy Research Center have major research facilities. It is also the headquarters of the “Fleet of the Future” program.

Johnson Hall (1955). The building houses the university health service, the counseling service, campus police, and the parking services office. Earle F. “Coxey” Johnson ’07, a director of General Motors Corp. and university trustee, provided funding for the structure.

Jordan Hall (1958). One of the original Bethlehem Steel buildings, this facility now houses the Military Science and Leadership program (Army ROTC) and the university investment office.

Lamberton Hall (1907). The structure served as the university commons and dining room until the renovation of Packer Hall in 1958. The building honors the memory of Robert A. Lamberton, third president. In January of 2006 it reopened as a late-night diner called the “Hawk’s Nest” and student programming facility in the Kenner Great Room.

Maginnes Hall (1970). The multilevel structure is headquarters for the College of Arts and Sciences and also houses the departments of history, international relations, and political science. New classrooms opened on the ground floor in January 2004. The building is named for Albert B. Maginnes ’21, who was a lawyer and university trustee.

Mart Science and Engineering Library (1968). This structure honors the memory of Leon T. Mart ’13, and his son, Thomas ’51. It was incorporated into the E. W. Fairchild-Martindale Library and Computing Center in 1985.

Seeley G. Mudd Building (1975). This seven-story building houses the chemistry department. The late Seeley G. Mudd was a California medical doctor. The Seeley G. Mudd Foundation, of Los Angeles, made a major gift toward the building.

Neville Hall (1975). This building in the chemistry complex has three auditoriums used for lectures and events. The building is named for Dr. Harvey A. Neville, president from 1961 to 1964, who was a chemist.

Packard Laboratory (1929). The structure was the gift of James Ward Packard, Class of 1884, the electrical pioneer and inventor of the Packard automobile who served as a university trustee. The first Packard automobile (1898) is displayed in the lobby. The building is the headquarters for the P. C. Rossin College of Engineering and Applied Science. It also houses classrooms and laboratories for mechanical engineering and mechanics, for electrical and computer engineering, and computer science and engineering. An auditorium accommodates large classes and various events.

Philosophy Building (1879). This small building just below Packer Memorial Church was constructed as a porter’s lodge. Today it houses the philosophy department.

Price Hall (1899) This structure formerly was a brewery named Die Alte Brauerei. In 1912 it was remodeled to serve as a dormitory, and it was named in honor of Henry Reese Price, president of the university board of trustees. It is currently vacant.

Rathbone Hall (1971). This building’s upper level is a major and recently renovated student dining facility, with window walls affording a panoramic view of the Lehigh Valley. The building bears the name of its donor, Monroe Jackson Rathbone ’21, president of the university board of trustees from 1957 to 1973. Rathbone was chairman of the board, Standard Oil Co. (New Jersey), now Exxon Corp., and was a major innovator in the oil industry. The lower level houses the Residential Services Office.

Rauch Business Center (1990). Philip Rauch ’33, L.L.D. ’79, retired chairman of the board and director of the Parker-Hannifin Corp., made the principal contribution to build this facility. Lehigh’s Rauch Business Center was dedicated in 1990 as the state-of-the-art home of the university’s College of Business and Economics. The $17.8-million facility has 115,000 square feet of floor space on five stories and features a diverse array of classrooms, auditoria, conference rooms, the Career Services Office, The Common Grounds Café, and is also home to the Perella Financial Services Lab.

Sayre Building (1869). Originally known as the Sayre Observatory, the dome that once housed the telescope can still be seen.

Sherman Fairchild Center for the Physical Sciences (1892, 1976, 1986). The center, completed with help from the Sherman Fairchild Foundation, houses classrooms and laboratories for undergraduate and graduate students in physics, faculty offices, and a 260-seat auditorium. The complex includes the Lewis Laboratory, the original five-story stone structure built in 1892, the Sherman Fairchild Laboratory for Solid-State Studies built in 1976, and the 1986 addition comprised of the Oberkotter Auditorium and research laboratories.

Sinclair Laboratory (1970). This facility houses the office of the Vice President for Research, the Center for Optical Technologies, The International Materials Institute, and other research laboratories. It is named for Francis MacDonald Sinclair, and was the gift of his widow, Jennie H. Sinclair. A 12,000-square foot research addition (The Smith Family Center for Optical Technologies) was completed in 2005.

STEPS Building (2010). This facility is the cornerstone of the new STEPS Initiative, which was founded to strengthen Lehigh’s commitment to collaboration, innovation, and scholarship in the areas of science, technology, environment, policy, and society. The new 137,000-square-foot building is at the corner of Packer Avenue and Vine Street on Lehigh’s Asa Packer campus. The building was designed to eliminate boundaries between the disciplines and features state-of-the-art teaching and research areas mingled with seminar rooms, study lounges, and faculty offices. The $60 million facility is the university’s first “green” building having been awarded LEED gold certification (Leadership in Energy and Environmental Design). It incorporates features such as heat recovery systems, a radiant-floor heating system, an abundance of natural lighting, an automated daylight harvesting system, an Energy Star roof membrane, and an 8,000-square-foot vegetated roof. It is home to the Earth and Environmental Sciences department and the Energy Systems Engineering Institute (ESEI) and contains research labs for environmental engineering and teaching labs for biological sciences and chemistry.

Whitaker Laboratory (1965). This five-story structure with an adjoining two-level classroom-auditorium section honors the memory of Martin Dewey Whitaker, university president from 1946 to 1960. The building serves the Department of Materials Science and Engineering and Center for Advanced Materials and Nanotechnology. There are laboratories for high-pressure research and reaction kinetics, nuclear studies, analog computation, process control, optoelectronics, high-temperature thermodynamics and kinetics, and fine structures and metallography. The Offices of Government and Community Relations and Technology Transfer are also located in the building.

Wilbur Powerhouse (1908). During most of its life, the building served as a power plant with some early engineering laboratory use. Renovated during the 1970s, it provided performing space for student theatrical productions, until the Zoeller Arts Center was built, and it is now the new home for student shops and project studios for the IPD (Integrated Product Development) and The Baker Institute for Entrepreneurship.

Williams Hall (1903). This brick structure was the gift of Edward H. Williams, Jr., Class of 1875. Dr. Williams was a professor of mining and geology and the founder of the Tau Beta Pi engineering society. The building was extensively renovated and a fourth story added in 1956 following a fire. Summer 2015 brings a refurbished and
repurposed historical Williams Hall that reinforces the integration of academic programs and student support. It is a global hub for the Lehigh community complete with a Global Commons, a Global Cafe, as well as departments of modern languages and literature and political science. Williams Hall is the university's second "green building" and attained Silver LEED certification upon completion.

Zoeller Arts Center (1997). With major gifts from Vickie and Robert Zoeller '54, Dorothy and Dexter Baker '50, and Claire and Theodore Diamond '37, Dagt-Saylor Architects created a 105,000-sq.-ft. structure designed to showcase Lehigh's rapidly growing programs in the performing and visual arts as well as the departments of music and theatre and 5,000 sq. ft. of exhibition space for the Lehigh University Art Galleries. Baker Hall has a seating capacity of more than 1,000, Diamond Theatre features a thrust stage and seating for 307; and a "black box" theater provides flexible space for experimental productions.

**Athletic and Convocational Facilities**

In the following list, the first date after the name of each building indicates the year of construction. The second date indicates the year of a major addition.

**Taylor Gymnasium** (1904 and 1913). This structure was the gift of Charles L. Taylor, Class of 1876, who was a friend and business associate of steel magnate Andrew Carnegie. There are two indoor swimming pools, two basketball courts, the Welch Fitness Center, men's and women's locker rooms, two racquetball and two squash courts, a multipurpose dance/aerobics room, a dance studio, a dance/spin studio, a climbing wall, a Sports Medicine Complex, and the Penske Hall of Fame. The athletic department offices are also housed in the Warren (Pete) Musser wing.

