ELECTRONICS ENGINEERING (OMAHA)

Description
Website: engineering.unl.edu/ece (http://engineering.unl.edu/ceen)

The electronics engineering program is administered by the Department of Electrical and Computer Engineering and the bachelor of science degree program is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org.

Mission
The mission of the Department of Electrical and Computer Engineering (ECE) programs on the Omaha Campus at the University of Nebraska is to develop and maintain programs of excellence in teaching and research which meet the educational needs of its constituents, which will support the state of Nebraska in its development as a leading center for high-technology computer/electronics/telecommunications industry and which will support national needs for well-educated ECE professionals.

Program Educational Objectives
The Program Educational Objectives (PEOs) for the electronics engineering program are a statement of what its graduates are doing or are capable of doing three to five years after graduation. The students in the electronics engineering program receive a strong foundation in engineering science and design that not only enables them to pursue productive careers in the electronics engineering field but also in other areas such as business, management, and medicine. Typical industries in which electronics engineering graduates are employed could include those in communication systems, telecommunication networks, analog systems, hardware/software integration, and digital and microprocessor systems.

The Program Educational Objectives for the electronics engineering program are that graduates will be:

1. Employed in business, academia, or government.
2. Successful engineers who have established productive careers in their field and have contributed to improve and provide innovative and effective solutions in electronics engineering or related fields.
3. Demonstrating technical and decision-making processes and the human interactions necessary to produce viable, responsible, and sustainable technological solutions.
4. 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.
5. 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.

Student Outcomes
Student outcomes are those abilities that a graduate of the electronics 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 electronics engineering program will have: a. An ability to apply knowledge of mathematics, science, and engineering. b. An ability to design and conduct experiments, as well as to analyze and interpret data. c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. d. An ability to function on multidisciplinary teams. e. An ability to identify, formulate, and solve engineering problems. f. An understanding of professional and ethical responsibility. g. An ability to communicate effectively. h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. i. A recognition of the need for, and an ability to engage in lifelong learning. j. A knowledge of contemporary issues. k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The individual holding this degree will have advanced knowledge in his or her field of engineering interest and in addition will have a university educational background involving mathematics, the physical sciences, and the humanities and social sciences. The curriculum has a strong focus in telecommunications engineering. Completion of this program will enable the graduate to enter employment in positions involving telecommunications engineering design, analog circuit design, telecommunications network performance analysis, and technical management of telecommunications networks. The program also leads to the preparation for graduate work in electronics engineering or electrical engineering.

Major Department Admission

General Requirements
Advisement
Upon entry into the program, each student will be assigned a faculty academic advisor. It is required that the student meet with the advisor prior to each class registration period and that all courses to be applied toward the degree be selected with the advice and approval of the advisor. Students are expected to have their academic records reviewed and obtain approval from the department prior to application to the University registrar for award of the degree in order to insure that all curricular requirements will be satisfied by the time of intended graduation.

Curriculum
Because of the rapid developments in the field of electronics engineering, the curriculum requirements are continually reviewed and upgraded to reflect technological advances. Curricular sequence and course descriptions contained herein are intended to serve as general guidelines. Contact the department for information on any changes to the requirements that are currently in effect but not listed in this catalog. Currently enrolled students are expected to modify their programs to take advantage of such revisions. Students who do not maintain continuous progress toward the degree through enrollment in applicable course work will be considered as new students upon reentering the computer or electronics engineering curricular sequence and will be subject to the requirements of the curriculum current at the time of their reentry. Certain courses may not be valid as prerequisites or as credit toward the degree.
after two academic years; the student's academic advisor should be consulted regarding applicability.

The department maintains a high standard of excellence in meeting its objective of providing the student with extensive experience in the fields of computer engineering and electronics engineering. The development of both hardware and software and the knowledge of the interrelationship of these areas is enhanced through the extensive use of laboratory equipment. The applicable University catalogs and College academic policies must be followed to ensure that the student satisfies the campus general education requirements.

**Capstone**
The capstone requirement provides a unique and challenging opportunity for the undergraduate student to demonstrate his/her ability to apply the knowledge gained in the course work sequence to the planning, design, execution, testing and reporting of a significant project in the applications of engineering principles. The initiative and responsibility expected of the student executing the senior thesis parallel the expectations of the employer of the program graduate.

**Electives**
Electronic engineering, electrical engineering and computer engineering courses which are described in the catalog but are not shown as requirements in the semester sequences are offered as the need arises to provide co-interest areas wherein the students may broaden their background in the applications of electronics engineering. In addition, appropriate specified technical electives will be selected to augment the student's particular area of interest. The applicability of transfer course work with engineering content toward credit in the curriculum is determined on a case-by-case basis by the department.

