Engineering Minors for Non-Engineering Students

Biomedical Engineering Minor
Associate Department Head of Undergraduate Education
Professor Conrad M. Zapanta
czapanta@cmu.edu
http://www.bme.cmu.edu/
The minor program is designed for engineering students who desire exposure to biomedical engineering but may not have the time to pursue the Biomedical Engineering additional major. The program is also open to students of all colleges and is popular among science majors. In conjunction with other relevant courses, the program may provide a sufficient background for jobs or graduate studies in biomedical engineering. Students interested in a medical career may also find this program helpful.
The Biomedical Engineering minor curriculum is comprised of three core courses and three electives. Students pursuing the minor may contact the Department Head (http://www.bme.cmu.edu/people/staff.html#UPC) for advice. Students interested in declaring Biomedical Engineering minor should contact the Director after they have successfully completed two introductory engineering courses (from list #1 below).

Requirements
Minimum units required for minor: 57
03-121 Modern Biology 9
42-101 Introduction to Biomedical Engineering (co-req. or pre-req. 03-121) 12
42-202 Physiology (pre-req. 03-121 or permission of instructor) 9
42-xxx BME Elective (>= 9 units). Any course offered by the Department of Biomedical Engineering numbered 42-300 or higher and worth at least 9 units
xx-xxx Elective I (>= 9 units) *
xx-xxx Elective II (>= 9 units) +

Some Special Topics, newly offered or intermittently offered 42-xxx may be acceptable as electives. Students should consult with their advisors and petition the Biomedical Engineering Undergraduate Affairs Committee for permission to include such courses.

Notes
* Elective I cannot be a required course in the student’s major. It may be counted as an elective.
1. Any required or additional track elective course selected from any of the four Biomedical Engineering tracks. See the online catalog (http://www.bme.cmu.edu/ugorlgcatatalog.html) for a listing of courses.
2. Any 42-xxx course with a 42-300 or higher number and worth at least 9 units.
3. 42-201 Biomedical Engineering Laboratory (or the cross-listed version 03-206 for students in the Health Professions Program). The course has a limited capacity and priority is given to students who have declared the Additional Major in Biomedical Engineering.
4. One semester of 42-200 Sophomore BME Research Project, 42-300 Junior BME Research Project, 42-400 Senior BME Research Project or 39-500 Honors Research Project. The project must be supervised by a core or courtesy Biomedical Engineering faculty member and for 9 or more units.

+ Elective II must be a Biomedical Engineering Required or additional track elective.
** Priority for enrollment in 42-203 or 03-206 will be given to students who have declared the Additional Major in Biomedical Engineering. If sufficient room in the course remains after all majors have been accommodated in a given semester, students who have declared the Biomedical Engineering Designated Minor will be given the next priority for enrollment. If space still allows, other students will be enrolled.

Engineering Studies Minor
(for non-engineering students)
Kurt Larsen, Director
Office: Scaife Hall 120
Carnegie Mellon undergraduate students enrolled in colleges other than engineering can complete a Minor in Engineering Studies in addition to their regular majors. Students pursuing this minor are required to complete courses from at least two different engineering departments in order to assure some breadth of exposure to engineering. In addition, the minor provides students the opportunity to pursue an in-depth concentration in a particular field of engineering.

For the Minor in Engineering Studies, students must complete five engineering courses as follows and must earn a cumulative QPA of 2.00 in these five courses. Students may declare the minor by contacting the Director after they have successfully completed two introductory engineering courses (from list #1 below).

Double counting of core courses in student’s primary major is not permitted.
Because of the nature of the courses offered by Engineering and Public Policy, only two EPP courses (including 19-101) can be used toward the minor requirements. Students need special permission to use an Engineering and Public Policy course (EPP-19-xxx) toward minor requirements. Students interested in EPP coursework should consider the Technology and Policy minor instead.

Requirements
1. Two of the following:
   12-100 Introduction to Civil and Environmental Engineering
   18-100 Introduction to Electrical and Computer Engineering
   19-101 Introduction to Engineering and Public Policy
   24-101 Fundamentals of Mechanical Engineering
   27-100 Engineering the Materials of the Future
   42-101 Introduction to Biomedical Engineering
   06-100 Introduction to Chemical Engineering

2. Three courses of at least 9 units each from one or more CIT departments
3. Up to one of the following Robotics courses can count toward the ES minor. But it cannot be double-counted with the Robotics minor or double major.
   16-311 Introduction to Robotics
   16-362 Mobile Robot Algorithms Laboratory
   16-384 Robot Kinematics and Dynamics
   16-385 Computer Vision
   16-421 Vision Sensors
   16-474 Robotics Capstone

4. **Note:** The following courses may NOT be included as part of the Minor in Engineering Studies. In addition to the courses listed, most EPP courses (19-xxx) are not permissible for the minor and students should contact the Director for prior approval of EPP courses.
   06-262 Mathematical Methods of Chemical Engineering
   12-201 Geology
   15-213 Introduction to Computer Systems
   18-090 Twisted Signals: Multimedia Processing for the Arts
   18-099 Special Topics: Mobile App Design & Development
   18-200 ECE Sophomore Seminar
   18-202 Mathematical Foundations of Electrical Engineering
   18-213 Introduction to Computer Systems
   24-311 Numerical Methods
   39-200 Business for Engineers
   42-202 Physiology
Technology and Policy Minor
(for non-engineering students)
Deanna H. Matthews, Director
Office: Baker Hall 129

The Technology and Policy Minor is administered by the Department of Engineering and Public Policy (EPP) for students who are majoring in areas other than engineering. The Technology and Policy Minor is designed to give students a basic understanding of the interactions between technology, society and policy and some project experience in problems involving technology and policy.