**Grace Hall** (1940 and 2013). The building is named for its donor, Eugene G. Grace, Class of 1899, who was chairman of Bethlehem Steel Corp. and president of the university's board of trustees, 1924 to 1956. Grace Hall serves as the headquarters and offices for Lehigh intramural and club sports. The lower level houses the Leeman-Turner Arena, and the upper level houses the recently renovated Caruso Wrestling Complex.

**Sayre Field** (1961). Located atop South Mountain, the field is used for intramural sports.

**Cundey Varsity House** (1963; expanded in 2002 & 2015). The building, expanded and renovated in 2002, houses a modern weight training facility, sports medicine and equipment areas, team meeting and reception areas, and locker rooms for several varsity teams. The Varsity House is located on the Murray H. Goodman Campus adjacent to the John C. Whitehead Football Practice Facility. The 2015 expansion of the west side of the building will accommodate Lehigh's growing athletic programs to better serve the student-athletes.

**Philip Rauch Field House** (1976). Philip Rauch '33, L.L.D. '79, made a gift toward the facility. The building has 62,000 square feet of uninterrupted floor space, the equivalent of two football fields, for a variety of athletic and non-athletic activities. It has a six-lane, one-eighth-mile flat track.

**Stabler Athletic & Convocational Center** (1979). This arena provides seating for 6,000 people for concerts, spectator sports, including Lehigh's basketball teams, and other events. University trustee Donald B. Stabler '30 made a major financial contribution toward the facility.

**Murray H. Goodman Stadium** (1988). Joanie and Murray Goodman '48, L.L.D. '88, were the principal benefactors. On October 1, 1988, Lehigh opened the gates to Murray H. Goodman Stadium, located on the Goodman Campus. Capacity is 16,000, and the stadium features a three-tiered press box and limited chair back seating, with picturesque South Mountain in the background.

**Lewis Tennis Facility** (1994). An anonymous donor made possible the construction of four indoor tennis courts for recreational use as well as team practice, and is named for former Lehigh President W. Deming Lewis. The building also includes men's and women's locker room facilities.

**Ulrich Sports Complex** (1999; expanded in 2009 & 2015). Lehigh chairman of the board of trustees, Ronald J. Ulrich '66, provided the principal funding for the construction of a multi-field game complex used for men's and women's soccer, men's and women's lacrosse, and field hockey. The complex features a natural grass and two artificial surface fields: Frank Banko Field and Ronald J. Ulrich Field. The complex has permanent seating, press boxes, and lighting for night contests. A group of students enrolled in the University's distinctive ILE (Integrated Learning Experience) program collaborated in the design of the original complex, illustrating the strong partnership between athletics and academics at Lehigh. The new Gould Shenfeld Half-Time building (2015) is a place for the competing teams to meet at halftime as well as pre and post game.

**Mulvihill Golf Learning Center** (2007). A USGA Qualified Training Facility with a driving range with five target greens, large practice green, and chipping green with three sand bunkers. The indoor facility houses a 672 square foot practice green and three indoor driving range bay providing year round training for the Men's and Women's Golf programs.

**Leadership Field, New Softball Field Complex** (2015). Located near the Goodman campus entrance, the complex includes a new playing field, video platforms, modern stands, enhanced dugouts, bullpens, batting cages, and a press box.

**Legacy Field, Baseball Field Complex** (2015). This newly renovated baseball includes larger and enhanced dugouts, a synthetic infield and a natural grass outfield, bullpens and batting cages, modern stands, a press box, and a cable and netting system.

**Residential Facilities**

In the following list, the first date after the name of each building indicates the year of construction. The second date indicates the year of a major addition.

**Brodhead House** (1979). This structure is the university’s first high-rise residential facility. The six-story building includes 4-person suites on the five upper floors, with a dining facility and lobby on the entrance level. The building is named in memory of Albert Brodhead, a member of the Class of 1888 who died in 1933, leaving 51 Bethlehem properties to his alma mater.

**Farrington Square** (2002). In August of 2002, Lehigh opened a 250-bed residential complex that includes the campus bookstore, the university post office, and several retail stores. Air-conditioned, two-, three-, and four-bedroom apartments are complete with full kitchen, private bathroom and fully furnished living room/dining room areas. Attached to the complex is a parking garage for 350 cars for residents' convenience.

**Dravo House** (1948). This 5-story stone edifice is the university’s largest residential facility. It bears the name of two brothers, Ralph M. Dravo, Class of 1889, and Francis F. Dravo, Class of 1887, who founded the Dravo Corp., a Pittsburgh-based international construction company. Both men served as university trustees.

**Drinker House** (1940). This stone building honors the memory of Henry S. Drinker, Class of 1871, university president from 1905 to 1920.

**McClintic-Marshall House** (1957). This U-shaped stone structure was built in memory of Howard H. McClintic and Charles D. Marshall, both Class of 1888, who founded the McClintic-Marshall Construction Co. The firm was the world’s largest independent steel fabricating firm before its acquisition by Bethlehem Steel Corp. in 1931. It built locks for the Panama Canal and constructed the Golden Gate Bridge in San Francisco Bay.

**Packer House** The Graduate Student Center and Office of Graduate Life moved here in the summer of 2009, offering multipurpose social programming and meeting space as well as residential space for graduate students.

**Richards House** (1938). The building honors the memory of Charles Russ Richards, president of the university from 1922 to 1935. The building is constructed of stone in modified Gothic design.

**Sayre Park Village** (1998). This residential complex is comprised of three apartment buildings and houses students in three- and four-person apartments. Included is a fourth multipurpose community building and outdoor recreation facilities.

**Taylor House** (1907, 1984). The U-shaped building is one of the earliest concrete structures ever built. It was the gift of industrialist Andrew Carnegie in honor of his friend and associate, university trustee Charles
L. Taylor, Class of 1876. The interior of the building was reconstructed and the exterior refinished prior to the facility becoming Lehigh’s first residential college in 1984.

**Trembley Park** (1975). This seven-building undergraduate apartment complex is named in memory of Francis J. Trembley, Lehigh professor and pioneer ecologist.

**Umoja House.** The Umoja House was established in 1989 to enhance the campus atmosphere for underrepresented students at Lehigh. The U House offers a safe and comfortable environment for any student who values multiculturalism.

**Warren Square Complex.** This cluster of four residence halls is located on Warren Square and Summit Street. They are upperclass facilities and some are used as special-interest houses.

**CENTENNIAL I COMPLEX (1965)**

**Congdon House.** Located at the east end of the Centennial I complex. Dr. Wray H. Congdon served as dean of students, dean of the graduate school, and special assistant to the president.

**Emery House.** It is named for Dr. Natt M. Emery, who was vice president and controller.

**Leavitt House.** The Rev. Dr. John McD. Leavitt was the second president, 1875 to 1879.

**McConn House.** C. Maxwell McConn was dean of the university from 1923 to 1938.

**Smiley House.** Dr. E. Kenneth Smiley served as vice president from 1945 to 1964.

**Thornburg House.** Dr. Charles G. Thornburg was professor and head of the Department of Mathematics, 1895 to 1923

**CENTENNIAL II COMPLEX (1970)**

**Beardslee House.** Dr. Claude G. Beardslee was chaplain from 1931 to 1947.

**Carothers House.** Dr. Neil Carothers was dean of business.

**Palmer House.** Dr. Philip M. Palmer was dean of the arts.

**Stevens House.** The Rt. Rev. William Bacon Stevens, of Philadelphia, was Protestant Episcopal bishop of the Diocese of Pennsylvania and first president of the university board of trustees. He was the principal architect of the university’s original academic plan.

