ELECTRICAL AND COMPUTER ENGINEERING - BACHELOR OF SCIENCE (BS)

Program Educational Objectives

- Graduates will be situated in growing careers involving the design, development or support of electrical, electronic and computer hardware and software systems, software engineering, devices instruments or products, or will be successfully pursuing an advanced degree.

Graduates attaining the Electrical and Computer Engineering (ECE) BS degree will have comprehensive knowledge and experience in the concepts and design of electrical, electronic and computer devices, circuits and systems. Besides emphasizing computer hardware and software, the ECE curriculum also emphasizes design, integration, implementation and application of computer systems, as well as experience in software development. This is achieved through a sequence of required courses in these areas, culminating in a major design project incorporating realistic engineering constraints. The curriculum also provides opportunities for specialization in areas such as compiler design, embedded systems, software engineering, and VLSI design, as well as in the electrical engineering specialties. ECE graduates will have attained other professional skills that will be useful throughout their careers, including verbal and written communication, and the ability to function on multidisciplinary teams. The ECE curriculum is rich in laboratory work. ECE graduates will have achieved extensive practical experience in the laboratory techniques, tools and skills that provide a bridge between theory and practice.

- Graduates will have advanced in professional standing based on their technical accomplishments and will have accumulated additional technical expertise to remain globally competitive.

ECE graduates experience a curriculum that contains a broad core of classes focused on mathematical and physical principles that are fundamental to the fields of electrical and computer engineering. Hence, they understand the physical and mathematical principles underlying electrical and electronic technology, and computer systems, and are able to analyze and solve electrical and computer engineering problems using this knowledge. In addition to basic classes in mathematics, science, and computing, the ECE curriculum includes a sequence of courses in analog and digital electronic circuits and systems, electromagnetic fields, probability, computer software, and computer design and architecture.

- Graduates will have demonstrated professional and personal leadership and growth.

To lay the foundation of a long career in a rapidly changing field, a broad background of fundamental knowledge is required. This is achieved in the ECE curriculum through a sequence of required classes in mathematics, physics, chemistry, and the ECE core. In addition, the graduate must be capable of lifelong learning; this is taught through assignments and projects that require independent research and study. The curriculum includes a significant component of electives in the humanities and social sciences. ECE graduates will have knowledge of the broader contemporary issues that impact engineering solutions in a global and societal context. They will have the verbal and written communications skills necessary for a successful career in industry or academia. Graduates also understand the meaning and importance of professional and ethical responsibility.

Student Outcomes

The ECE curriculum is designed to prepare our graduates to meet these as follows:

- an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- an ability to communicate effectively with a range of audiences
- an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
- an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Concurrent Degree Program

BS/MS in Electrical & Computer Engineering and Electrical Engineering

The concurrent BS/MS program enables especially well qualified electrical & computer engineering majors to be admitted to the MS program during the junior year of their BS program, and to work simultaneously toward their BS degree along with an MS in electrical engineering. This program allows for early planning of the MS portion of the student’s education, taking graduate courses as part of the BS degree, more flexibility in the order in which courses are taken, and more efficient use of what would otherwise be a final semester with a light credit-hour load.

For more information, visit the department’s BS/MS Degrees (http://www.colorado.edu/ecee/undergraduate-program/degrees/bs-ms-degrees) webpage.

Requirements

Required Courses

A minimum grade of C- is required for any course that is a prerequisite for a subsequent course.

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<thead>
<tr>
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<td>APPM 1350</td>
<td>Calculus 1 for Engineers (Recommended)</td>
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</tr>
<tr>
<td>or MATH 1300</td>
<td>Calculus 1</td>
<td>4</td>
</tr>
<tr>
<td>APPM 1360</td>
<td>Calculus 2 for Engineers (Recommended)</td>
<td>4</td>
</tr>
<tr>
<td>or MATH 2300</td>
<td>Calculus 2</td>
<td>4</td>
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</tr>
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<td>Calculus 3 for Engineers (Recommended)</td>
<td>4</td>
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</tbody>
</table>
or MATH 2400 Calculus 3
APPM 2360 Introduction to Differential Equations with Linear Algebra (Recommended)
ECEN 3810 Introduction to Probability Theory (Recommended)
or APPM 3570 Applied Probability
or MATH 4510 Introduction to Probability Theory

