ELECTRICAL ENGINEERING, BACHELOR OF SCIENCE

The Department of Electrical and Computer Engineering offers a complete electrical engineering undergraduate program to students on the City (Lincoln) and Scott (Omaha) campuses of the University of Nebraska. Curriculum requirements are nearly identical on both campuses and students can complete all degree requirements on either campus.

Electrical engineering is concerned with the production, transmission, and utilization of electrical energy and the creation, transmission and processing of information. This includes power generation and transmission systems, motors, batteries and control systems, as well as radio frequency (RF) systems, telecommunications, remote sensing, signal processing, digital circuits, instrumentation, audio, video and opto-electronics. Employment opportunities for electrical engineers cover a wide spectrum of activities including design, development, research, sales, and management. These activities are carried on in industrial organizations, public and private utilities, the communications and computer industry, governmental and educational institutions, and consulting engineering firms. The objective of this major is to offer students an education to become productive electrical engineers and be active, contributing citizens of the nation and the world.

This department has over 40 faculty involved in research related to electronic materials, nanotechnology, optical systems, communications, biomedical applications, signal processing, microelectronics design, energy systems, and electromagnetics. Students are encouraged to participate in research activities, and have opportunities to travel and present their research results.

The department has extensive research facilities for all areas including design, development, research, sales, and management. These activities are carried on in industrial organizations, public and private utilities, the communications and computer industry, governmental and educational institutions, and consulting engineering firms. The objective of this major is to offer students an education to become productive electrical engineers and be active, contributing citizens of the nation and the world.

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The program Educational Objectives (PEOs) for the electrical engineering program are that graduates will be:

• Employed in business, academia, or government.
• Successful engineers who have established productive careers in their field and have contributed to improve and provide innovative and effective solutions in electrical engineering or related fields.
• Demonstrating technical and decision-making processes and the human interactions necessary to produce viable, responsible, and sustainable technological solutions.
• Engaging in lifelong learning, which may include postgraduate education, to successfully adapt to technological, industry specific, and cultural changes and to foster adept functioning in society.
• Performing engineering practice in a context that reflects awareness of the ethics of their profession and of the impacts of their work on the profession and society at large.

These Program Educational Objectives were developed with input from the program’s educational objectives constituency, consisting of employers (including the Industry Advisory Board), graduates of the program, and faculty of the department.

Learning Outcomes
Learning Outcomes are those abilities that a graduate of the Electrical Engineering program will have attained so that he/she can meet the educational objectives established for the program.

At the time of graduation, students in the ECE Electrical Engineering program will have:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. 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
3. an ability to communicate effectively with a range of audiences
4. 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
5. 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
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Professional Admission Requirements
Pre-professionally admitted College of Engineering students majoring in electrical engineering will be granted profession admission into the electrical engineering program if the students have:

• maintained a cumulative GPA of at least 2.4 and is in good standing in the College of Engineering, and
• completed ECEN 2130 Electrical Circuits I or ECEN 2150 Electronics and Circuits I and ECEN 2140 Electrical Circuits II or ECEN 2160 Electronics and Circuits II with a grade of C or better.

Accreditation
The Electrical and Computer Engineering (ECE) department’s Electrical Engineering Program (EE) is accredited by the Engineering Accreditation Commission of ABET (http://www.abet.org/)

Program Educational Objectives
The Program Educational Objectives (PEOs) for the electrical engineering program are a statement of what its graduates are doing or are capable of doing three to five years after graduation. Electrical engineering is concerned with the production, transmission, and utilization of electrical energy and the transmission and processing of information. Employment opportunities for electrical engineers cover a wide spectrum of activities including design, development, research, sales, and management. These activities are carried on in industrial organizations, public and private utilities, the communications and computer industry, governmental and educational institutions, and consulting engineering firms. Careers may encompass electronic materials, nanotechnology, optical systems, communications, biomedical applications, signal processing, microelectronics design, energy systems, and electromagnetics. The objective of this program is to offer students an education to become productive electrical engineers and be active, contributing citizens of the nation and the world.

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A transfer student will be admitted if he/she has:

- completed courses equivalent to ECEN 2130 or ECEN 2150 and ECEN 2140 or ECEN 2160 at other institutions with acceptable transfer grades of C or better, and
- earned a GPA of 2.4 or better during their first 12 credit hours in electrical engineering course work at UNL/UNO.

Transfer students will be able to appeal to the College's Academic Appeals Committee for admission for an additional semester if they fail to meet the GPA requirement.