**Stoughton House.** Dr. Bradley Stoughton was dean of the engineering college, 1936 to 1939.

**Williams House.** Dr. Clement C. Williams was president of the university, 1935 to 1944.

**SAUCON VILLAGE APARTMENTS (1974)**

The five-building garden apartment complex includes housing for married, graduate, and undergraduate students.

**Diamond.** Dr. Herbert M. Diamond, professor emeritus of economics, retired in 1964.

**Gipson.** Dr. Lawrence Henry Gipson, research professor of history, bequeathed his estate to the university to establish the Lawrence Henry Gipson Institute for Eighteenth-Century Studies. Dr. Gipson wrote a monumental 15-volume history, *The British Empire before the American Revolution*. He won the Pulitzer Prize for volume 10, *The Triumphant Empire: Thunderclouds Gather in the West, 1763-1766*.

**Hartman.** Dr. James R. Hartman was chairman of the department of mechanical engineering and mechanics.

**More.** Dr. Robert P. More ’10, dean of the College of Arts and Sciences, who also taught German for forty years, bequeathed to the university his $746,000 estate, amassed after investing $3,000 in IBM stock. The university child care center is located in this building.

**Severs.** Dr. J. Burke Severs, of Bethlehem, is distinguished professor emeritus of English. He is a Chaucerian scholar.

### FRATERNITIES AND SORORITIES

The university has a strong fraternity tradition, dating back to 1872. Since the admission of undergraduate women in 1971, several sororities have come into being. Some 450 men live in 16 fraternities.

All of the fraternities have houses located on Asa Packer campus. All are chapters of national fraternities.

An alphabetical listing follows. The date of the founding of the chapter is given in the first column. The second column lists the date the chapter occupied its present house; any additional date indicates the most recent addition or major renovation.

<table>
<thead>
<tr>
<th>Fraternity</th>
<th>Chapter Founded</th>
<th>Present House Occupied</th>
<th>Recent Addition or Renovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha Tau Omega</td>
<td>1882</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chi Phi</td>
<td>1972</td>
<td>1923</td>
<td>1968</td>
</tr>
<tr>
<td>Chi Psi</td>
<td>1983</td>
<td>1915</td>
<td>2005</td>
</tr>
<tr>
<td>Delta Chi</td>
<td>1952</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delta Upsilon</td>
<td>1885</td>
<td>1968</td>
<td></td>
</tr>
<tr>
<td>Kappa Alpha</td>
<td>1994</td>
<td>1961</td>
<td></td>
</tr>
<tr>
<td>Kappa Sigma</td>
<td>1900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phi Delta Theta</td>
<td>1879</td>
<td>2015</td>
<td></td>
</tr>
<tr>
<td>Phi Kappa Theta</td>
<td>1919</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phi Sigma Kappa</td>
<td>1901</td>
<td>1956</td>
<td>1970</td>
</tr>
<tr>
<td>Pi Kappa Alpha</td>
<td>1929</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psi Upsilon</td>
<td>1884</td>
<td>1909</td>
<td>1966</td>
</tr>
<tr>
<td>Sigma Chi</td>
<td>1887</td>
<td>1953</td>
<td></td>
</tr>
<tr>
<td>Sigma Phi Epsilon</td>
<td>1907</td>
<td>1963</td>
<td></td>
</tr>
<tr>
<td>Theta Chi</td>
<td>1942</td>
<td>1964</td>
<td></td>
</tr>
<tr>
<td>Theta Xi</td>
<td>1904</td>
<td>1967</td>
<td></td>
</tr>
</tbody>
</table>

There are nine sororities and all are nationally affiliated. Over 380 women live in sororities.

The sororities are listed with year of establishment at Lehigh in the first column and year of moving into their present house in the second column.

<table>
<thead>
<tr>
<th>Sorority</th>
<th>Establishment at Lehigh</th>
<th>Present House Occupied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha Chi Omega</td>
<td>1988</td>
<td>2007</td>
</tr>
<tr>
<td>Alpha Gamma Delta</td>
<td>1975</td>
<td>2000</td>
</tr>
<tr>
<td>Alpha Omicron Pi</td>
<td>1983</td>
<td>2004</td>
</tr>
<tr>
<td>Alpha Phi</td>
<td>1975</td>
<td>1996</td>
</tr>
<tr>
<td>Gamma Phi Beta</td>
<td>1975</td>
<td>1998</td>
</tr>
<tr>
<td>Kappa Alpha Theta</td>
<td>1984</td>
<td>2006</td>
</tr>
<tr>
<td>Kappa Delta</td>
<td>2013</td>
<td>2013</td>
</tr>
<tr>
<td>Pi Beta Phi</td>
<td>1997</td>
<td>2008</td>
</tr>
<tr>
<td>Zeta Tau Alpha</td>
<td>2010</td>
<td>2011</td>
</tr>
</tbody>
</table>
Administration, Faculty and Staff

This section lists the people whose talents and abilities constitute the university’s most important resource. Members of the board of trustees contribute their expertise to establish the policies of the university. Also listed are the administration, the members of the faculty and staff, and the members of the visiting committees who help to keep courses of instruction current and of maximum value to the students and their prospective employers.

Board of Trustees

When only the year of the degree is listed, the degree was awarded by Lehigh University. Brad Eric Scheler, chair; Jane P. Jamieson, vice chair; Kevin L. Clayton, vice chair; Frank A. Roth, corporate secretary; Denise M. Blew, treasurer; David L. Hammer, assistant treasurer

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Jennifer Gonzalez, B.A. ’08, M.A. ’09, Principal Environmental Planner, The Louis Berger Group, Inc.
Jordan Hitch, B.S. ’88, M.B.A. ’95, University of Chicago, former managing director, Bain Capital
Lia Iacocca-Assad, B.A. ’86 (Communications), Oakland University, founder, Kacoon Enterprises, LLC
Francis J. Ingrassia, B.S. ’75, ’17P, president and chief executive officer, Clever Devices, Inc.
Jane P. Jamieson, B.A. ’75, M.S. ’76, Boston University, retired executive vice president, marketing, Fidelity Investments
Stephen K. Klasso, ’74, M.D. ’78, Hahnemann University, M.B.A. ’86, University of Pennsylvania Wharton School, president and chief executive officer, Thomas Jefferson University and Jefferson Health System
Anne R. Kline, B.A. ’81, senior vice president, Revere Bank
Mark V. Mactas, B.A. ’74, retired president and chief operating officer, Towers Watson
James R. Maido, B.S. ’85, ’17P, ’19P, J.D. ’90, Rutgers University, president, Gaming Laboratories International LLC
Kira Cauwels Mendez, B.S.E.E. ’83, M.S. ’85, Rensselaer Polytechnic Institute, M.B.A. ’88, Harvard Business School; Senior Advisor to social sector leaders; Former Partner, The Bridgespan Group
Peter A. Morales, B.A. ’84, managing director, Black Hawk Beverage Group