Physics
PHYS 1110 General Physics 1 4
PHYS 1120 General Physics 2 4
PHYS 1140 Experimental Physics 1 1

Computer Programming
ECEN 1310 C Programming for ECE (Recommended) 4
or CSCI 1300 Computer Science 1: Starting Computing
or CSCI 1310
or CSCI 1320 Computer Science 1: Starting Computing-Engineering Application

ECEN 1030 Special Topics (Programming with Mathematical Software) 1

Electrical Engineering Core
ECEN 2250 Introduction to Circuits and Electronics 3
ECEN 2260 Circuits as Systems 3
ECEN 2270 Electronics Design Lab 3
ECEN 2350 Digital Logic 3
ECEN 3350 Programming Digital Systems 3
ECEN 3360 Digital Design Laboratory 3

Computer Engineering Core
ECEN 2703 Discrete Mathematics for Computer Engineers (Recommended) 3
or APPM 3170 Discrete Applied Mathematics
or MATH 2001 Introduction to Discrete Mathematics
or CSCI 2824 Discrete Structures
CSCI 2270 Computer Science 2: Data Structures 4
ECEN 4593 Computer Organization 3

Capstone Design Lab
ECEN 4610 Capstone Laboratory Part 1 (Fall only) 1 3
ECEN 4620 Capstone Lab, Part 2 (Spring only) 3

Total Credit Hours 67

1 Minimum grade of C- required.

Electives

Economics & Social Sciences
1XXX/2XXX A&S Core Lower Division 9
3XXX/4XXX A&S Core Upper Division 6
Choose an approved upper-division writing course: 3

HUEN 1010 Humanities for Engineers (first-year students only)
HUEN 3100 Advanced Humanities for Engineers
WRTG 3030 Writing on Science and Society
WRTG 3035 Technical Communication and Design
PHYS 3050 Writing in Physics: Problem-Solving and Rhetoric

General Science Elective
Choose one: 3-5

PHYS 2130 General Physics 3
MCEN 3012 Thermodynamics
EBIO 1210 General Biology 1
MCDM 1150 Introduction to Cellular and Molecular Biology
IPHY 3410 Introduction to Human Anatomy
CHEN 1211 General Chemistry for Engineers (CHEM 1221 is optional)

Free Electives
Choose 8 credits of electives. 8

Electrical Electives (Advanced Concentration Electives)
Choose two: 6

ECEN 4341 Bioelectromagnetics
ECEN 4242 Communication Theory
ECEN 4652 Communication Laboratory
ECEN 4632 Introduction to Digital Filtering
ECEN 4532 Digital Signal Processing Laboratory
ECEN 4138 Control Systems Analysis
ECEN 4638 Control Systems Laboratory
ECEN 3410 Electromagnetic Waves and Transmission
ECEN 4634 Microwave and RF Laboratory
Electrical and Computer Engineering - Bachelor of Science (BS)

ECEN 4797  Introduction to Power Electronics
ECEN 4517  Power Electronics and Photovoltaic Power Systems Laboratory
ECEN 4827  Analog IC Design
ECEN 3170  Electromagnetic Energy Conversion 1
ECEN 4606  Undergraduate Optics Laboratory

Technical Electives (Advanced Concentration Electives)

Complete additional Technical Electives to get 128 credits in the program. Technical Electives can come from 3XXX/4XXX-level courses housed in any Engineering department or APPM, MATH, PHYS, ATLS, ASTR, ATOC, CHEM, ENVB, GEOG, IPHY, MCDB, PSYC.

Total Credit Hours 61

1. Transfer students can replace these credits with additional ACE Technical Electives.
2. Students can replace these credits with additional ACE Technical Electives.
3. Minimum grade of C- required.
4. Both must be completed prior to enrolling in ECEN 4620. Students may take one concurrently with ECEN 4610. From the three courses offered, be sure to pick the two that open up (or are the prerequisites for) the ACE Electrical Electives you plan on taking.
5. Other upper-division software courses allowed by petition.
6. One course must be at the 4XXX level or above. Other ECEN course work accepted by petition.
7. Students may also elect to count up to 6 credits of 3XXX/4XXX-level ECON, BUSM or EMEN courses toward TE requirements. Students may not choose: CSCI 4250/5250, MATH 4430, ECEN 3070, EBIO 3010 or PHYS 3000/3221. It is the student's responsibility to ensure that courses will count toward the degree prior to enrolling in them. Students must meet prerequisites for these courses.

