

Electrical and Computer Engineering (ECE)

FALL 2009-SPRING 2010

OFFICES:

Undergraduate Affairs, Room 2705 and 2707

Engineering Building Unit 1, Warren College

<http://www.ece.ucsd.edu/>

Program Mission Statement

To educate tomorrow's technology leaders.

Program Educational Objectives

- To provide our students with training in the fundamental science and mathematics that underlie engineering, and with a general breadth and depth in engineering and in engineering design so that they are prepared for graduate school and for engineering careers. Students should have both proficiency in a specific technical area, and the flexibility and broad knowledge base needed for life-long engineering careers in a changing technical environment.
- To ensure that our students are educated in the classical sense. In particular, that they are broadly aware of social and environmental issues and of the impact of their profession on these issues.
- To assist our students in preparing themselves to work effectively in their profession. Specifically, to develop communications, teamwork, and leadership skills.

Program Outcomes and Assessment

Program outcomes have been established based on the Program Educational Objectives. Graduates of the ECE Program in Electrical Engineering are expected to have:

1. An understanding of the underlying principles of, and an ability to apply knowledge of mathematics, science, and engineering to electrical engineering problems
2. An ability to design and conduct experiments, as well as to analyze and interpret data
3. A knowledge of electrical engineering safety issues
4. An ability to design a system, component, or process to meet desired needs
5.
 1. An ability to collaborate effectively with others
 2. An ability to function on multidisciplinary teams
6. An ability to identify, formulate, and solve engineering problems
7. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice, including familiarity with computer programming and information technology
8. An understanding of professional and ethical responsibility
9.
 1. An ability to communicate effectively in writing
 2. An ability to communicate effectively in speech
 3. An ability to communicate effectively with visual means
10. The broad education necessary to understand the impact of engineering solutions in a global and societal context
11. A recognition of the need for, and the ability to engage in, lifelong learning
12. A knowledge of contemporary issues

The Undergraduate Programs

The Department of Electrical and Computer Engineering offers undergraduate programs leading to the B.S. degree in **electrical engineering, engineering physics**, and computer engineering, and the B.A. degree in **electrical engineering and society**. Each of

these programs can be tailored to provide preparation for graduate study or employment in a wide range of fields. The Electrical Engineering Program is accredited by the Accreditation Board for Engineering and Technology (ABET).

The Electrical Engineering Program has a common lower-division and a very flexible structure in the upper-division. After the lower-division core, all students take seven breadth courses during the junior year. They must then satisfy a depth requirement which can be met with five courses focused on some specialty, and a design requirement of at least one project course. The remainder of the program consists of six electives, which may range as widely or as narrowly as needed.

The Engineering Physics Program is conducted in cooperation with the Department of Physics. Its structure is very similar to that of electrical engineering except the depth requirement includes seven courses and there are only four electives.

The Computer Engineering Program is conducted jointly with the Department of Computer Science and Engineering. It has a more prescribed structure. The program encompasses the study of hardware design, data storage, computer architecture, assembly languages, and the design of computers for engineering, information retrieval, and scientific research.

The B.A.-Electrical Engineering and Society Program intends to better prepare engineering students in the areas of social sciences and the humanities, as a response to the globalization of engineering and technology. We recognize that “engineering only” training may not be sufficient when students seek alternate career paths besides engineering upon graduation, such as in the law, finance, and public policy sectors.

For information about the program and about academic advising, students are referred to the section on ECE departmental regulations. In order to complete the programs in a timely fashion, students must plan their courses carefully, starting in their freshman year. Students should have sufficient background in high school mathematics so that they can take freshman calculus in the first quarter.

For graduation, each student must also satisfy general-education requirements determined by the student’s college. The six colleges at UC San Diego require widely different numbers of general-education courses. Students should choose their college carefully, considering the special nature of the college and the breadth of education required. They should realize that some colleges require considerably more courses than others. Students wishing to transfer to another college should see their college advisor.

Graduates of community colleges may enter ECE programs in the junior year. However, transfer students should be particularly mindful of the freshman and sophomore course requirements when planning their programs.

These programs have strong components in laboratory experiments and in the use of computers throughout the curricula. In addition, the department is committed to exposing students to the nature of engineering design. This is accomplished throughout the curricula by use of design-oriented homework problems, by exposure to engineering problems in lectures, by courses which emphasize student-initiated projects in both laboratory and computer courses, and finally by senior design-project courses in which teams of students work to solve an engineering design problem, often brought in from industry.

IT IS IMPERATIVE THAT STUDENTS DISCUSS THEIR CURRICULUM WITH THE APPROPRIATE DEPARTMENTAL ADVISOR IMMEDIATELY UPON ENTRANCE TO UCSD, AND THEN AT LEAST ONCE A YEAR UNTIL GRADUATION.

B.S. Electrical Engineering Program

Students must complete 180 units for graduation, including the general-education requirements (GER). Note that 144 units (excluding GER) are required.

Lower-Division Requirements (total of sixty-eight units)

Mathematics (twenty-four units):

Math. 20A-B-C-D-E-F.

Physics (sixteen units):

Phys. 2A-B-C-D or Phys. 4A-B-C-D-E. Math. 20A is a prerequisite for Phys. 2A. Students whose performance on the mathematics placement test permits them to start with Math. 20B or higher may take Phys. 2A in the fall quarter of the freshman year.

Chemistry (four units):

Chem. 6A.

Programming Course (four units):

ECE 15.