Edward Ramos, B.S. ’89, M.B.A. ’93, Columbia University, senior vice president, Cornerstone Capital Management Holdings, LLC
Joseph R. Perella, B.S. ’64, M.B.A. ’72, Harvard University, ’06H, founding partner and chairman, Perella Weinberg Partners LP
Brad Eric Scheler, B.A. ’74, ’05P, ’08P, ’09PG, J.D. ’77, Hofstra University; senior partner, Fried, Frank, Harris, Schriver & Jacobson LLP and chairman of the firm’s bankruptcy restructing practice
Philip B. Sheibley, B.S. ’81, venture capital investor and former managing partner, Accenture LLP
Safiya Jafari Simmons, B.A. ’03, M.A. ’06, St. Joseph’s University, CEO and chief strategist, SJS Consulting, founder, Leap Luncheon Series and Executive Strategies
Dennis E. Singleton, III, B.S. ’66, M.B.A. ’68 Harvard University, retired chief financial officer, chief investment officer and vice chair, Spieker Properties, Inc.
Tara I. Stacom, B.S. ’80, executive vice chairman, Cushman & Wakefield
Frank E. “Ted” Walsh III, B.S.B.U. ’88, partner, WR Capital Partners
Gina N. Whittfield, B.S.M.E. ’05, M.B.A. ’13, University of Texas-Austin, business development manager, Sunoco Logistics
Michael J. Yaszenski, B.S.Ch ’77, M.S. ’78, M.D. ’83, Georgetown University, Ph.D. ’95, Massachusetts Institute of Technology, John and Posy Krehbiel Endowed professor of orthopedic surgery and biomedical engineering, Mayo Clinic, and director of its Polymeric Biomaterials and Tissue Engineering Laboratory
Mark R. Yeager, B.S. ’81, founder and owner, MRY Associates LLC

TRUSTEES EMERITI

Peter E. Bennett, B.S. ’63, ’93P, MBA ’67, Columbia University, chairman, Liberty Partners LP
Nancy M. Berman, B.A. ’67, Wellesley College, M.A., Hebrew Union College, Honorary Doctor of Humane Letters ’97, president, Philip & Muriel Berman Foundation
Michael J. Caruso, B.A. ’67, chairman/chief executive officer, Caruso Benefits Group, Inc., a division of National Penn Bank
James J. Duane, III, B.A. ’73, ’04P, ’06P, ’06PG, M.A. ’75, Manchester University; J.D. ’78, Harvard University, partner, Peabody & Arnold LLP
Murray H. Goodman, B.S. ’48, Honorary Doctor of Laws ’88, chairman, The Goodman Company
William F. Hecht, B.S. ’64, M.S. ’70, retired chairman and chief executive officer, PPL
Douglas C. Lane, B.S. ’67, M.B.A. ’68, University of Michigan-Ann Arbor, president, Douglas C. Lane & Associates
Paul Leitner, B.S.B.U. ’76, M.B.A. ’80 New York University, principal and founding partner, The Leitner Thomas Group
Eugene Mercy Jr., B.S. ’59, Honorary Doctor of Laws ’98, former chairman, Granite Capital International Group
Philip R. Peller, B.S. ’60, M.B.A. ’61 New York University; retired partner, Andersen World Wide
Lehigh University 2016-2017

Educational information (degrees earned and colleges and universities attended) may be found in the alphabetical listing that follows in this section. The highest degree earned is given here. All offices, unless otherwise noted, are located at Bethlehem, PA 18015; the area code, unless otherwise noted, is (610).

**PRINCIPAL OFFICERS**

**John D. Simon**, Ph.D., president; 758-3156

**Patrick V. Farrell**, Ph.D., provost and vice president for academic affairs; 758-3605

**Fred J. McGrail**, B.A., vice president for communications and public affairs; 758-4487

**Frank A. Roth**, J.D., general counsel, secretary to the board; 758-3572

**Erik J. Walker**, M.A., chief of staff, Office of the President; 758-3131

**Patricia A. Johnson**, M.B.A., vice president for finance and administration; 758-3178

**Denise M. Blew**, B.S., CMA, CPA, associate vice president for finance and administration and assistant secretary to the board; 758-3179

**Alan J. Snyder**, Ph.D., vice president & associate provost for research & graduate studies; 758-6964

**Joseph D. Sterrett**, Ed.D., Murray H. Goodman dean of athletics; 758-4320

**Kristin Agatone**, M.B.A., chief investment officer; 758-3034

**Cheryl Ann Matherly**, Ed.D., vice president and vice provost for international affairs; 758-4709

**Georgette Phillips**, J.D., Kevin L. and Lisa A. Clayton dean, College of Business and Economics; 758-8725

**Donald E. Hall**, Ph.D., Herbert J. and Ann L. Siegel dean, College of Arts and Sciences; 758-4570

**Gary M. Sasso**, Ph.D., dean, College of Education; 758-3221

**John Coulter**, Ph.D., interim dean, P.C. Rossin College of Engineering and Applied Science; 758-5308

**Vincent G. Munley**, Ph.D., deputy provost for faculty affairs; 758-3165

**Jennifer Jensen**, Ph.D., deputy provost for academic affairs; 758-3705

**J. Leon Washington**, M.A., vice provost of admissions and financial aid; 758-3101

**Bruce M. Taggart**, Ph.D., vice provost for library and technology services; 758-3025

**Henry Odi**, Ph.D., vice provost for academic diversity; 758-3813

**Henry Zheng**, Ph.D., vice provost for institutional research; 758-5890

Vice president for advancement - TBD

Vice provost for student affairs - TBD

**College Offices**

**College of Arts and Sciences**

Maginnes Hall
9 West Packer Avenue; 758-3300

Donald E. Hall, Ph.D., Herbert J. and Ann L. Siegel dean

Diane Hyland, Ph.D., senior associate dean for faculty and staff

Cameron Wesson, Ph.D., associate dean, undergraduate programs

Garth Isaak, Ph.D., associate dean, research and graduate programs

**College of Business and Economics**

Rauch Business Center
621 Taylor Street; 758-3400

Georgette C. Phillips, J.D., Kevin L. and Lisa A. Clayton dean

Katrina Zalatan, Ph.D., associate dean and director of the undergraduate programs

Andrew Ward, Ph.D., associate dean, graduate programs

**College of Education**

Iacocca Hall
111 Research Drive; 758-3221

Gary M. Sasso, Ph.D., dean

Ward Cates, Ed.D., associate dean

**P.C. Rossin College of Engineering and Applied Science**

Packard Laboratory
19 Memorial Drive West; 758-4025

John P. Coulter, Ph.D., interim dean

Gregory L. Tonkay, Ph.D., associate dean, undergraduate studies

Raymond Pearson, Ph.D., associate dean, graduate studies and research

**Offices and Resources**

In this section, only the principal officers are listed. For degree information, consult the alphabetical listing that follows.

**Academic Outreach**

618 Brodhead Avenue; 758-4802

Angela Scott, director of academic diversity and outreach

**Admissions**

27 Memorial Drive West; 758-3100

J. Leon Washington, dean of admissions and financial aid

**Advancement**

27 Memorial Drive West; 758-4711

Vice president for advancement - TBD

**Alumni Association**

27 Memorial Drive West; 758-5799

Jennifer Cunningham, assistant vice president, alumni engagement

**Art Galleries/Museum Operations**

420 East Packer Avenue; 758-3615

Ricardo Viera, director/curator

**Athletics**

641 Taylor Street; 758-4300

Joseph D. Sterrett, Murray H. Goodman dean of athletics

**Ben Franklin Technology Center**

125 Goodman Drive; 758-5200

R. Chad Paul, president & chief executive officer

**Bookstore**

9 West Packer Avenue; 758-3383

Brian Adler, General Manager

**Budget Office**

422 Brodhead Avenue; 758-4204

Stephen J. Guttmann, director of budget
Bursar  
27 Memorial Drive West; 758-3160  
Michael J. King, bursar

Business Services  
516 Brodhead Avenue; 758-3840  
Mark R. Ironside, executive director

Career Services  
621 Taylor Street, 484 RBC; 758-3710  
Lori Kennedy, director

Center for Writing, Math and Study Skills  
35 Sayre Drive; 758-3098  
Edward E. Lotto, director

Chaplaincy Services  
661 Taylor Street; 758-3877  
Rev. Dr. Lloyd H. Steffen, university chaplain and professor of religion studies