See the College of Engineering section of the catalog for details on admission to the college.

Students graduating with a Bachelor of Science in Electrical Engineering degree must successfully complete 125 credit hours as follows:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Required electrical engineering courses</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>Required math and science courses</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>Technical electives</td>
<td>27</td>
</tr>
</tbody>
</table>

Of the 27 credit hours of technical electives, at least 12 credit hours must be taken as electrical engineering (ECEN) courses, which are referred to as "EE Technical Electives." The remaining 15 credit hours of technical electives which are referred to as "EE or Other Technical Electives" may be taken from any 300 or 400 level course offering (with some exceptions) in the department of Electrical and Computer Engineering or in any other engineering department within the College of Engineering, or in the departments of Biological Sciences, Chemistry, Computer Science and Engineering, Mathematics, Statistics, or Physics and Astronomy at UNL or UNO.

**Requirements**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>First Semester</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECEN 1030</td>
<td>ELECTRICAL AND COMPUTER ENGINEERING FUNDAMENTALS</td>
<td>4</td>
</tr>
<tr>
<td>MATH 1950</td>
<td>CALCULUS I</td>
<td>5</td>
</tr>
<tr>
<td>CIST 1400</td>
<td>INTRODUCTION TO COMPUTER SCIENCE</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 1160</td>
<td>ENGLISH COMPOSITION II</td>
<td>3</td>
</tr>
<tr>
<td><strong>Credits</strong></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td><strong>Second Semester</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECEN 1060</td>
<td>MICROPROCESSOR APPLICATIONS</td>
<td>3</td>
</tr>
<tr>
<td>ECEN 1234</td>
<td>INTRODUCTION TO ELECTRICAL AND COMPUTER ENGINEERING</td>
<td>1</td>
</tr>
<tr>
<td>ECEN 2250</td>
<td>ELECTRICAL AND COMPUTER ENGINEERING SEMINAR</td>
<td>1</td>
</tr>
<tr>
<td>MATH 1960</td>
<td>CALCULUS II</td>
<td>5</td>
</tr>
<tr>
<td>PHYS 2110</td>
<td>GENERAL PHYSICS I - CALCULUS LEVEL</td>
<td>4</td>
</tr>
<tr>
<td>CMST 1110</td>
<td>PUBLIC SPEAKING FUNDS</td>
<td>2</td>
</tr>
<tr>
<td><strong>Credits</strong></td>
<td></td>
<td>17</td>
</tr>
</tbody>
</table>

| **Second Year** | | |
| **First Semester** | | |
| ECEN 2150 | ELECTRONICS AND CIRCUITS I | 3 |
| ECEN 2184 | ELECTRICAL CIRCUITS LABORATORY I | 1 |
| MATH 2050 | APPLIED LINEAR ALGEBRA | 3 |
| MATH 2350 | DIFFERENTIAL EQUATIONS | 3 |
| PHYS 2120 | GENERAL PHYSICS-CALCULUS LEVEL | 4 |
| **Second Semester** | | |
| ECEN 2160 | ELECTRONICS AND CIRCUITS II | 3 |
| ECEN 2220 | ELECTRONIC CIRCUITS | 4 |
| ECEN 3130 | SWITCHING CIRCUITS THEORY | 4 |
| MATH 1970 | CALCULUS III | 4 |
| **Credits** | | 15 |

| **Total Credits** | | 125 |

1. Choose one course from not yet satisfied ACE outcomes 5, 6, 7, 8 or 9.
2. ENGR 1000 may be substituted for CMST 1110
3. The department maintains of approved list of technical electives (within and outside of ECE) on the department website.

**Technical Electives**

Each EE undergraduate student must choose one of the emphasis areas listed below for the EE technical electives.

**Electrical Engineering Emphasis Areas**
Communications and Signal Processing

Electromagnetic Fields and Optics

Electronics

Energy and Power Systems

Materials and Devices

Bioengineering

Modeling and Simulation

Telecommunications

Electives

There are 27 credit hours of technical electives required. Of these 27 credit hours, at least 12 credit hours must be taken in one of the electrical engineering (ECEN) emphasis areas. Below is a list of courses in each emphasis area.