Electrical engineering (twenty units):

ECE 25, 30, 35, 45, and 65.

Additional Notes:

1. Students with AP math credit are strongly advised to take Math. 20B in the fall quarter, leaving room for a GER in the winter quarter.
2. The ECE undergraduate Web site shows several scheduling options. Please refer to the Web site and consult with the staff advisors in the undergraduate offices, rooms 2705 and 2707 in EBU1.

**Upper-Division Requirements
(total of seventy-six units)**

a. Electrical Engineering BREADTH Courses (twenty-eight units)

Courses required of all electrical engineering majors:

The seven courses, ECE 100, 101, 102, 103, 107, 108, and 109 are required of all electrical engineering majors and they are an assumed prerequisite for senior-level courses, even if they are not explicitly required. Although the courses are largely independent, there are some prerequisites. ECE 65 is a prerequisite for ECE 100 and 102. Students who delay some of the breadth courses into the spring should be careful that it does not delay their depth sequence. For the ECE 109 requirement, credit will not be allowed for ECON 120A, Math. 180A-B, Math. 183, or Math. 186.

b. Electrical Engineering DESIGN Course (4 units)

Note: In order to fulfill the design requirement, students must complete one of the following courses with a grade C– or better. Graduation will not be approved until a written copy of the design project is submitted to the ECE undergraduate office. ECE 111, 118, 191 cannot be used to satisfy both the Design and Depth requirements.

The electrical engineering design requirement can be fulfilled in any of the following three ways:

1. Take ECE 191: Engineering Group Design Project
2. Take ECE 190: Engineering Design This course requires the department stamp. Specifications and enrollment forms are available in the undergraduate office.
3. Take one of the following courses:
 - o ECE 111: Advanced Digital Design Project
 - o ECE 118: Computer Interfacing
 - o ECE 155B or 155C: Digital Recording Projects

Students who wish to take one of these courses to satisfy the design requirement must fill out an enrollment form and have departmental approval for the design credit prior to taking the course. The project must meet the same specifications as ECE 190.

c. Electrical Engineering ELECTIVES (twenty-four units)

- Three upper-division engineering, mathematics, or physics courses.
- Three additional electives which students may use to broaden their professional goals.

(For additional information, please refer to the section on “Elective Policy for Electrical Engineering and Engineering Physics Majors.”)

d. Electrical Engineering Depth Requirement (twenty units)

Students must complete a “depth requirement” of at least five quarter courses to provide a focus for their studies. This set must include a clear chain of study of at least three courses which depend on the “breadth” courses. Students may choose one of the approved depth sequences listed below, or propose another with the approval of their faculty advisor. Some of the approved sequences have lower-division prerequisites and thus list six courses. Students choosing one of these sequences will have to complete only two “professional” electives. Guidelines for meeting the depth requirement can be obtained from the undergraduate office. *ECE 111, 118, 191 cannot be used to satisfy both the Design and Depth requirements.*

Electronics Circuits and Systems:

ECE 163, 164, 165, and any two of ECE 111, 118, 161A, 161B, 161C, and 166.

Electronic Devices and Materials:

ECE 135A, ECE 135B, 136L, 139, and 183.

Controls and Systems Theory:

ECE 171A, 171B, 173, 174, and 118 or 191.

Machine Intelligence:

ECE 173, 174, 172A and any two of ECE 161A, ECE 175, ECE 176A, 187, 253A, 285, and COGS 108F.

Photonics:

ECE 181, 182, 183, 184, and 185.

Communications Systems:

ECE 161A, 153, 154A-B-C.

Networks:

ECE 153, 159A, 159B, 158A-B.

Queuing Systems:

ECE 171A, 174, 159A-B, and Math. 181A.

Signal and Image Processing:

ECE 161A, 161B, 161C, 153, and ECE 172A or 174.

Computer Design:

CSE 12, 21, and 141, ECE 158A, 111 or 118, and 165.

Software Systems:

CSE 12, 21, 100, 101, 141, and 120.

B.S. Engineering Physics

Students must complete a total of 180 units for graduation, including the general-education requirements. Note that 146 units (excluding GER) are required.

All students will initially be placed in pre-major status. Upon successful completion of the following courses (with a minimum 2.0 GPA by the end of the first three quarters if a transfer student, six quarters if an incoming freshman), students will be admitted into full Engineering-Physics major status.

1. Math. 20A-B-C
2. Phys. 2A-B
3. ECE 15, 25, and 35

To initiate the change from pre-major status to full major status, transfer students must see the ECE undergraduate advisor by the end of their third quarter at UCSD; incoming freshmen by the end of their sixth quarter.

Please refer to the section “Undergraduate Regulations and Requirements” for important details.

Lower-Division Requirements (total of seventy units)

Mathematics (twenty-four units):

Math. 20A-B-C-D-E-F.

Physics (sixteen units):

Phys. 2A-B-C-D or Phys. 4A-B-C-D-E. Math. 20A is a prerequisite for Phys. 2A. Students whose performance on the mathematics placement test permits them to start with Math. 20B or higher may take Phys. 2A in the fall quarter of the freshman year.

Physics Lab (two units):

Phys. 2DL is required.

Chemistry (four units):

Chem. 6A.

Programming Course (four units):

ECE 15.

Electrical engineering (twenty units):

ECE 25, 30, 35, 45, and 65.