Child Care Center  
5 Duh Drive #21; 758-5437  
Kathy N. Calabrese, director

Community and Regional Affairs  
343 Whitaker Lab, 5 E. Packer; 758-5801  
Adrienne Washington, assistant vice president, community relations

Computing Center (see Information Resources)

Conference Services  
63 University Drive, Rathbone Hall; 758-5306  
Mary Kay Baker, director

Controller's Office  
524 Brodhead Avenue; 758-3140  
Kathleen J. Miller, controller

Corporate and Foundation Relations  
27 Memorial Drive West; 758-6845  
Cameron J. McCoy, assistant vice president, economic engagement

Counseling & Psychological Services  
36 University Drive; 758-3880  
Ian T. Birky, director

Dean of Students  
29 Trembley Drive, C108 University Center; 758-4156  
Sharon K. Basso, associate vice provost and dean of students

Development (see Advancement)

Distance Education (see Special Academic Programs)

Environmental Health and Safety  
616 Brodhead Avenue; 758-4251  
Barbara A. Plohocki, director

Facilities Services and Planning  
461 Webster Street; 758-3970  
Associate vice president - TBD

Finances and Administration  
27 Memorial Drive West; 758-3180  
Denise M. Blew, associate vice president

Financial Aid  
218 W. Packer Avenue; 758-3181  
Jennifer Mertz, director

Fraternity and Sorority Affairs  
29 Trembley Drive B004; 758-4157  
Ashley Baudouin, assistant dean and director

General Counsel  
27 Memorial Drive West, Room 307; 758-3572  
Frank A. Roth, Esq., general counsel  
Heather K. Hosfeld, Esq., deputy general counsel

Government Relations and Economic Development  
5 Whitaker Lab; 758-5802  
William D. Michalery, associate vice president; 758-5802  
Vito G. Gallo, assistant vice president for state relations; 758-5801

Graduate Student Life  
217 W. Packer Ave.; 758-4722  
Kathleen S. Hutnik, director of graduate student life

Health Center  
36 University Drive, Johnson Hall; 758-3870  
Susan C. Kitei, M.D., director

Human Resources  
428 Brodhead Avenue; 758-3900  
Chris Halladay, associate vice president

Institutional Research  
422 Brodhead Ave.; 758-5890  
Henry Zheng, vice provost for institutional research

Internal Audit  
526 Brodhead Avenue; 758-5012  
Robert J. Eichenlaub, director

International Affairs  
32 Sayre Drive, Coxe Hall; 758-4709  
Cheryl Ann Matherly, vice president and vice provost for international affairs

Library and Technology Services  
8A East Packer Avenue; 758-3025  
Bruce M. Taggart, vice provost

Mailing and Printing Services  
118 ATLSS Drive; 758-5402 (Mailing); 758-5408 (Printing)  
Glenn H. Strause, director

Manufacturers Resource Center  
125 Goodman Drive; 758-5599  
Jack E. Pfunder, executive director

Parking Services  
36 University Drive, 106 Johnson Hall; 758-3893  
Sharon Field, manager

Personnel (see Human Resources)

Police (see University Police)

President’s Office  
27 Memorial Drive West; 758-3156  
John D. Simon, president

Provost’s Office  
27 Memorial Drive West; 758-3605  
Patrick V. Farrell, provost and vice president for academic affairs

Purchasing  
516 Brodhead Avenue; 758-3840  
Mark Ironside, executive director

Registrar  
27 Memorial Drive West; 758-3200  
Emil Gnasso, registrar

Research  
7 Sinclair Laboratory, Rm. 305; 758-6964  
Alan J. Snyder, vice president & associate provost for research & graduate studies

Research and Sponsored Programs  
526 Brodhead Avenue; 758-3021  
Thomas J. Meischeid, director

Residential Services  
63 University Drive, Rathbone Hall; 758-3500  
Ozzie Breiner, director

Risk Management  
616 Brodhead Ave.; 758-3899  
Richard Freeman, director

Special Academic Programs (Distance Education and Summer Studies)  
436 Brodhead Avenue; 758-3966 (Summer); 758-4373 (Distance)  
Margaret Portz, director

Sports Communications  
641 Taylor Street; 758-3174
Steve Lomangino, director

Student Affairs
29 Trembley Drive, University Center; 758-3890
John W. Smeaton, vice provost for student affairs

Student Auxiliary Services
63 Rathbone Hall; 758-5339
David M. Joseph, executive director

Summer Studies (see Special Academic Programs)

Transportation Services
126 Goodman Drive; 758-4410
Bob Bruneio, manager

Treasurer (see Finance and Administration)

University Police
321 East Packer Avenue; 758-4200
Edward K. Shupp, chief

University Communications and Public Affairs
125 Goodman Drive; 758-4487
Fred J. McGrail, vice president for communications and public affairs

Women’s Center
29 Trembley Drive; 758-6484
Rita Jones, director

Zoellner Arts Center
420 East Packer Avenue; 758-5323
Andrew Cassano, administrative director

Faculty and Emeriti

The first date after the name is the date of appointment to continuous service on the Lehigh University faculty; the second date, when the first fails to do so, indicates the date of appointment to the present professional rank. Where the name of the institution awarding a high-level degree is not given, the institution is the same one that awarded the previous degree listed.

P.E. indicates certification as a professional engineer; C.P.A. indicates certified public accountant. A.P.R. indicates accreditation by Public Relations Society of America.


J. Richard Aronson (1965, 1972), professor emeritus of economics. Clark University, BAC, 1959; Stanford University, MA, 1961; Clark University, PhD, 1964.

Catherine M. Arrington (2005, 2011), associate professor of psychology. Furman University, BA, 1994, BS, 1994; Wake Forest University, MA, 1996; Michigan State University, PhD, 2002.

Kelly F. Austin (2012), Frank Hook Assistant Professor and program director of Health, Medicine and Society Program and assistant professor of sociology and anthropology. Oregon State University, BA, 2006, BS, 2006; North Carolina State University, MS, 2008, PhD, 2012.


Nicholas W. Balabkins (1957), professor emeritus of economics. Rutgers University, MA, 1953, PhD, 1956.


Linda M. Bambara (1988, 2002), professor of special education. State University of NY, Oneonta, BS, 1975; State University of NY, Binghamton University, MS, 1979; State University of NY, Binghamton University, PhD, 1985.

Southee Bandypadhyay (2010), assistant professor of mathematics. St. Xavier's College, Calcutta(India), BA, 2003; Indian Statistical Institute(India), MA, 2005; Texas A&M University, PhD, 2010.

Arindam Banerjee (2012), assistant professor of mechanical engineering and mechanics. Jadavpur University(India), BS, 1999; Florida Institute of Technology, MS, 2002; Texas A&M University, PhD, 2006.

Henri J. Barkey (1987, 1999), Bernard L and Bertha Cohen Chair in International Relations and professor of international relations. City University London(United Kingdom), BS, 1975; University College London(United Kingdom), MS, 1976; University of Pennsylvania, PhD, 1984.

Robert F. Barnes, Jr. (1965, 0), professor emeritus of philosophy. Massachusetts Institute of Technology, BS, 1957; Dartmouth College, MA, 1959; University of California Berkeley, PhD, 1965.

Donald D. Barry (1963, 1970), professor emeritus of political science. Ohio State University, BA, 1956; Syracuse University, MA, 1959, PhD, 1963.


Floyd D. Beachum (2009), Peter E. Bennett '63 Chair in Urban Principalship and program director of Educational Leadership and associate professor of education leadership. Alabama State University, BA, 1995, MS, 1999; Bowling Green State University, PhD, 2002.


Sean Beienburg (2015), assistant professor of political science. Pomona College, BA, 2008; Princeton University, PhD, 2015.