Pre-requisites
Students should have prerequisite knowledge in economics (73-102 Principles of Microeconomics or higher level economics course) and statistics (36-202 Statistics & Data Science Methods or higher level statistics course) in order to pursue the Technology and Policy Minor.

Course Requirements
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-101</td>
<td>Introduction to Engineering and Public Policy</td>
<td>12</td>
</tr>
<tr>
<td>19-301</td>
<td>Decision Making Methods for Engineers and Scientists</td>
<td>9</td>
</tr>
<tr>
<td>or 19-351</td>
<td>Applied Decision Science course</td>
<td></td>
</tr>
<tr>
<td>19-451</td>
<td>EPP Projects</td>
<td>12</td>
</tr>
<tr>
<td>or 19-452</td>
<td>EPP Projects</td>
<td>12</td>
</tr>
<tr>
<td>xx-xx</td>
<td>Two EPP Policy-Elective Courses</td>
<td>18</td>
</tr>
</tbody>
</table>

EPP Technical Electives include courses in CIT, MCS, or SCS that address problems at the society-technology interface and the means of analyzing these issues. A list of qualifying Technology-Policy electives is assembled each semester and is available from the EPP Department. Example Technology-Policy electives include:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-211</td>
<td>Ethics and Policy Issues in Computing</td>
<td>9</td>
</tr>
<tr>
<td>19-365</td>
<td>Water Technology Innovation and Policy</td>
<td>9</td>
</tr>
<tr>
<td>19-402</td>
<td>Telecommunications Technology and Policy for the Internet Age</td>
<td>12</td>
</tr>
<tr>
<td>19-411</td>
<td>Global Competitiveness: Firms, Nations and Technological Change</td>
<td>9</td>
</tr>
<tr>
<td>19-424</td>
<td>Energy and the Environment</td>
<td>9</td>
</tr>
</tbody>
</table>

Students must earn a cumulative QPA of 2.0 in all courses taken for the minor. Required courses taken for a student’s primary major may not be counted toward the Technology and Policy Minor. Elective courses for a student’s primary major or courses fulfilling general education requirements may be counted, however.

Robotics Minor
Director: Dr. Howie Choset
Administrative Coordinator: Barbara (B.J.) Fecich
Website: http://undergrad.ri.cmu.edu/academics/minor/

The Minor in Robotics provides an opportunity for undergraduate students at Carnegie Mellon to learn the principles and practices of robotics through theoretical studies and hands-on experience with robots. The Minor is open to students in any major of any college at Carnegie Mellon. Students initially learn the basics of robotics in an introductory robotics overview course. Additional required courses teach control systems and robotic manipulation. Students also choose from a wide selection of electives in robotics, perception, computer vision, cognition and cognitive science, or computer graphics. Students have a unique opportunity to undertake independent research projects, working under the guidance of Robotics Institute faculty members; this provides an excellent introduction to robotics research for those considering graduate studies.

All Robotics Minors are required to take Introduction to Robotics (16-311). This course is designed to help students understand the big picture of what is going on in robotics through topics such as kinematics, mechanisms, motion planning, sensor based planning, mobile robotics, sensors, and vision. The minor also requires students to take a controls class and a kinematics class. These courses provide students with the necessary intuition and technical background to move on to more advanced robotics courses. In addition to the required courses, students must take 2 electives. The student must have course selection approved by the Director during the application submission process.

A 2.5 QPA in the Minor curriculum is required for graduation. Courses that are taken Pass/Fail or audited cannot be counted for the Minor.

Admission
Admission to the Undergraduate Minor in Robotics is limited to current Carnegie Mellon students. Students interested in signing up for the minor should fill out the application form available on the program website.

Prerequisite
Successful candidates for the Robotics Minor will have prerequisite knowledge of C language, basic programming skills, and familiarity with basic algorithms. Students can gain this knowledge by taking 15-122 Principles of Imperative Computation.

Required Courses

Overview: Introduction to Robotics 12

Electives
Two Electives (chosen from the following): Units
10-401 Introduction to Machine Learning (Undergrad) or (10-601 Introduction to Machine Learning) 12
11-344 Machine Learning in Practice 12
15-381 Artificial Intelligence: Representation and Problem Solving 9
15-424 Logical Foundations of Cyber-Physical Systems 12
15-462 Computer Graphics 12
15-463 Computational Photography 12
15-494 Cognitive Robotics: The Future of Robot Toys 12
16-264 Humanoids 12
16-362 Mobile Robot Algorithms Laboratory 12
16-385 Computer Vision 9
16-421 Vision Sensors 12
16-423 Designing Computer Vision Apps 12
16-597 Undergraduate Reading and Research Var.
18-342 Fundamentals of Embedded Systems 12
18-349 Introduction to Embedded Systems 12
18-578 Mechatronic Design 12
85-370 Perception 9
85-395 Applications of Cognitive Science 9
85-412 Cognitive Modeling 9
85-419 Introduction to Parallel Distributed Processing 9
85-426 Learning in Humans and Machines 9

Graduate level Robotics courses may be used to meet the elective requirement with permission from the Program Director. Graduate level Mechanical Engineering and Electrical and Computer Engineering courses that are relevant to robotics may be used to meet the elective requirement with permission from the Program Director.

Students may count up to 12 units of 16-597 Undergraduate Reading and Research towards the minor requirements.

Double-Counting Restriction
Courses being used to satisfy the requirements for the Robotics Minor may not be counted towards another minor. Students are permitted to double count a maximum of two courses from their Major (excluding General
Education requirements) towards the Minor in Robotics. Free electives are not subject to the double counting policy.