Additional Notes:

1. Students with AP math credit are strongly advised to take Math. 20B in the fall quarter, leaving room for a GER in the winter quarter.
2. The ECE undergraduate Web site shows several scheduling options. Please refer to the Web site and consult with the staff advisors in the undergraduate offices, rooms 2705 and 2707 in EBU1.

Upper-Division Requirements (seventy-six units)

a. Engineering Physics BREADTH Courses (twenty-eight units)

The electrical engineering breadth courses ECE 100, 101, 102, 103, 107, 108, and 109, are also required of engineering physics majors. However, because of the scheduling of Math. 110, Phys. 110A and 130A, they can only be taken in a specific order (please consult the ECE Web site). For the ECE 109 requirement, credit will not be allowed for ECON 120A, Math. 180A-B, Math. 183, or Math. 186.

b. Engineering Physics DESIGN Course (four units)

Note: In order to fulfill the design requirement, students must complete one of the following courses with a grade C– or better. Graduation will not be approved until a written copy of the design project is submitted to the ECE undergraduate office.

The engineering physics design requirement can be fulfilled in any of the following three ways:

1. Take ECE 191: Engineering Group Design Project
2. Take ECE 190: Engineering Design. This course requires the department stamp. Specifications and enrollment forms are available in the undergraduate office.
3. Take one of the following courses:
 - ECE 111: Advanced Digital Design Project
 - ECE 118: Computer Interfacing
 - ECE 155B or 155C: Digital Recording Projects

Students who wish to take one of these courses to satisfy the design requirement must fill out an enrollment form and have departmental approval for the design credit prior to taking the course. The project must meet the same specifications as ECE 190.

c. Engineering Physics ELECTIVES (sixteen units)

- One upper-division engineering, mathematics, or physics course.
- Three additional electives which students may use to broaden their professional goals.

(For additional information, please refer to the section on Elective Policy for Electrical Engineering and Engineering Physics Majors.)

d. Engineering Physics DEPTH Courses (twenty-eight Units)

All B.S. engineering physics students are required to take Phys. 110A, 130A-B, 140A, Math. 110, ECE 123 and 166; or ECE 135A and 135B; or ECE 182 and (181 or 183).

Elective Policy for Electrical Engineering and Engineering Physics Majors

1. Technical Electives:

Technical electives must be upper-division engineering, math or physics courses (except for the bioengineering track). At most one lower-division course in engineering may be used but it must receive prior approval from the ECE department. Certain courses listed below are not allowed as electives because of overlap with ECE courses.

Physics:

Students may not receive upper-division elective credit for any lower-division physics courses. Students may not receive credit for both Phys. 100A and ECE 107, Phys. 100B and ECE 107, Phys. 100C and ECE 123.

Mathematics:

Math. 180A overlaps ECE 109 and 153, and therefore will not qualify for elective credit of either type. Math. 183 or Math. 186 will not be allowed as an elective. Math. 163 will only be allowed as a professional elective. All lower-division mathematics is excluded from elective credit of either type.

Bioengineering:

The following series of courses will provide “core” preparation in bioengineering and will satisfy up to five courses of the ECE elective requirements:

BILD 1, BILD 2, BE 100, BE 140A-B.

The bioengineering department will guarantee admission to these courses for ECE students on a space available basis.

CSE:

The following courses are excluded as electives: CSE 1, 2, 5A-B, 8A-B, 11, 123A (duplicates ECE 158A), 140 (duplicates ECE 25), 140L (duplicates ECE 36), 143 (duplicates ECE 165). CSE 12, 20, and 21 will count toward the three professional electives ONLY.

Mechanical and Aerospace Engineering (MAE):

Credit will not be allowed for MAE 105, 139, 140, 143B, or 170.

Special Studies

Courses 195–199: At most four units of 195–199 may be used for elective credit.

2. Professional Electives:

Normally these will be upper-division courses in engineering, mathematics, or physics. Students may also choose upper-division courses from other departments provided that they fit into a coherent professional program. In such cases, a lower-division prerequisite may be included in the electives. Courses other than upper-division engineering, mathematics, or physics must be justified in terms of such a program, and must be approved by a faculty advisor.

Biology and Chemistry:

Of the three electives intended to allow for the professional diversity, one lower-division biology or chemistry course from BILD 1, 2, Chem. 6B-C may be counted for credit in combination with two upper-division biology or chemistry courses. Furthermore, this will count only if the student can demonstrate to a faculty advisor that they constitute part of a coherent plan for professional/career development.

Upper-division biology and chemistry courses will count toward the three professional electives but not the three math/physics/engineering electives.

Economics:

Suitable electives would include:

Econ. 1 and 3 followed by the courses in one of the following tracks:

- Macroeconomics: Econ. 110A-B.
- Monetary economics: Econ. 111, and another economics upper division elective.

Economics 1 and 2 followed by two courses in one of the following tracks:

- Public and Environmental: Econ. 118, 130, 131, 132, 133, 137, 145.
- Labor and Human Resources: Econ. 137, 139, 140.

Note: Econ. 100A can be substituted for Econ. 2

Econ. 1 and 100A followed by two courses in one of the following tracks

- Microeconomics: Econ.100B-C.
- Financial Markets: Econ. 120B and 173A.
- Operations Research: Econ.172A-B (after taking ECE 109 and Math. 20F).
- Human Resources: Econ. 100B and 136.

Note: Econ. 120A, and 158-159 will not be allowed as professional electives. If Economics is chosen for professional electives, only two technical electives are required for electrical engineering majors.

