## 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 Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY 005</td>
<td>Concepts In Physics (or equivalent)</td>
<td>1</td>
</tr>
<tr>
<td>MATH 051</td>
<td>Survey of Calculus I (or equivalent)</td>
<td>1</td>
</tr>
</tbody>
</table>

### Required Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMC 001</td>
<td>Macro and Micro View of Engineering</td>
<td>3</td>
</tr>
<tr>
<td>EMC 002</td>
<td>Engineering Practicum</td>
<td>3</td>
</tr>
</tbody>
</table>

### Electives

Select three of the following:

<table>
<thead>
<tr>
<th>Group A - Engineering Fundamentals</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMC 105</td>
<td>Engineering Structures and Motion</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>EMC 110</td>
<td>Energy Engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMC 115</td>
<td>Engineering Materials and Electronics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>EMC 120</td>
<td>Systems Engineering</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Group B - Integrated Engineering</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMC/CSE 042</td>
<td>Game Design</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>EMC 150</td>
<td>Information and Knowledge Engineering</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>EMC 155</td>
<td>Enterprise Engineering</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>EMC 156</td>
<td>Embedded Systems</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>EMC 160</td>
<td>Computer Aided Engineering and Control Systems</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>EMC/ISE 168</td>
<td>Production Analysis</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>EMC 170</td>
<td>Software Engineering and Collaborative Environments</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>EMC/CHE/CEE/ES 171</td>
<td>Fund of Environmental Technology</td>
<td>3</td>
<td></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.

### Notes

- 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

The key elements of modeling and engineering the corporation. Development of functional requirements and satisfactory designs. Investments across the major stages of life of an engineering system. 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 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
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 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 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 (BIOE 452, CHE 452, 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.

ENGR 490 Thesis (Moc) 1 Credit
ENGR 499 Dissertation (Moc) 1 Credit