Russell E. Benner (1962, 1994), professor emeritus of mechanical engineering and mechanics. Cornell University, BS, 1947; Lehigh University, MS, 1951, PhD, 1959.


Bryan W. Berger (2010, 2015), Class of '61 Professor and associate professor of chemical & biomolecular engineering. University of Illinois Urbana-Champaign, BSCH, 1999; University of Delaware, PhD, 2005.


Keith A. Botner (2015), assistant professor of marketing. University of Louisville, BS, 1996; Michigan State University, MBA, 1999; University of Utah, PhD, 2015.


Paul Brockman (2009), Joseph R. Perella and Amy M. Perella Chair and associate dean and professor of finance. Ohio State University, BA, 1986; Nova College, MBA, 1987; Louisiana State University, PhD, 1994.


Angela C Brown (2013), P.C. Rossin Assistant Professor and assistant professor of chemical & biomolecular engineering. The Pennsylvania State University, BS, 2000; Drexel University, MS, 2006, PhD, 2008.


Javier Buceta Fernandez (2014), associate professor of chemical & biomolecular engineering. Complutense University of Madrid(Spain), BS, 1994, MS, 1994; National University of Distance Education(Spain), PhD, 2000.


Yinzi Cao (2015), assistant professor of computer science and engineering. Tsinghua University(Republic of China), BS, 2008; Northwestern University, PhD, 2014.


Nancy B. Carlisle (2016), assistant professor of psychology. Michigan State University, BS, 2005; Vanderbilt University, Peabody College, PhD, 2011.


David Casagrande (2012), associate professor of sociology and anthropology. Southern Connecticut State University, BA, 1984; Yale University, MA, 1996; University Georgia Athens, PhD, 2002.


Paola M Careghetti Biagio (2012, 2014), professor of practice of physics. University of Zurich(Switzerland), BA, 2002; Swiss Federal Institute of Technology(Switzerland), MS, 1996; University of Pennsylvania, MA, 2007; Swiss Federal Institute of Technology(Switzerland), PhD, 2000.


Helen M. Chan (1986, 1995), New Jersey Zinc Company Professor and professor of materials science and engineering. Imperial College London(United Kingdom), BS, 1979, PhD, 1982.


Brian Y Chen (2010, 2016), associate professor of computer science and engineering. Rutgers University, BA, 2000; Rice University, MA, 2003, PhD, 2007.


Liang Cheng (2002, 2009), associate professor of computer science and engineering. Huazhong University of Science and Technology(Republic of China), BE, 1994; Tsinghua University(Republic of China), ME, 1997; Rutgers University, PhD, 2002.


Shin-Yi Chou (2003, 2010), Arthur F. Searing Chair and professor of economics. National Taiwan University(Taiwan), BA, 1994; Duke University, PhD, 1999.


Weijia Dai (2015), assistant professor of economics. Wuhan University(Peoples Republic of China), BA, 2007; University Southern Calif, MA, 2008; University of Maryland, PhD, 2015.


Dena S Davis (2011), Presidential Chair in Health - Social Sciences and Humanities and professor of religion studies. Marlboro College, BA, 1972; University of Iowa, PhD, 1986; University of Virginia, JD, 1990.


Minyi Shih Dennis (2010), assistant professor of special education. National Chengchi University(Republic of China), BA, 1994; University Texas, Austin, MA, 2000, PhD, 2005.


Bridget V. Dever (2013), Frank Hook Assistant Professor and assistant professor of school psychology. University of Notre Dame, BA, 2002; Marywood University, MA, 2004; University of Michigan Ann Arbor, PhD, 2009.


Volkmar R. Dierolf (2000, 2008), University Distinguished Professor and chairperson and professor of physics and materials science and engineering. University of Stuttgart(Germany), MA, 1987; University of Utah, PhD, 1992.


Yuju Ding (2002, 2005), professor of electrical and computer engineering. Jilin University(Peoples Republic of China), BS, 1984; Purdue University, MS, 1987; Johns Hopkins University, PhD, 1990.

Panayiotis Dipsas (2013), P.C. Rossin Senior Professor and chairperson and professor of civil and environmental engineering. National Technical University of Athens(Greece), BS, 1979; University of Minnesota Twin Cities, MS, 1983, PhD, 1986.


Louise E. Donohue (2011, 2015), professor of practice of education leadership. Immaculata University, BS, 1976; Villanova University, MS, 1981; Lehigh University, PhD, 1995.


John Alwyn Eades (1997), professor emeritus of materials science and engineering. Trinity Western University (Canada), BS, 1962; University of Cambridge (United Kingdom), PhD, 1967.


Matthias M. Falk (2003, 2016), professor of biological sciences. University of Giessen (Germany), BS, 1984, MS, 1987; Ruprecht Karl University of Heidelberg (Germany), PhD, 1992.

Hsai-Yang Fang (1966, 1976), professor emeritus of civil and environmental engineering. Hangzhou University (People's Republic of China), BS, 1947; Purdue University, MS, 1957; West Virginia Unive, PhD, 1966.


Robert A. Flowers, II (2003, 2004), Danser Distinguished Faculty Chair in Chemistry and professor of chemistry. East Stroudsburg University, BS, 1986; Lehigh University, PhD, 1991.


John Thomas Fox (2012), assistant professor of civil and environmental engineering. Virginia Military Institute, BS, 2006; The Pennsylvania State University, MS, 2009, PhD, 2011.


Yinan He (2014), associate professor of international relations. CIEE University of Peking(Peoples Republic of China), BA, 1992; Fudan University, MA, 1995; Massachusetts Institute of Technology, PhD, 2004.


Angela Hicks (2016), assistant professor of mathematics. Furman University, BS, 2007; University of California San Diego, MA, 2009, PhD, 2013.


Craig Hochbein (2013), assistant professor of education leadership. Northwestern University, BA, 1999; University of Notre Dame, MS, 2006; University of Virginia, PhD, 2009.


James C. Hwang (1988), professor of electrical and computer engineering. National Taiwan University (Taiwan), BS, 1970; Cornell University, MS, 1976, PhD, 1978.


Wonpil Im (2016), Presidential Chair in Health - Science and Engineering and professor of biological sciences. Hanyang University, BS, 1994, MS, 1996; Cornell University, PhD, 2002.


Heather Jaeger (2013), assistant professor of chemistry. Indiana-Purdue Unive, BS, 2006; University Georgia Athens, PhD, 2010.


Himanshu Jain (1985, 1993), Theodore L Diamond Distinguished Chair in Engineering and Applied Science and center/institute director of International Materials Institute and professor of materials science and engineering, Christ Church College (India), BSC, 1970; Banaras Hindu University (India), MSC, 1972; Indian Institute of Technology Kanpur (India), MOT, 1974; Columbia University, EngScD, 1979.


Kristen Jellison (2003, 2010), associate professor of civil and environmental engineering. Cornell University, BS, 1997; Massachusetts Institute of Technology, PhD, 2003.


Michael Jorgensen (2013, 2015), professor of practice of music. Eastman School of Music, BMUS, 2003; Guildhall School of Music and Drama(United Kingdom), MMus, 2004; Florida State University, DMUS, 2008.


Chad Kautzer (2016), associate professor of philosophy. University of Wisconsin at Madison, BA, 1998; Stony Brook University, PhD, 2008.


Jacob Y. Kazakia (1974, 1989), professor of mechanical engineering and mechanics. Istanbul Technical University(Turkey), MS, 1968; Lehigh University, PhD, 1972.


Christopher J. Kiely (2002), Harold Chambers Senior Professor in Materials Science and Engineering and professor of materials science and engineering and chemical & biomolecular engineering. University of Bristol(United Kingdom), BS, 1983, PhD, 1986.