B.S. Computer Engineering

Students wishing to pursue the computer engineering curriculum may do so in either the ECE or CSE department. The set of required courses and allowed electives is the same in both departments; please note that the curriculum requires twenty upper-division courses. The Computer Engineering Program requires a total of 151 units (not including the general-education requirements).

The Computer Engineering Program offers a strong emphasis on engineering mathematics and other basic engineering science as well as a firm grounding in computer science. Students should have sufficient background in high school mathematics so that they can take freshman calculus in their first quarter. Courses in high school physics and computer programming, although helpful, are not required for admission to the program.

Lower-Division Requirements (total of seventy-five units)

Mathematics (twenty units):

Math. 20A-B-C-D-F.

Physics (sixteen units):

Phys. 2A-B-C-D, or Phys. 4A-B-C-D. Math. 20A is a prerequisite for Phys. 2A. Students whose performance on the mathematics placement test permits them to start with Math. 20B or higher may take Phys. 2A in the fall quarter of the freshman year.

Computer Science (twenty-seven units):

CSE 11 or 8B*, 12, 15L, CSE 20 or Math. 15A, CSE 21 or Math. 15B, CSE 30, CSE 70, and CSE 91.

* CSE 8A and CSE 8B are not required if a student completes CSE 11. CSE 11 is a faster paced version of CSE 8A and CSE 8B. Students will self-select which course they wish to take. Students without programming experience in a compiled language are advised to take CSE 8A and then CSE 8B instead of CSE 11.

Electrical Engineering (twelve units):

ECE 35, ECE 45, ECE 65.

Upper-Division Requirements (total of seventy-six units)

1. All B.S. computer engineering students are required to take CSE 100 or Math. 176, CSE 101 or Math. 188, CSE 105 or Math. 166, CSE 120, 130, 131, 140, 140L (CSE 140 and 140L must be taken concurrently), 141, 141L (CSE 141 and 141L must be taken concurrently).
2. In addition, all B.S. computer engineering students must fulfill the following upper-division ECE requirements:
 - Engineering Probability and Statistics ECE 109. This course can be taken in the sophomore year.

- Electronic Circuits and Systems ECE 102 and 108. The department recommends that these courses be taken in the junior year.
 - Linear systems ECE 101.
3. Technical electives: All B.S. computer engineering majors are required to take six technical electives.
- One technical elective must be either ECE 111 or ECE 118.
 - Of the remaining five technical electives, four must be ECE or CSE upper-division or graduate courses.
 - The remaining course can be any upper-division course listed under the non-CSE/ECE electives. (See the section on electives below.)

Electives

The discipline of computer engineering interacts with a number of other disciplines in a mutually beneficial way. These disciplines include mathematics, computer science, and cognitive science. The following is a list of upper-division courses from these and other disciplines that can be counted as technical electives.

At most four units of 197, 198, or 199 may be used towards technical elective requirements. ECE/CSE 195 cannot be used towards course requirements. Undergraduate students must get instructor's permission and departmental stamp to enroll in a graduate course.

Students may not get duplicate credit for equivalent courses. The *UC San Diego General Catalog* should be consulted for equivalency information and any restrictions placed on the courses. Additional restrictions are noted below. Any deviation from this list must be petitioned.

Mathematics:

All upper-division courses except Math. 168A-B, 179A-B, 183, 184A-B, 189A-B, and 195–199. If a student has completed CSE 167, then he or she cannot get elective credit for Math. 155A. Students may receive elective credit for only one of the following courses: CSE 164A, Math. 174, Math. 173, Phys. 105A-B, MAE 107, CENG 100. No credit for any of these courses will be given if Math. 170A-B-C is taken. Students will receive credit for either Math. 166 or CSE 105 (but not both), either Math. 188 or CSE 101 (but not both), and either Math. 176 or CSE 100 (but not both).

Computer Science and Engineering:

All CSE upper-division courses except CSE 195. Students will receive credit for either CSE 123A or ECE 158A (but not both).

Cognitive Science:

Sensation and Perception 101A, Learning, Memory, and Attention 101B, Language 101C, Distributed Cognition 102A, Cognitive Ethnography 102B, Cognitive Engineering 102C, Neuroanatomy and Physiology 107A, Systems Neuroscience 107B, Cognitive Neuroscience 107C, Programming Methods for Cognitive Science 108D, Neural Networks Models of Cognitive I 108E, Advanced Programming Methods for Cognitive Science 108F, Human Computer Interaction 120, Human Computer Interaction Programming 121, Semantics 150, Language Comprehension 153, Natural and Artificial Symbolic Representational Systems 170, Neural Network Models of Cognition II 181, Artificial Intelligence Modeling II 182.

Students may not get credit for both CSE 150 and Advanced Programming Methods for Cognitive Science 108F or for both CSE 151 and Artificial Intelligence Modeling II 182.

Mechanical and Aerospace Engineering (MAE):

All upper-division MAE courses except MAE 140, and MAE 195-199.

Students may receive elective credit for only one of the following courses: CSE 164A, Math. 174, Math. 173, Phys. 105A-B, CENG 100, MAE 107. Students may only get credit for one of the two courses, CSE 167 or MAE 152.

Economics:

Microeconomics 100A-B, Game Theory 109, Macroeconomics 110A-B, Mathematical Economics 113, Econometrics 120B-C, Applied Econometrics 121, Management Science Microeconomics 170A-B, Decisions Under Uncertainty 171, Introduction to Operations Research 172A-B-C, Economic and Business Forecasting 178.