Recommended Four-Year Plan of Study

The following information represents a sample eight-semester sequence of study only. Up-to-date curricular information and policies are contained in the ECEE HELP Guide.

Course     Title                                      Credit Hours
Year One
Fall Semester
APPM 1350  Calculus 1 for Engineers                4
ECEN 1100  Exploring ECE                           1
ECEN 1400  Introduction to Digital and Analog Electronics 3
PHYS 1110  General Physics 1                        4
Humanities/social sciences elective 1               3

Spring Semester
APPM 1360  Calculus 2 for Engineers                4
ECEN 1200  Programming Digital Systems             3
ECEN 1210  Introduction to Probability Theory      3
ECEN 1220  Analog Elective                         3
Humanities/social sciences elective 1               3

Year Two
Fall Semester
APPM 2350  Calculus 3 for Engineers                4
ECEN 2260  Circuits as Systems                     3
ECEN 2270  Electronics Design Lab                  3
ECEN 2350  Digital Logic                           3
General science elective                           3

Spring Semester
APPM 2360  Introduction to Differential Equations with Linear Algebra 1
ECEN 2360  Special Topics (Special Topics - MATLAB Programming) 3
ECEN 2370  Discrete Mathematics for Computer Engineers 3
Humanities/social sciences elective 1               3

Year Three
Fall Semester
CSCI 2270  Computer Science 2: Data Structures     4
ECEN 3350  Programming Digital Systems             3
ECEN 3810  Introduction to Probability Theory      3
ECEN 3XXX  Analog Elective                         3
Humanities/social sciences elective 1               3

Spring Semester
APPM 3360  Calculus 4 for Engineers                4
ECEN 3400  Computer Science 3: Microprocessors     3
ECEN 3410  Introduction to Electromagnetics        3
ECEN 3420  Analog Electronics                      3
Humanities/social sciences elective 1               3

Year Four
Fall Semester
APPM 4360  Calculus 5 for Engineers                4
ECEN 4370  Introduction to Power Electronics       3
ECEN 4380  Power Electronics and Photovoltaic Power Systems Laboratory 3
ECEN 4390  Electromagnetic Energy Conversion 2     3
ECEN 4400  Undergraduate Optics Laboratory         3
Humanities/social sciences elective 1               3

Total Credit Hours 16
<table>
<thead>
<tr>
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<th>Credit</th>
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<tbody>
<tr>
<td>ECEN 3360</td>
<td>Digital Design Laboratory</td>
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</tr>
<tr>
<td>ECEN 4593</td>
<td>Computer Organization</td>
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<tr>
<td>ECEN 3XXX</td>
<td>Analog Elective</td>
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<tr>
<td>Technical electives</td>
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<tr>
<td>College-approved writing course</td>
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### Year Four

**Spring Semester**

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<th>Course Code</th>
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<tr>
<td>Capstone, Part 1</td>
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<tr>
<td>Technical electives</td>
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<td>Free electives</td>
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<td><strong>Total</strong></td>
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**Fall Semester**

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit</th>
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<tbody>
<tr>
<td>Capstone, Part 2 (minimum grade of C- required)</td>
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<tr>
<td>Software elective</td>
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<tr>
<td>Technical elective</td>
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<tr>
<td>Humanities/social sciences elective</td>
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<td>3</td>
</tr>
<tr>
<td>Free elective</td>
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<td><strong>Total</strong></td>
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<td><strong>15</strong></td>
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</table>

**Total Credit Hours**: 128

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1. Students may choose courses from the list of college-approved humanities and social sciences (HSS) electives (http://www.colorado.edu/engineering/academics/policies/hss).

2. Students may choose a course from the list of college-approved writing courses (http://www.colorado.edu/engineering/academics/policies/hss).