Communications & Signal Processing

- **ECEN 4100** Multivariate Random Processes
- **ECEN 3250/ECEN 4620** Communications Systems
- **ECEN 4240/ECEN 4630** Digital Signal Processing
- **ECEN 4610/ECEN 4640** Digital Communications Media
- **ECEN 4650** Intro Data Compression

Electromagnetic Fields and Optics

- **ECEN 4080** Engineering Electromagnetics
- **ECEN 4670** Electromagnetic Theory and Applications
- **ECEN 4680** Microwave Engineering
- **ECEN 4790** Optical Fiber Communications
- **ECEN 4800** Introduction to Lasers and Transceivers
- **ECEN 4860** Applied Photonics

Electronics

- **ECEN 3100/ECEN 4740** Digital Design and Interfacing
- **ECEN 3520/ECEN 3610** Electronic Circuits II
- **ECEN 3620** Data and Telecommunications
- **ECEN 4690** Analog Integrated Circuits
- **ECEN 4700** Digital and Analog VLSI Design
- **ECEN 3380** Intro Power and Energy Systems

Energy and Power Systems

- **ECEN 4060** Power Systems Analysis
- **ECEN 4280** Power Electronics
- **ECEN 4300** Wind Energy
- **ECEN 4360** Electric Machines
- **ECEN 4440** Linear Control Systems
- **ECEN 4980 X** Solar Energy

Materials and Devices

- **ECEN 4980** Semiconductor Fundamentals II
- **ECEN 4200** Plasma Processing of Semiconductors
- **ECEN 4210** Principles of Semiconductor Materials and Devices I
- **ECEN 4220** Chemistry of Solids

Bioengineering

- **ECEN 4170** Bioinformatics
- **ECEN 4600** Labview Programming
- **ECEN 4530** Computational and Systems Biology
- **ECEN 4980** Computational Modeling and Simulation

Modeling and Simulation

- **ECEN 4060** Semiconductor Fundamentals II
- **ECEN 4200** Plasma Processing of Semiconductors
- **ECEN 4210** Principles of Semiconductor Materials and Devices I
- **ECEN 4220** Chemistry of Solids

Telecommunications

- **ECEN 4610/ECEN 4640** Digital Communications Media
- **ECEN 4660** Digital Communication Systems
- **ECEN 4980** Digital Communications Media

Of the 12 credit hours required in an emphasis area, 6 credit hours must be taken from one of the eight EE emphasis areas listed. This must include at least one Core Course in that area.

In addition, at least one 3 credit hour course from a different EE emphasis area must be taken. The remaining 3 credits may be satisfied by any non-required 3000- or 4000-level ECEN course except ECEN 3990 Undergraduate Research.

The remaining 15 credit hours of technical electives which are referred to as “EE or other technical electives” may be taken from any 3000- or 4000-level course offering (with the exception of those listed below) in the Department of Electrical and Computer Engineering or in any other engineering department within the College of Engineering at UNL, or in the UNO Departments of Biology, Chemistry, Computer Science, Mathematics,
or Physics or in the UNL Departments of Biological Sciences, Chemistry, Computer Science and Engineering, Mathematics, Statistics, or Physics and Astronomy.

**Not Allowed 300- and 400-Level Technical Electives**

- ENGR 4690 Technology, Science and Civilization
- BIOL 3500 Biological Principles of Aging
- BIOL 3660 Introduction to Sustainable Landscape Design
- CSCI 3710 Introduction to Digital Design and Computer Organization
- STAT 3000

**Allowed 100 and 200 Level Technical Electives**

- UNL BIOS 310 School of Biological Sciences Seminar
- UNL IMSE 305 Introduction to Engineering Management
- MATH 4980 Seminar or UNL MATH 495 (http://bulletin.unl.edu/undergraduate/courses/MATH/495/ Seminar)
- UNL MATH 496 (http://bulletin.unl.edu/undergraduate/courses/MATH/496/) Seminar in Mathematics

or any other seminar-type courses.

**Research Option**

1. Selection of a faculty advisor (ECE department faculty), research topic, and thesis committee (at least one other faculty).
2. Registration for 6 credit hours of undergraduate research (ECEN 3990) over at least two consecutive semesters on the same research topic.
3. GPA of above 3.0.
4. Write an undergraduate thesis or report and make an oral presentation to be graded by thesis committee members.

**Science Electives**

- BIOL 145O BIOLOGY I (5 cr) or UNL LIFE 120 and LIFE 120L FUNDAMENTALS OF BIOLOGY I
- CHEM 1180 (3 cr) and CHEM 1184 (1 cr) or UNL CHEM 109 or CHEM 111 or CHEM 113
- PHYS 2130 (4 cr) or UNL PHYS 213