Students cannot take Economics 120A since it duplicates ECE 109.

Linguistics:

Phonetics 110, Phonology I 111, Phonology II 115, Morphology 120, Syntax I 121, Syntax II 125, Semantics 130, Mathematical Analysis of Languages 160, Computers and Language 163, Computational Linguistics 165, Psycholinguistics 170, Language and the Brain 172, and Sociolinguistics 175.

Engineering:

Team Engineering 101 (see course description under the Jacobs School of Engineering section).

Music:

Computer Music II 172, Audio Production: Mixing and Editing 173.

Psychology:

Engineering Psychology 161.

B.A. Electrical Engineering and Society

Students must complete a total of 180 units for graduation, including the general-education requirements (GER). Note that 144 units (excluding GER) are required.

Lower-Division Requirements (total of seventy-six units)

Mathematics (twenty-four units):

Math. 20A-B-C-D-E-F.

Physics (sixteen units):

Phys. 2A-B-C-D or Phys. 4A-B-C-D-E. Math. 20A is a prerequisite for Phys. 2A. Students whose performance on the mathematics placement test permits them to start with Math. 20B or higher may take Phys. 2A in the fall quarter of the freshman year.

Chemistry (four units):

Chem. 6A.

Programming Course (four units):

ECE 15.

Electrical Engineering (twenty units):

ECE 25, 30, 35, 45, and 65.

Elective Courses in Social Sciences and Humanities Studies (eight units):

These can be prerequisite courses for the upper-division depth sequence in social sciences/humanities. For instance, for history studies, this can be two history lower-division courses (HILD 2,7,10–12). Historically oriented HUM, MMW, and CAT courses would count as well. At least one lower-division course should have a writing component. For economics studies, this can be two lower-division courses (ECON 1, and ECON 4 for the finance track); or one lower-division course (ECON 1) plus one upper-division course for the data analysis track. For political science, the following courses may be utilized: PS10, PS11, PS12, PS13, PS30. For sociology studies, students will choose two lower-division courses from SOCI 1, 2, and 30, of which 30 is highly recommended.

Additional Notes:

1. Students with AP math credit are strongly advised to take Math. 20B in the fall quarter, leaving room for a GER in the winter quarter.
2. The ECE undergraduate Web site shows several scheduling options. Please refer to the Web site and consult with the staff advisors in the undergraduate offices, rooms 2705 and 2707 in EBU1.

**Upper-Division Requirements
(total of sixty-eight units)**

a. Electrical Engineering BREADTH Courses (twenty-eight units)

Courses required of all electrical engineering majors:

The seven courses—ECE 100, 101, 102, 103, 107, 108, and 109—are required of all electrical engineering majors and they are an assumed prerequisite for senior-level courses, even if they are not explicitly required. Although the courses are largely independent, ECE 65 is a prerequisite for ECE 100 and 102. Students who delay some of the BREADTH courses until the spring should be careful to not have delayed their depth sequence.

b. Electrical Engineering DESIGN Course (four units)

Note: In order to fulfill the design requirement, students must complete one of the following courses with a grade C– or better. When taking this course, the student has the option of having a portion of the project related to his/her social sciences/humanities study. Graduation will not be approved until a written copy of the design project is submitted to the ECE undergraduate office.

The electrical engineering design requirement can be fulfilled in any of the following three ways:

1. Take ECE 191. Engineering Group Design Project
2. Take ECE 190. Engineering Design. This course requires the department stamp. Specifications and enrollment forms are available in the undergraduate office.
3. Take one of the following courses:
 - o ECE 111. Advanced Digital Design Project
 - o ECE 118. Computer Interfacing
 - o ECE 155B or 155C. Digital Recording Projects

Students who wish to take one of these courses to satisfy the design requirement must fill out an enrollment form and have departmental approval for the design credit prior to taking the course. The project must meet the same specifications as ECE 190.

c. Electrical Engineering ELECTIVES (twelve units)

Three upper-division engineering, mathematics, or physics courses.

d. Social Sciences/Humanities Studies Depth Requirement (twenty-four units)

Students must complete a “depth requirement” of at least six quarter courses to provide a focus for their studies. Sample depth programs for history and economics students are discussed below. Students may choose this demonstrated sequence or they may propose another with the approval of their faculty co-advisor from the respective social sciences/humanities department.

History Studies (six courses, twenty-four units):

- At least four of these should belong to the specific field the student is pursuing (e.g., History of: East Asia, United States, Europe, Science, etc.).
- At least one course should be in the field of history of science and technology.
- At least one course should be a colloquium (i.e., a small course, with an emphasis on essay writing).

