## Engineering

See additional information on the P.C. Rossin College of Engineering and Applied Science (http://catalog.lehigh.edu/coursesprogramsandcurricula/engineeringandappliedscience).

### ENGINEERING MINOR

See additional information on the Engineering Minor under the heading of the P.C. Rossin College of Engineering and Applied Science (http://catalog.lehigh.edu/coursesprogramsandcurricula/engineeringandappliedscience).

### Core Prerequisites to begin the program

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY 005</td>
<td>Concepts In Physics (or equivalent)</td>
</tr>
<tr>
<td>MATH 051</td>
<td>Survey of Calculus I (or equivalent)</td>
</tr>
</tbody>
</table>

### Required Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMC 001</td>
<td>Macro and Micro View of Engineering</td>
</tr>
<tr>
<td>EMC 002</td>
<td>Engineering Practicum</td>
</tr>
</tbody>
</table>

### Electives

Select three of the following:

<table>
<thead>
<tr>
<th>Required Courses</th>
<th>Electives</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMC 001 3</td>
<td>Group A - Engineering Fundamentals</td>
</tr>
<tr>
<td>EMC 002 3</td>
<td>Group B - Integrated Engineering</td>
</tr>
</tbody>
</table>

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
Mandatory for and open only for first year RCEAS students.

Introduction to various engineering disciplines and degree programs.

Professionalism; innovative solution development and implementation.

Design, project planning, communication, teamwork, ethics and responsibility, and professional ethics; the Internet, and related technologies in changing the standard of work and quality. Environmental life cycle analysis and planning, operations planning and control, work measurement, and scheduling.

An interactive exploration of the current and future role of computers, the Internet, and related technologies in changing the standard of work and quality. Environmental life cycle analysis and planning, operations planning and control, work measurement, and scheduling.

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.

Learn why and how collaborative environments are becoming essential to modern engineering projects and require the tools and techniques of software engineering to succeed.

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.

Semiconductor process engineering, including technology to process raw silicon wafers to electronics integrated circuits (ICs). Crystal growth, thin film deposition, photolithography, doping technology.

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

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
Offer 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, MAT 212, ME 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
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 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-Louiville 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