**Special Interest Areas**
Opportunities are provided for the development of areas of special interest through enrollment in the Individual Study in Computer and Electronics Engineering courses which are offered at the freshman through senior level for the student who may wish to develop a topic under the guidance of a department faculty member. Enrollment is by permission after approval of a written proposal. Special Topics in Computer and Electronics Engineering classes also are offered by the department as the need arises to cover topics needing emphasis as a result of the rapidly developing fields of computer engineering and electronics engineering. Academic advisors should be consulted regarding the particular topics to be covered and the necessary prerequisites for each offering of this course.

Students who expect to continue their education at the graduate level after the award of the baccalaureate degree should consult their advisor regarding course selections that would enhance that objective.

Students are encouraged to develop their professional and leadership potential through participation in student chapters of related professional organizations and in University extracurricular activities. Participation in the University Honors Program is encouraged for those who qualify.

**College Requirements**

**College Admission**

**College Entrance Requirements**
Students must have high school credit for (one unit is equal to one high school year):

1. 4 units of mathematics: 2 of algebra, 1 of geometry, 1 of precalculus and trigonometry.

2. 4 units of English.

3. 3 units of natural science that must include 1 unit of physics and 1 unit of chemistry (chemistry requirement waived for students in construction management).

4. 2 units of a single foreign language.

5. 3 units of social studies.

6. Students having a composite ACT score of 28 or greater (or equivalent SAT score) will be admitted to the College of Engineering even if they lack any one of the following: trigonometry, chemistry, or physics.

7. Students having an ACT score of 19 or less in English (or equivalent SAT score) must take ENGL 150 Writing and Inquiry or ENGL 151 Writing and Argument.

A total of 16 units is required for admission.

Students must have an ACT (enhanced) score of 24 or greater (or equivalent SAT). Students who lack entrance requirements may be admitted based on ACT scores, high school rank and credits, or may be admitted to pre-engineering status in the Exploratory and Pre-Professional Advising Center. Pre-engineering students are advised within the College of Engineering.

Students for whom English is not their language of nurture must meet the minimum English proficiency requirements of the University.

Students who lack entrance units may complete precollege training by Independent Study through the UNL Office of On-line and Distance Education, in summer courses, or as a part of their first or second semester course loads while in the Exploratory and Pre-Professional Advising Center or other Colleges at UNL.

Students should consult their advisor, their department chair, or Engineering Student Services if they have questions on current policies.

**Other Admission Requirements**

Students who transfer to the University of Nebraska–Lincoln from other accredited colleges or universities and wish to be admitted to the College of Engineering (COE) must meet COE freshman entrance requirements and have a minimum cumulative GPA of 2.5 for Nebraska residents or 3.0 for non-residents, and be calculus-ready. Students not meeting either of these requirements must enroll in the Explore Center or another UNL college until they meet COE admission requirements.

The COE accepts courses for transfer for which a C or better grade was received. Although UNL accepts D grades from the University of Nebraska at Kearney and at Omaha, not all majors in the COE accept such low grades. Students must conform to the requirements of their intended major and, in any case, are strongly encouraged to repeat courses with a grade of C- or less.

All transfer students must adopt the curricular requirements of the undergraduate catalog current at the time of transfer to the COE—not that in use when they entered UNL. Upon admission to UNL, students wishing to pursue degree programs in the COE will be classified and subject to the policies defined in the subsequent section.

**College Degree Requirements**

**Grade Rules**

**Grade Appeals**
In the event of a dispute involving any college policies or grades, the student should appeal to his/her instructor, and appropriate department chair or school director (in that order). If a satisfactory solution is not
achieved, the student may appeal his/her case through the College Academic Appeals Committee on his/her campus.

Catalog Rule
Students must fulfill the requirements stated in the catalog for the academic year in which they are first admitted at UNL. In consultation with advisors, a student may choose to follow a subsequent catalog for any academic year in which they are admitted to and enrolled as a degree-seeking student at UNL in the College of Engineering. Students must complete all degree requirements from a single catalog year. The catalog which a student follows for degree requirements may not be more than 10 years old at the time of graduation.