HISC 105. History of Environmentalism
HISC 106. The Scientific Revolution
HISC 107. The Emergence of Modern Science
HISC 108. Science and Technology in the Twentieth Century
HISC 109. Science in Western Civilization
HISC 111. The Atomic Bomb and the Atomic Age
HISC 115. Making Modern Medicine
HISC 131. Science Technology and Law
HISC 173/273. Darwin and Darwinism
HILD 2A. United States History
HILD 7A. Race and Ethnicity
HILD 10. East Asia: The Great Tradition
HILD 11. East Asia and the West
HILD 12. Twentieth-Century East Asia
HIUS 140. Economic History of the United States
HIUS 151. American Legal History 1865 to the Present
HIUS 187. Social Movements in the United States
HIUS 148. American Cities in the Twentieth Century
HIEU 143. European Intellectual History
HIGR 222. European History
HILA 102. Latin America in the Twentieth Century

Economics Studies

Track A: Finance (six courses, twenty-four units):

- Intermediate Microeconomic sequence: ECON 100A-B-C
- Finance sequence: ECON 173A-B
- One elective course from the following: ECON 104, 105, 109, 113, 119, 120B, 141, 142, 143, 147, 150, 151, 155, 171, 172A

Track B: Data Analysis (seven courses, twenty-eight units, one of them can be taken during lower-division years)

- Intermediate Microeconomic sequence: ECON 100A-B-C
- Data Analysis sequence: ECON 120B-C
- Two elective courses from the following: ECON 104, 105, 109, 119, 121, 125, 150, 151, 152, 155, 173A, 173B, 174, 176, 178
- Other upper-division courses for satisfying the depth sequences for other studies in social sciences/humanities will be available after an agreement is established between ECE and the respective department/program in social sciences/humanities.

Political Science Studies (six courses, twenty-four units):

Policy Analysis

At least four courses from:

PS 160AA. Introduction to Policy Analysis
PS 160AB. Introduction to Policy Analysis
PS 162. Environmental Policy

PS 163. Analyzing Politics
PS 165. Special Topic: Policy Analysis
PS 168. Policy Assessment
PS 170A. Introductory Statistics for Political Science and Public Policy

and at least two courses from:

PS 100H. Race and Ethnicity
PS 102J. Advanced Topics in Urban Politics
PS 103A. California Government and Politics
PS 103B. Politics and Policymaking in Los Angeles
PS 103C. Politics and Policymaking/San Diego
PS 125. Politics of Conservation
PS 125A. Communities and the Environment
PS 126AA. Modern Capitalism
PS 142A. United States Foreign Policy
PS 142B. U.S. Foreign Economic Policy
PS 142J. National Security Strategy
PS 142M. U. S. Foreign Policy/Regional Security

Sociology Studies (six courses, twenty-four units):

Students may specialize in one of four departmental concentrations or complete the “general sociology” track.

Students will choose eight courses, two lower-division and six upper-division courses from their choice of concentrations in: Science and Medicine, Law and Society, Economy and Society, International Studies, or General Sociology. *SOCI30 and SOCI 168T are highly recommended for all tracks.

Concentration in Science and Medicine (eight courses, thirty-two units)

Students will choose two lower division courses from SOCI 1, 2, and 30, of which 30 is highly recommended; and six upper division courses from the list below, in which SOCI 168T is highly recommended.

Lower-Division

SOCI 1. The Study of Society
SOCI 2. The Study of Society
SOCI 30. Science, Technology, and Society (highly recommended)

Upper-Division

SOCI 168T. Sociology of Technology (highly recommended)
SOCI 113. Sociology of the AIDS Epidemic
SOCI 134. The Making of Modern Medicine
SOCI 135. Medical Sociology
SOCI 136A. Sociology of Mental Illness: An Historical Approach
SOCI 136B. Sociology of Mental Illness in Contemporary Society
SOCI 138. Genetics and Society
SOCI 149. Sociology of the Environment
SOCI 167. Science and War
SOCI 168E. Sociology of Science

Concentration in Law and Society (eight courses, thirty-two units)

Students will choose two lower-division courses from SOC1 1, 2, and 30, of which 30 is highly recommended; and six upper-division courses from the list below, in which SOCI 168T is highly recommended.

Lower-Division

SOCI 1. The Study of Society
SOCI 2. The Study of Society
SOCI 30. Science, Technology, and Society (highly recommended)

Upper-Division

SOCI 168T. Sociology of Technology (highly recommended)
SOCI 111. Human Rights
SOCI 112. Social Psychology
SOCI 142. Social Deviance
SOCI 143. Suicide
SOCI 146. Law Enforcement in America
SOCI 160L. Law and Culture
SOCI 173. Elite Crime
SOCI 140. Sociology of Law
SOCI 140F. Law and the Workplace
SOCI 141. Crime and Society
SOCI 147. Organizations, Society, and Social Justice
SOCI 159. Special Topics in Social Organizations and Institutions
SOCI 163. Migration and the Law

Concentration in Economy and Society (eight courses, thirty-two units)

Students will choose two lower-division courses from SOCI 1, 2, and 30, of which 30 is highly recommended; and six upper-division courses from the list below, in which SOCI 168T is highly recommended.

Lower-Division

SOCI 1. The Study of Society
SOCI 2. The Study of Society
SOCI 30. Science, Technology, and Society (highly recommended)

Upper-Division

SOCI 168T. Sociology of Technology (highly recommended)
SOCI 125. Sociology of Immigration
SOCI 137. Sociology of Food
SOCI 121. Economy and Society
SOCI 132. Gender and Work
SOCI 139. Social Inequality: Class, Race, and Gender
SOCI 140F. Law and the Workplace
SOCI 148E. Inequality and Jobs
SOCI 152. Social Inequality and Public Policy
SOCI 163. Migration and the Law
SOCI 167. Science and War
SOCI 185. Globalization and Social Development

Concentration in International Studies (eight courses, thirty-two units)

Students will choose two lower-division courses from SOCI 1, 2, and 30, of which 30 is highly recommended; and six upper-division courses from the list below, in which SOCI 168T is highly recommended.