Taewan Kim (2013), assistant professor of marketing. Korea University(Republic of Korea), BA, 2002; Stanford University, MS, 2004; University of North Carolina, MS, 2007; Syracuse University, PhD, 2013.


Kamil Klier (1968, 1973), professor emeritus of chemistry. Acad Sciences Czech Republic(Czech Republic), PhD, 1961.


Nevena Taneva Koukova (2005, 2012), James T. Kane Faculty Fellow and associate professor of marketing. University of National and World Economy(Bulgaria), BS, 1994; Case Western Reserve University, MBA, 2000; University of Maryland, PhD, 2005.


Jacqueline Krasas (2005), associate dean and associate professor of sociology and anthropology. Lehigh University, BA, 1987; University of Southern California, MA, 1994, PhD, 1995.


Frank F. Luh (1965, 1995), professor emeritus of accounting. National Taiwan University(Taiwan), BS, 1957; University of Illinois Urbana, MA, 1961; Ohio State University, PhD, 1965.

John F. Lule (1990, 1999), Iacocca Chair and chairperson and professor of journalism and communication and global studies. State University of NY, Binghamton University, BS, 1976; Temple University, MA, 1981; University Georgia Athens, PhD, 1987.


Jill McDermott (2016), assistant professor of earth and environmental sciences. Dartmouth College, BA, 2008; University of New Hampshire, MS, 2009; Massachusetts Institute of Technology, PhD, 2014.

Judith A. McDonald (1990, 2009), professor of economics. University of Western Ontario(Canada), BEC, 1979; Princeton University, PhD, 1986.


Anne S. Melitzer (1990, 1995), Francis J. Trembley Chair in Earth and Environmental Sciences and professor of earth and environmental sciences. Guilford College, BS, 1980; University of North Carolina, MA, 1982; Rice University, PhD, 1989.


Rajan M. Menon (1985, 2012), professor emeritus of international relations. Stephens College, BS, 1974; Lehigh University, MS, 1975; University of Illinois Urbana, PhD, 1979.

Joseph R. Merkel (1962, 1965), professor emeritus of chemistry. Moravian College, BS, 1948; Purdue University, MS, 1950; University of Maryland College Park, PhD, 1952.

Chad Meyerhoefer (2008, 2011), Arthur F. Searing Chair and associate professor of economics. State University of NY, Binghamton University, BA, 1997; Cornell University, MA, 2000, PhD, 2002.

Fortunato J. Micale (1966, 1995), professor emeritus of chemistry. St Bonaventure Univ, BA, 1956; Niagara University, BS, 1959; Purdue University, MS, 1961; Lehigh University, PhD, 1965.


Monica R. Miller (2013, 2016), program director of Women, Gender, and Sexuality Studies and associate professor of religion studies and african studies. Fordham University, BA, 2004; Drew University, MA, 2006; Chicago Theological Seminary, PhD, 2010.

Rebecca S. Miller (2004), professor of practice of chemistry. Shippenburg University, BS, 1992; Duke University, PhD, 1996.


Jeetain Mittal (2009, 2015), Dolores T. and William E. Schiesser Faculty Fellow and associate professor of chemical & biomolecular engineering. Punjab University(Pakistan), BOT, 2000; Indian Institute of Technology Kanpur(India), MS, 2002; University Texas, Austin, PhD, 2007.


Bruce E. Moon (1987, 1997), professor emeritus of international relations. Ohio State University, BS, 1972, MS, 1974, PhD, 1977.

Ozias A. Moore (2016), assistant professor of management. University of Pittsburgh, BS; Cornell University, MS; University of Pennsylvania, MSE.


Peter Mueller (1980, 1984), associate professor of civil and environmental engineering. ETH Zurich(Switzerland), DSc, 1978.

Rosemary J. Mundhenk environment engineering. ETH Zurich(Switzerland), DSc, 1978.


Peter Mueller (1980, 1984), associate professor of civil and environmental engineering. ETH Zurich(Switzerland), DSc, 1978.

Rosemary J. Mundhenk environment engineering. ETH Zurich(Switzerland), DSc, 1978.


Murat Ozturk (2008), professor of practice of mechanical engineering and mechanics. Istanbul Technical University(Turkey), BS, 1982; Lehigh University, MS, 1987, PhD, 1992.


Shamim N. Pakzad (2008, 2014), associate professor of civil and environmental engineering. Baha'i Institute for Higher Education(Iran), BS, 1995; San Jose State University, MS, 2000; University of California Berkeley, PhD, 2008.


Frank J. Pazzaglia (1999, 2007), professor of earth and environmental sciences. The Pennsylvania State University, BS, 1986; University of New Mexico, MS, 1989; The Pennsylvania State University, PhD, 1993.


Alan W. Pence (1957, 1997), professor emeritus of materials science and engineering. Cornell University, BS, 1957; Lehigh University, MS, 1959, PhD, 1962.


Mesut Pervizpour (2013), professor of practice of civil and environmental engineering. Bogazici University(Turkey), BS, 1990; Portland State University, MS, 1992; Lehigh University, MS, 1994, PhD, 2000.


Charles Robert Phillips, II (1975, 2015), professor emeritus of history. Yale University, BA, 1970; Oxford University(United Kingdom), BA, 1972, MA, 1979; Brown University, PhD, 1974.


Janos D Pinter (2016), professor of practice of industrial and systems engineering. Eotvos Lorand University(Hungary), MS, 1973, PhD, 1977; Lomonosov Moscow State University(Russia), PhD, 1982.

Marcos Pires (2011), assistant professor of chemistry. Ithaca College, BA, 2003; Purdue University, PhD, 2009.


Louis J. Plebani, Jr. (1976, 1982), associate professor of industrial and systems engineering. Lehigh University, BS, 1968; American University, MS, 1972; Lehigh University, PhD, 1976.


Corinne A. Post (2008, 2013), Scott Hartz ’68 Term Professor and associate professor of management. University of Geneva(Switzerland), BS, 1994; University Lausanne(Switzerland), MS, 1996; Rutgers University Newark, PhD, 2003.

Steven McKay Price (2010, 2016), Webster A. Collins and the Murray H. Goodman Endowed Chair in Real Estate Studies and associate professor of finance. University of Utah, BA, 1999; Massachusetts Institute of Technology, MA, 2005; Florida State University, PhD, 2010.


Marina Puzakova (2014), assistant professor of marketing. Voronezh State University, BS, 2006; Drexel University, PhD, 2012.

Spencer E. Quiel (2013), assistant professor of civil and environmental engineering. University of Notre Dame, BS, 2004; Princeton University, PhD, 2009.


Spencer E. Quiel (2013), assistant professor of civil and environmental engineering. University of Notre Dame, BS, 2004; Princeton University, PhD, 2009.


Rosi Jan Reed (2015), assistant professor of physics. San Jose State University, BS, 2002, MS, 2006; University of California Davis, MS, 2008, PhD, 2011.

Steven L. Regen (1985), University Distinguished Professor and professor of chemistry. Rutgers University, BSCM, 1968; Massachusetts Institute of Technology, PhD, 1972.


Seth Richards-Shubik (2015), assistant professor of economics. Harvard University, BA, 1997; Syracuse University, MPA, 2004; University of Pennsylvania, PhD, 2010.


Augustine Ripa, Jr. (1979, 1994), professor of theatre. Loyola University, BA, 1974; Northwestern University, MFA, 1976.


Heibatollah Sami (2005), John B. O'Hara Professor and professor of accounting. Iranian Institute of Advanced Accounting(Iran), BS, 1973; Central Michigan University, MS, 1981; Louisiana State University, PhD, 1984.


Steven L. Savino (2011), professor of practice of marketing. Villanova University, BA, 1979; Wake Forest University, MBA, 1983.