Major Requirements
Requirements for the Degree

First Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECEN 103</td>
<td>Computer and Electronics Engineering Fundamentals</td>
<td>4</td>
</tr>
<tr>
<td>CSCE 155A</td>
<td>Computer Science I</td>
<td>3</td>
</tr>
<tr>
<td>or CSCE 155E</td>
<td>Computer Science I: Systems Engineering Focus</td>
<td></td>
</tr>
<tr>
<td>MATH 106</td>
<td>Calculus I</td>
<td>5</td>
</tr>
<tr>
<td>ACE Elective SLO 5</td>
<td></td>
<td>3</td>
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</table>

Credit Hours Subtotal: 15

Second Semester

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<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>ECEN 106</td>
<td>Microprocessor Applications</td>
<td>3</td>
</tr>
<tr>
<td>ECEN 194</td>
<td>Special Topics in Computer and Electronics Engineering I</td>
<td>1-4</td>
</tr>
<tr>
<td>ECEN 225</td>
<td>Computer and Electronics Engineering Seminar</td>
<td>1</td>
</tr>
<tr>
<td>COMM 109</td>
<td>Fundamentals of Human Communication</td>
<td>3</td>
</tr>
<tr>
<td>MATH 107</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 211</td>
<td>General Physics I</td>
<td>4</td>
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Credit Hours Subtotal: 16

Third Semester

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<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>ECEN 213</td>
<td>Electrical Circuits I</td>
<td>3</td>
</tr>
<tr>
<td>ECEN 218</td>
<td>Electrical Circuits Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>MATH 221</td>
<td>Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>MATH 314</td>
<td>Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 212</td>
<td>General Physics II</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 222</td>
<td>General Physics Laboratory II</td>
<td>1</td>
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Credit Hours Subtotal: 15

Fourth Semester

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<thead>
<tr>
<th>Course Code</th>
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<th>Credit Hours</th>
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<tr>
<td>ECEN 214</td>
<td>Electrical Circuits II</td>
<td>3</td>
</tr>
<tr>
<td>ECEN 222</td>
<td>Electronic Circuits I</td>
<td>4</td>
</tr>
<tr>
<td>ECEN 313</td>
<td>Switching Circuits Theory</td>
<td>4</td>
</tr>
<tr>
<td>MATH 208</td>
<td>Calculus III</td>
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Credit Hours Subtotal: 15

Fifth Semester

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<tr>
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<th>Course Name</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>ECEN 307</td>
<td>Electrical Engineering Laboratory I</td>
<td>2</td>
</tr>
<tr>
<td>ECEN 328</td>
<td>Applied Fields and Lines I</td>
<td>3</td>
</tr>
<tr>
<td>ECEN 352</td>
<td>Electronics Circuits II</td>
<td>4</td>
</tr>
<tr>
<td>ECEN 355</td>
<td>Signals and Linear Systems</td>
<td>3</td>
</tr>
<tr>
<td>MATH 380 /</td>
<td>Statistics and Applications</td>
<td>3</td>
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<td>STAT 380</td>
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Credit Hours Subtotal: 15

Sixth Semester

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<tr>
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<tbody>
<tr>
<td>ECEN 325</td>
<td>Communications Systems</td>
<td>4</td>
</tr>
<tr>
<td>ECEN 362</td>
<td>Data and Telecommunications Transceivers</td>
<td>4</td>
</tr>
<tr>
<td>JGEN 300</td>
<td>Technical Communication II</td>
<td>3</td>
</tr>
<tr>
<td>ACE Elective SLO 6 &amp; 7</td>
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<td>6</td>
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</table>

Credit Hours Subtotal: 17

Seventh Semester

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<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>ECEN 461</td>
<td>Digital Communications Media</td>
<td>4</td>
</tr>
<tr>
<td>ECEN 466</td>
<td>Telecommunications Engineering I</td>
<td>4</td>
</tr>
<tr>
<td>ECEN 496</td>
<td>Capstone I</td>
<td>2</td>
</tr>
<tr>
<td>ENGR Elective</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>ENGR 469</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

Credit Hours Subtotal: 16

Eighth Semester

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<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>ECEN 499</td>
<td>Capstone II</td>
<td>3</td>
</tr>
<tr>
<td>ENGR Elective</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>ACE Elective SLO 8 &amp; 9</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

Credit Hours Subtotal: 14

Total Credit Hours 123

NOTE: 3 hours of the engineering electives can be chosen from a list of approved non-ECEN courses.

Additional Major Requirements

Grade Rules
Student must have a grade of C or better in ECEN 213 and ECEN 313 before taking any course which has these courses as prerequisites.

