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 state of the art computing facilities, integrated circuits and systems research facilities, communications and signal processing laboratories, applied electromagnetics research, solid state laboratories, nanostructures research, electro-optics research and energy systems laboratories.

The curriculum is designed to provide a broad education in fundamental principles and laboratory applications, and an awareness of the socioeconomic impact of technology. Technical electives are normally selected from advanced courses in electrical engineering to provide for specialization in selected areas. However, technical electives can also be selected from courses offered by other departments of the College of Engineering or from appropriate physics, chemistry, mathematics, and biological sciences courses.

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.

The Program Educational Objectives 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.
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>Required electrical engineering courses</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Required math and science courses</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>Technical electives</td>
<td>27</td>
<td></td>
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</tbody>
</table>

1 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

Course                  | Title                                | Credits |
------------------------|--------------------------------------|---------|
First Year              &                                      |         |
First Semester          &                                      |         |
ECEN 1030               | ELECTRICAL AND COMPUTER ENGINEERING FUNDAMENTALS | 4       |
MATH 1950               | CALCULUS I                           | 5       |
CIST 1400               | INTRODUCTION TO COMPUTER SCIENCE I   | 3       |
ENGL 1160              | ENGLISH COMPOSITION II               | 3       |
                        |                                      | 15      |
Second Semester         &                                      |         |
ECEN 1060              | MICROPROCESSOR APPLICATIONS          | 3       |
ECEN 1234              | INTRODUCTION TO ELECTRICAL AND COMPUTER ENGINEERING | 1       |
ECEN 2250              | ELECTRICAL AND COMPUTER ENGINEERING SEMINAR | 1       |
MATH 1960              | CALCULUS II                          | 5       |
PHYS 2110              | GENERAL PHYSICS I - CALCULUS LEVEL   | 4       |
CMST 1110              | PUBLIC SPEAKING FUNDS 2              | 3       |
                        |                                      | 17      |
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       |
                        |                                      |         |
| PHYS 1164              | GENERAL PHYSICS LABORATORY II        | 1       |
                        |                                      | 15      |
Second Semester         &                                      |         |
ECEN 2160              | ELECTRONICS AND CIRCUITS II          | 3       |
ECEN 2220              | ELECTRONIC CIRCUITS I                | 4       |
ECEN 3130              | SWITCHING CIRCUITS THEORY            | 4       |
MATH 1970              | CALCULUS III                         | 4       |
                        |                                      | 15      |
Third Year              &                                      |         |
First Semester          &                                      |         |
ECEN 3040              | SIGNALS AND SYSTEMS I                | 3       |
ECEN 3060              | ELECTROMAGNETIC FIELD THEORY (ACE Elective) | 3       |
ECEN 3074              | ELECTRICAL ENGINEERING LABORATORY I | 2       |
Electrical Engineering Option Elective | 3       |
Engineering Elective    | 3                                   |
ACE Elective 1          | 3                                   |
                        |                                      | 17      |
Second Semester         &                                      |         |
ECEN 3050              | PROBABILITY THEORY AND STATISTICS FOR ELECTRICAL AND COMPUTER ENGINEERS | 3       |
ECEN 3474              | ELECTRICAL ENGINEERING LABORATORY II | 1       |
Electrical Engineering Option Elective | 3       |
Engineering Elective 3  | 3                                   |
Science Elective       | 4                                   |
ACE Elective 1          | 3                                   |
                        |                                      | 17      |
Fourth Year             &                                      |         |
First Semester          &                                      |         |
ECEN 4940              | CAPSTONE I                           | 2       |
Electrical Engineering Option Elective | 3       |
Engineering Elective 3  | 3                                   |
ACE Electives 1         | 3                                   |
                        |                                      | 14      |
Second Semester         &                                      |         |
ECEN 4950              | CAPSTONE II                          | 3       |
Electrical Engineering Option Elective | 3       |
Engineering Electives 3 | 3                                   |
ACE Elective 1          | 3                                   |
                        |                                      | 6       |
                        |                                      | 15      |
                        |                                      | 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.