Laura Brook E. Sawyer (2012), assistant professor of teaching learning and technology. University of Delaware, BS, 1996; University of Pennsylvania, MS, 1997; University of Virginia, PhD, 2003.

Katya Scheinberg (2010, 2014), Harvey E. Wagner Endowed Chair in Manufacturing Systems Engineering and professor of industrial and systems engineering. Lomonosov Moscow State University (Russia), BA, 1992; Columbia University, MS, 1994, PhD, 1997.


Kelly Schultz (2013), P.C. Rossin Assistant Professor and assistant professor of chemical & biomolecular engineering, Northeastern University, BS, 2006; University of Delaware, PhD, 2011.


K. Sivakumar (2001, 2003), Arthur C. Tauck Chair in International Marketing and Logistics and professor of marketing. University of Madras (India), BE, 1980; Institute of Rural Management (India), PGDRM, 1982; Syracuse University, PhD, 1992.


Bruce M. Smackey (1971, 1990), professor emeritus of marketing. Rensselaer Polytechnic Institute, BS, 1962; Case Western Reserve University, MS, 1964; Rensselaer Polytechnic Institute, PhD, 1969.


Arnold R. Spokane (1989), program director of Counseling Psychology and professor of counseling psychology. Ohio University, BA, 1970; University of Kentucky Fort Knox, MA, 1972; Ohio State University, PhD, 1976.


Sarah Eliza Stanlick Kimball (2015), program director of Center for Community Engagement and professor of practice of sociology and anthropology. Lafayette College, BA, 2004; Brandeis University, MA, 2008; Lehigh University, PhD, 2015.


Alekzandr Stolyar (2014), Timothy J. Wilmott '80 Endowed Faculty Chair in Industrial Engineering and professor of industrial and systems engineering. Moscow College of Transportation Engineering(Russia), MS, 1982; USSR Academy of Science(Russia), PhD, 1989.


Nicholas Strandwitz (2013), Harold Chambers Junior Professor in Materials Science and Engineering and assistant professor of materials science and engineering. The Pennsylvania State University, BA, 2004; University of California Santa Barbara, PhD, 2009.

James E. Sturm (1956, 1995), professor emeritus of chemistry. St Johns University Mn, BA, 1951; University of Notre Dame, PhD, 1957.


Jennifer Swann (1995, 2008), program director of Student Success and professor of biological sciences. The Pennsylvania State University, BS, 1976; Florida State University, MS, 1979; Northwestern University, PhD, 1984.

Susan Szczepanski (1982, 1989), associate professor of mathematics. LaSalle University, BA, 1975; Rutgers University New Brunswick, PhD, 1980.

Martin Takac (2014), P.C. Rossin Assistant Professor and assistant professor of industrial and systems engineering. Comenius University(Slovakia), BS, 2010, MS, 2010; University of Edinburgh(United Kingdom), PhD, 2014.


Tamas Terlaky (2008), Soteria and George Kledaras ‘87 Chair and chairperson and professor of industrial and systems engineering. Eotvos Lorand University(Hungary), MS, 1979, PhD, 1987.

Theodore A. Terry (1951, 1995), professor emeritus of mechanical engineering and mechanics. Drexel University, BS, 1950; Lehigh University, MS, 1951, PhD, 1963.

Damien Thevenin (2011), assistant professor of chemistry. Paul Sabatier University(France), BA, 1999; Institut National Sciences Appliquees(France), MA, 2000; University of Delaware, PhD, 2007.


Robert J. Trent (1992, 2008), center/institute director of Center for Value Chain Research and professor of management. Michigan State University, BS, 1980; Wayne State University, MBA, 1982; Michigan State University, PhD, 1993.


Tara J. Troy (2013), P.C. Rossin Assistant Professor and assistant professor of civil and environmental engineering. Lehigh University, BS, 2001, BA, 2002; Princeton University, PhD, 2010.


Kenneth Kai-Ming Tzeng (1969, 2004), professor emeritus of electrical and computer engineering. National Taiwan University(Taiwan), BS, 1959; University of Illinois Urbana, MS, 1962, PhD, 1969.


David A. Van Horn (1962, 1995), professor emeritus of civil and environmental engineering. Iowa State University, BS, 1951, MS, 1956, PhD, 1959.


Dmitri V. Vezzenov (2006, 2013), associate professor of chemistry. Lomonosov Moscow State University(Russia), BS, 1991; Case Western Reserve University, MS, 1994; Harvard University, PhD, 1999.


Arkady Voloshin (1984, 1991), professor of mechanical engineering and mechanics. St Petersburg State University, Russia(Russia), MS, 1969; Tel Aviv University(Israel), PhD, 1978.


Ting Wang (2015), assistant professor of computer science and engineering. Zhejiang University, BS, 2004; University of British Columbia(Canada), MS, 2006; Georgia Institute of Technology, PhD, 2011.


George P. White (1989, 2002), Iacocca Chair and center/institute director of Center for Developing Urban Educational Leaders and professor of education leadership. West Chester University, BS, 1974; University of Northern Colorado, MS, 1979; Vanderbilt University, Peabody College, EdD, 1989.


Albert Wilansky (1948, 1992), professor emeritus of mathematics. Dalhousie University (Canada), BA, 1941, BS, 1942, MA, 1944; Brown University, PhD, 1947.

Darius Williams (2013), assistant professor of theatre and africana studies. Jackson State Univ, BA, 1997; Bowling Green State University, MA, 1998; Antioch University, MFA, 2004; Ohio State University, PhD, 2012.


Robert C. Williamson (1963, 1984), professor emeritus of sociology and anthropology. University of California Los Angeles, BA, 1938, MA, 1940; University of Southern California, PhD, 1951.


Xiaoji G. Xu (2014), assistant professor of chemistry. CIEE University of Peking (Peoples Republic of China), BS, 2004; University of British Columbia (Canada), PhD, 2009.


Ke Yang (2008, 2015), Eugene and Sue Mercy Professor and associate professor of finance. Henan University of Science & Technology (China), BS, 2000; University of Nebraska Omaha, MA, 2002; University of Iowa, PhD, 2008.

Yuliang Yao (2003, 2015), George N. Beckwith ’32 Professor in Marketing and chairperson and professor of management. Shanghai Jiao Tong University (Peoples Republic of China), BE, 1995; Rensselaer Polytechnic Institute, MBA, 1997; University of Maryland College Park, PhD, 2002.


Ben T. Yen (1957, 1977), professor emeritus of civil and environmental engineering. National Taiwan University (Taiwan), BSCE, 1955; Lehigh University, MS, 1959, PhD, 1963.


Katrina Ann Zalatan (2009), associate dean and program director of undergraduate programs of business and economics. The Pennsylvania State University, BA, 1984; Florida State University, MS, 1985; University of Rochester, MBA, 1992; University at Albany, PhD, 2006.


Xiaohui Zhang (2010), assistant professor of mechanical engineering and mechanics. National Sun Yat-sen University (Taiwan), BA, 1995; University of Hong Kong (Hong Kong), MA, 1999; University of Miami, PhD, 2003.

Dawei Zhang (2015), assistant professor of management. Sun Yat-sen University, BS, 2005; Hong Kong University Science (Hong Kong), MS, 2006; University of Calgary (Canada), PhD, 2013.


Haibei Zhao (2016), assistant professor of finance. Shandong University (China), BS, 2005; Chinese Academy of Science (Peoples Republic of China), MS, 2008; Virginia Tech, MS, 2010; Georgia State University, PhD, 2016.


Perry A. Zirkel (1977, 2016), professor emeritus of education leadership. State University of NY, Oswego, BS, 1966; Yale University, LLM, 1982; University of Connecticut, PhD, 1972, JD, 1976.

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