ECEN 103 Computer and Electronics Engineering Fundamentals
Prerequisites: MATH 106/108H or (UNO) MATH 1950, or parallel.
Description: Introduction to DC circuit analysis and digital logic. Ohm’s and Kirchoff’s laws, mesh and nodal analysis, Boolean algebra, logic gates, minimization, counters, and flip-flops. Uses of computer based resources for data analysis and report generation. Use of internet to locate and retrieve engineering resources.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: ECEN 213; ECEN 225
ECEN 106 Microprocessor Applications
Prerequisites: ECEN 103 or (UNO) ECEN 1030; CSCE 155A, 155E, 155H, 155N, 155T or (UNO) CIST 1400.
Description: Introduction to assembly language programming of microprocessors / microcontrollers, assemblers, and debugging tool utilization. Microprocessor system hardware components, control signals, and 'C' language micro-controller programming.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 224; ECEN 313; ECEN 332; ECEN 345

ECEN 121 Introduction to Electrical Engineering I
Description: Introduction to basic electrical engineering concepts including energy, power systems, communications and signal processing.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 122 Introduction to Electrical Engineering II
Description: Introduction to several electrical engineering areas including digital, circuits, electromagnetics, materials and devices, and optics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 220

ECEN 192 Individual Study in Computer and Electronics Engineering I
Description: Individual study in a selected computer or electronics engineering area under the supervision and guidance of a computer and electronics engineering faculty member. ECEN 192 (UNO - ECEN 1920) requires a ECE departmentally approved proposal.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Format: IND

ECEN 194 Special Topics in Computer and Electronics Engineering I
Prerequisites: Freshman standing.
Description: Special topics in the emerging areas of computer and electronics engineering which may not be covered in other courses in the computer and electronics engineering curriculum.
Credit Hours: 1-4
Min credits per semester: 1
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

ECEN 198 Special Topics in Electrical Engineering I
Prerequisites: Permission.
Description: Offered as the need arises to treat electrical engineering topics for first-year students not covered in other courses.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Format: LEC

ECEN 211 Elements of Electrical Engineering I
Prerequisites: Prerequisite or parallel: MATH 107/(UNO) MATH 1960 and PHYS 211/(UNO) PHYS 2110.
Notes: Not for electrical engineering majors.
Description: Basic circuit analysis including direct and alternating currents and operational amplifiers. Digital signals and circuits.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: AGEN 325, BSEN 325; ECEN 231; MECH 350

ECEN 213 Electrical Circuits I
Prerequisites: ECEN 103 or (UNO) ECEN 1030; ECEN 225 or (UNO) ECEN 2500; MATH 221/221H/821 or parallel.
Description: Electrical circuit theory, Kirchoff's and Ohm's laws, circuit analysis theorems, Norton and Thevenin equivalence. The analysis of resistor circuits, with capacitors and inductors, in DC and AC steady state. Transients and variable frequency responses are studied, including computer solutions to circuit problems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 217; ECEN 218; ECEN 222

ECEN 214 Electrical Circuits II
Prerequisites: ECEN 213 or (UNO) ECEN 2130; ECEN 218 or (UNO) ECEN 2184; (UNO) MATH 2050 or parallel.
Description: Introduction to the analysis of electrical circuits in sinusoidal steady states. The concepts of impedance, phasors, power, frequency response, resonance, magnetic circuits, and two-port networks. Transform techniques for circuit analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 304; ECEN 338; ECEN 355