Lower-Division

SOCI 1. The Study of Society
SOCI 2. The Study of Society
SOCI 30. Science, Technology, and Society (highly recommended)

Upper-Division

SOCI 168T. Sociology of Technology (highly recommended)
SOCI 111A. Human Rights: Principles and Problems

SOCI 111B. Human Rights: Practices and Cases
SOCI 130. Population and Society
SOCI 145. Violence and Society
SOCI 151. Comparative Race and Ethnic Relations
SOCI 162R. Religion and Popular Culture in East Asia
SOCI 148. Political Sociology
SOCI 152. Urban Sociology
SOCI 157. Religion in Contemporary Society
SOCI 158. Islam in the Modern World
SOCI 169. Citizenship, Community, and Culture
SOCI 176. War and Society
SOCI 177. International Terrorism
SOCI 178. The Holocaust
SOCI 179. Social Change
SOCI 180. Social Movements and Social Protest
SOCI 181. Modern Western Society
SOCI 182. Ethnicity and Indigenous Peoples in Latin America
SOCI 183. Minorities and Nations
SOCI 185. Globalization and Social Development
SOCI 187. African Societies Through Film
SOCI 188E. Community and Social Change in Africa
SOCI 188G. Chinese Society
SOCI 188F. Modern Jewish Societies and Israeli Society
SOCI 188D. Latin America: Society and Politics
SOCI 188J. Change in Modern South Africa
SOCI 189. Special Topics in Comparative-Historical Sociology

General Sociology (eight courses, thirty-two units)

Students will choose two lower-division courses from SOCI 1, 2, and 30, of which 30 is highly recommended; and six upper-division courses, including one from EACH of the following four concentrations:

Science and Medicine
Law and Society
Economy and Society
International Studies

*SOCI 30 and SOCI 168T are highly recommended as two of the eight total courses.

Minor Curricula

ECE offers three minors in accord with the general university policy that a minor requires five upper-division courses. Students must realize that these upper-division courses have extensive lower-division prerequisites (please consult the ECE undergraduate office). Students should also consult their college provost's office concerning the rules governing minors and programs of concentration.

Electrical Engineering: Twenty units chosen from the breadth courses ECE 101, 102, 103, 107, 108, 109.

Engineering Physics: Twenty units chosen from the junior year courses Phys. 110A, 130A, Math. 110, ECE 101, 102, 103, 107, 108, 109.

Computer Engineering: Twenty units chosen from the junior year courses ECE 102, 108, CSE 100, 101, 105, 120, 140, 140L, 141, 141L.

The department will consider other mixtures of upper-division ECE, CSE, physics, and mathematics courses by petition.

Undergraduate Admissions, Policies, and Procedures

Freshman Eligibility:

1. Computer Engineering:

Freshmen students who have declared Computer Engineering on their application will be directly admitted into the major.

2. Electrical Engineering:

Freshmen students who have declared Electrical Engineering on their application will be directly admitted into the major.

3. Engineering Physics:

All students will initially be placed in pre-major status. Upon successful completion of the following courses (with a minimum 2.0 GPA by the end of the first three quarters if a transfer student, six quarters if an incoming freshman), students will be admitted into full Engineering-Physics major status.

1. Math. 20A-B-C
2. Phys. 2A-B
3. ECE 15, 25, and 35

To initiate the change from pre-major status to full major status, transfer students must see the ECE undergraduate advisor by the end of their third quarter at UCSD; incoming freshmen by the end of their sixth quarter.

Please refer to the section “Undergraduate Regulations and Requirements” for important details.

Transfer Students Eligibility

It is strongly recommended that transfer students complete the following course preparation for engineering majors:

- Calculus I—for Science and Engineering (Math. 20A)
- Calculus II—for Science and Engineering (Math. 20B)
- Calculus and Analytic Geometry (Math. 20C)
- Differential Equations (Math. 20D)
- Linear Algebra (Math. 20F)
- Complete calculus-based physics series with lab experience (Phys. 2A-B-C)
- Chemistry 6A (except computer science and computer engineering majors)
- Highest level of introductory computer programming language course offerings at the community college*

*Refer to the UC San Diego General Catalog to select major prerequisite requirement for computer language courses.

1. Computer Engineering:

Applicants seeking admission as transfer students will be directly admitted into the Computer Engineering major.

2. Electrical Engineering:

Applicants seeking admission as transfer students will be directly admitted into the electrical engineering major.

3. Engineering Physics:

Students are accepted into the pre-major and must complete the following courses in order to be accepted into the engineering physics major: Math. 20A-B-C, Phys. 2A-B, ECE 15, 25, and 35. Students who wish to enter in the engineering physics major must contact the department before the beginning of the fall quarter, submitting course descriptions and transcripts for courses used to

satisfy their lower-division requirements. Normally, admission will be for the fall quarter; students entering in the winter or spring quarter should be aware that scheduling difficulties may occur because upper-division sequences normally begin in the fall quarter.

Grade Requirement in the Major

Courses required for the major must be taken for a letter grade. All major courses must be completed with a grade of C– or better.

A GPA of 2.0 is required in all upper-division courses in the major, including technical electives. The grade of D will not be considered an adequate prerequisite for any ECE course and will not be allowed for graduation. The engineering design requirement must be completed with a grade of C– or better.