Total Credit Hours Required for Graduation - 125 Hours

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
- ECEN 4100: Multivariate Random Processes
- ECEN 4060: Power Systems Analysis

Electromagnetic Fields and Optics
- ECEN 4280 core: Power Electronics

Electronics
- ECEN 4300: Wind Energy

Energy and Power Systems
- ECEN 4360: Electric Machines

Materials and Devices
- ECEN 4440: Linear Control Systems

Bioengineering
- ECEN 4980 X: Solar Energy

Modeling and Simulation
- Materials and Devices

Telecommunications
- ECEN 4170: Semiconductor Fundamentals II

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 4060: Power Systems Analysis
- ECEN 3250/ECEN 4620 core: Communications Systems
  - ECEN 4500 core: Bioengineering
- ECEN 4620 core: Digital Signal Processing/Digital Signal Processing/Communications Systems
  - ECEN 4530: Computational and Systems Biology
- ECEN 4640: Digital Communications Media
  - ECEN 4980 S: Bioengineering Image and Signal Processing
- ECEN 4650: Intro Data Compression
  - ECEN 3980 M core: Computational Modeling and Simulation: Discrete Systems

Electromagnetic Fields and Optics
- ECEN 4080 core: Engineering Electromagnetics
  - ECEN 4980: Computational Modeling and Simulation: Continuous Systems
- ECEN 4670 core: Electromagnetic Theory and Applications
  - ECEN 4980: Computational Modeling and Simulation: Continuous Systems
- ECEN 4680: Microwave Engineering
  - ECEN 3620: Data and Telecommunications Transceivers
- ECEN 4980: Computational Modeling and Simulation: Continuous Systems
- ECEN 4800 applications
- ECEN 4860: Applied Photonics
  - ECEN 4640: Digital Communications Media

Electronics
- ECEN 3100/ECEN 4740 core: Digital Design and Interfacing
  - ECEN 4620: Data and Telecommunications
- ECEN 3520/ECEN 3610 core: Electronic Circuits II/Advanced Electronics and Circuits
  - ECEN 4980: Computational Modeling and Simulation: Continuous Systems
- ECEN 4690: Analog Integrated Circuits
  - ECEN 4640: Digital Communications Media
- ECEN 4700: Digital and Analog VLSI Design

Energy and Power Systems
- ECEN 3380 core: Intro Power and Energy Systems

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 STAT 3010 Statistical Methods I & II

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.

**Allowed 100 and 200 Level Technical Electives**

UNL AGEN 225 (http://bulletin.unl.edu/undergraduate/courses/AGEN/225) Engineering Properties of Biological Materials (BSEN 225 (http://bulletin.unl.edu/undergraduate/courses/BSEN/225))

PHYS 4350 Astrophysics or ASTR 204 Introduction to Astronomy & Astrophysics

UNL ASTR 224 (http://bulletin.unl.edu/undergraduate/courses/ASTR/224) Astronomy & Astrophysics Lab

BIOL 2140 Genetics or UNL BIOS 206 (http://bulletin.unl.edu/undergraduate/courses/BIOS/206) General Genetics

BIOL 2740 Human Physiology and Anatomy I or UNL BIOS 213 (http://bulletin.unl.edu/undergraduate/courses/BIOS/213) Human Physiology

CHEM 1190 General Chemistry II and CHEM 1194 General Chemistry II Laboratory or UNL CHEM 110 (http://bulletin.unl.edu/undergraduate/courses/CHEM/110) General Chemistry II

CHEM 1190 General Chemistry II or UNL CHEM 114 (http://bulletin.unl.edu/undergraduate/courses/CHEM/114) Fundamental Chemistry II

Any 2000 level chemistry course or UNL CHEM 2xx

CSCI 1620 Introduction to Computer Science II or UNL CSCE 156 (http://bulletin.unl.edu/undergraduate/courses/CSCE/156) Computer Science II

MATH 2030 Discrete Mathematics or UNL CSCE 235 (http://bulletin.unl.edu/undergraduate/courses/CSCE/235) Introduction to Discrete Structures

UNL CSCE 251 (http://bulletin.unl.edu/undergraduate/courses/CSCE/251) Unix Programming Environment

UNL MATL 260 (http://bulletin.unl.edu/undergraduate/courses/MATL/260) Elements of Materials Science

UNL MATL 262 (http://bulletin.unl.edu/undergraduate/courses/MATL/262) Materials Lab I

MENG 2230 or UNL MECH 200 Engineering Statics

MENG 2500 or UNL MECH 250 Mechanics

MENG 2000 or UNL MECH 200 Engineering Thermodynamics

No more than a total of 3 credit hours may be taken in ECEN 3990 or similar offerings from other departments.

However, students can choose a “Research Option.” The purpose of research option is to provide research experiences and offer opportunities for students to work with a faculty advisor on a specific research topic. A certificate of completion of thesis will be awarded to the students, and outstanding thesis awards will be presented at the end of semester functions. Requirements for the research option are listed below.

**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 1450 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