Advising

Students are required to complete an academic planning form and to discuss their curriculum with the appropriate departmental advisor immediately upon entrance to UCSD, and then every year until graduation. This is intended to help students in: a) their choice of depth sequence, b) their choice of electives, c) keeping up with changes in departmental requirements. A faculty advisor will be assigned by the ECE department undergraduate office.

New Transfer Students in Electrical Engineering and Engineering Physics

The entire curriculum is predicated on the idea of actively involving students in engineering from the time they enter as freshmen. The freshman courses have been carefully crafted to provide an overview of the engineering mindset with its interrelationships among physics, mathematics, problem solving, and computation. All later courses are specifically designed to build on this foundation. All transfer students should understand that the lower-division curriculum is demanding. Transfer students will be required to take all lower-division requirements or their equivalent. Transfer students are advised to consult the ECE Web site for sample recommended course schedules and for the ECE course requirement guide.

New Transfer Students in Computer Engineering

Transfer students are advised to consult the ECE Web site for sample recommended course schedules and for the ECE course requirement guide.

Students who do not have any programming experience are encouraged to take the CSE 8A-B sequence instead of CSE 11. Experience has shown that most students who are not familiar with programming and take CSE 11 have to retake the class because the accelerated pace makes it difficult to learn the new material.

Note: Transfer students are encouraged to consult with the ECE undergraduate office for academic planning upon entrance to UCSD.

ECE Honors Program

The ECE Undergraduate Honors Program is intended to give eligible students the opportunity to work closely with faculty in a project, and to honor the top graduating undergraduate students.

Eligibility for Admission to the Honors Program:

1. Students with a minimum GPA of 3.5 in the major and 3.25 overall will be eligible to apply. Students may apply at the end of the winter quarter of their junior year and no later than the end of the second week of fall quarter of their senior year. No late applications will be accepted.
2. Students must submit a project proposal (sponsored by an ECE faculty member) to the honors program committee at the time of application.
3. The major GPA will include ALL lower-division required for the major and all upper-division required for the major that are completed at the time of application (a minimum of twenty-four units of upper-division course work).

Requirements for Award of Honors:

1. Completion of all ECE requirements with a minimum GPA of 3.5 in the major based on grades through winter quarter of the senior year.
2. Formal participation (i.e., registration and attendance) in the ECE 290 graduate seminar program in the winter quarter of their senior year.
3. Completion of an eight-unit approved honors project (ECE 193H: Honors Project) and submission of a written report by the first day of spring quarter of the senior year. This project must contain enough design to satisfy the ECE B.S. four-unit design requirement.
4. The ECE honors committee will review each project final report and certify the projects which have been successfully completed at the honors level.

Procedure for Application to the Honors Program:

Between the end of the winter quarter of their junior year and the second week of the fall quarter of their senior year, interested students must advise the department of their intention to participate by submitting a proposal for the honors project sponsored by an ECE faculty member. Admission to the honors program will be formally approved by the ECE honors committee based on GPA and the proposal.

Unit Considerations

Except for the two-unit graduate seminar, this honors program does not increase a participant's total unit requirements. The honors project will satisfy the departmental design requirement and students may use four units of their honors project course as a technical elective.

Five-Year B.S./Master's Program

Undergraduates in the ECE department who have maintained a good academic record in both departmental and overall course work are encouraged to participate in the five-year B.S./master's program offered by the department. Participation in the program will permit students to complete the requirements for the M.S. degree within one year following receipt of the B.S. degree. Complete details regarding admission to and participation in the program are available from the ECE Undergraduate Affairs office.

Admission to the Program

Students should submit an application for the B.S./master's program, including three letters of recommendation, by the program deadline during the spring quarter of their junior year. Applications are available from the ECE Undergraduate Affairs office. No GRE's are required for application to the B.S./master's program. A GPA of at least 3.0 both overall and in the major and strong letters of recommendation are required to be considered for program admission. Students should indicate at that time whether they wish to be considered for the M.S. degree program.

In the winter quarter of the senior year, applications of students admitted to the program will be forwarded by the department to the UCSD Office of Graduate Studies. Each student must submit the regular graduate application fee prior to the application deadline for their application to be processed. Students who have been accepted into the B.S./master's program will automatically be admitted for graduate study beginning the following fall provided they maintain an overall GPA through the winter quarter of the senior year of at least 3.0. Upper-division (up to twelve units) or graduate courses taken during the senior year that are not used to satisfy undergraduate course requirements may be counted towards the forty-eight units required for the M.S. degree.

Continuation in the Program

Once admitted to the B.S./master's program, students must maintain a 3.0 cumulative GPA in all courses through the winter quarter of the senior year and in addition must at all times maintain a 3.0 cumulative GPA in their graduate course work. Students not satisfying these requirements may be re-evaluated for continuation in the program.

Admission for graduate study through the B.S./master's program will be for the M.S. degree only. Undergraduate students wishing to continue toward the Ph.D. degree must apply and be evaluated according to the usual procedures and criteria for admission to the Ph.D. program.

Curriculum

Students in the five-year B.S./master's program must complete the same requirements as those in the regular M.S. program. Completion of the M.S. degree requirements within one year following receipt of the B.S. degree will generally require that students begin graduate course work in their senior year. All requirements for the B.S. degree should be completed by the end of the senior (fourth) year, and the B.S. degree awarded prior to the start of the fifth year. Courses taken in the senior year may be counted toward the B.S. degree requirements or the M.S. degree requirements, but not both. Students must have received their B.S. degree before they will be eligible to enroll as graduate students in the department.