ECEN 215 Electronics and Circuits I
Prerequisites: Prerequisite or parallel: MATH 208/(UNO) MATH 1970.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 216; ECEN 306
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
<th>Description</th>
<th>Credit Hours</th>
<th>Max credits per semester</th>
<th>Max credits per degree</th>
<th>Format</th>
<th>Prerequisite for</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECEN 216</td>
<td>Electronics and Circuits II</td>
<td>ECEN 215/(UNO) ECEN 2150 with a grade of &quot;C&quot; or better.</td>
<td>Steady state power calculations for sinusoidal single-phase and balanced three-phase circuits. Mutual inductance. Kirchhoff's laws and circuit analysis theorems applied to steady state diode circuits. Modern computer methods employed.</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>LEC</td>
<td>ECEN 304; ECEN 316; ECEN 338</td>
</tr>
<tr>
<td>ECEN 217</td>
<td>Electrical Circuits III</td>
<td>ECEN 213 or (UNO) ECEN 2130</td>
<td>Analysis of first and second order RLC circuits using differential equations and Laplace transforms. Variable frequency network performance analysis.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>LEC</td>
<td>ECEN 213 or (UNO) ECEN 2130</td>
</tr>
<tr>
<td>ECEN 218</td>
<td>Electrical Circuits Laboratory</td>
<td>ECEN 213/(UNO) ECEN 2130 or parallel.</td>
<td>The use of laboratory tools for measurement and verification of electrical concepts. Experiments using both passive and semiconductor devices at audio frequencies. Analysis verification with computer simulation.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>LEC</td>
<td>ECEN 214; ECEN 222</td>
</tr>
<tr>
<td>ECEN 220</td>
<td>Introduction to Embedded Systems</td>
<td>ECEN 122/(UNO) ECEN 1220 or CSCE 230, and CSCE 155E, or working knowledge of C programming.</td>
<td>Basic hardware and software concepts of embedded microprocessor systems and interfacing with other hardware components. Simple circuits are designed and drivers to run them are written. Design and build hardware and write drivers in assembly or C programming languages.</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>LEC</td>
<td>ECEN 307</td>
</tr>
<tr>
<td>ECEN 222</td>
<td>Electronic Circuits I</td>
<td>ECEN 213/(UNO) ECEN 2130 with a grade of &quot;C&quot; or better; ECEN 218/(UNO) ECEN 2184</td>
<td>Analysis and design of modern electronic circuits. Diode circuits, bipolar and field effect transistor switching and amplifier circuits, and operational amplifier circuits.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>LEC</td>
<td>ECEN 310, ECEN 325</td>
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<tr>
<td>ECEN 224</td>
<td>Introduction to Signal Processing</td>
<td>ECEN 106 or (UNO) ECEN 1060; CSCE 155A, 155E, 155H, 155N, 155T or (UNO) CIST 1400; MATH 107/107H or (UNO) MATH 1960.</td>
<td>The use of mathematical and digital computation tools key to engineering applications. Auditory and visual senses are used in the presentation and study of sinusoidal signals, sampling, frequency response and filtering theory.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>LEC</td>
<td>FALL/SPR</td>
</tr>
<tr>
<td>ECEN 225</td>
<td>Computer and Electronics Engineering Seminar</td>
<td>ECEN 103 or (UNO) ECEN 1030.</td>
<td>An overview of computer, electronics and telecommunication fields. There will be information on professional careers available upon graduation. Professionalism and ethics are addressed as well as the need for lifelong learning experiences.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>LEC</td>
<td>ECEN 213</td>
</tr>
<tr>
<td>ECEN 231</td>
<td>Electrical Engineering Laboratory</td>
<td>ECEN 211/(UNO) ECEN 2110.</td>
<td>A professional overview of computer, electronics and telecommunication fields.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>LAB</td>
<td>ECEN 214; ECEN 222</td>
</tr>
<tr>
<td>ECEN 235</td>
<td>Introductory Electrical Laboratory I</td>
<td>ECEN 215/(UNO) ECEN 2150.</td>
<td>Laboratory accompanying ECEN 215/(UNO) ECEN 2150.</td>
<td>1</td>
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<td>LAB</td>
<td>ECEN 236</td>
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<tr>
<td>ECEN 236</td>
<td>Introductory Electrical Laboratory II</td>
<td>ECEN 235/(UNO) ECEN 2350; Prerequisite or parallel: ECEN 216/(UNO) ECEN 2160.</td>
<td>Laboratory accompanying ECEN 216/(UNO) ECEN 2160.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>LAB</td>
<td>ECEN 307</td>
</tr>
</tbody>
</table>
ECEN 292 Individual Study in Computer and Electronics Engineering II
Prerequisites: Sophomore standing.
Notes: ECEN 292 (UNO - ECEN 2920) requires a ECE departmentally approved proposal.
Description: Individual study in a selected computer or electronics engineering area under the supervision and guidance of an Electrical & Computer Engineering faculty member.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Format: IND

ECEN 294 Special Topics in Electrical Engineering II
Prerequisites: Sophomore standing.
Description: Special topics in the emerging areas of computer and electronics engineering which may not be covered in other courses in the Electrical & Computer Engineering curriculum.
Credit Hours: 1-4
Min credits per semester: 1
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

ECEN 296 Special Topics in Electrical Engineering II
Prerequisites: Permission.
Description: Offered as the need arises to treat electrical engineering topics for second-year students not covered in other courses.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Format: LEC

ECEN 304 Signals and Systems I
Prerequisites: ECEN 214 or (UNO) ECEN 2140 or ECEN 216 or (UNO) 2160 with a grade of "C" or better; MATH 221 or 221H or (UNO) MATH 2350.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 305

ECEN 305 Probability Theory and Statistics for Electrical and Computer Engineers
Prerequisites: ECEN 304/(UNO) ECEN 3040.
Description: Random experiment model, random variables, functions of random variables, and introduction to random processes; statistics and practical data analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 850, ECEN 450

ECEN 306 Electromagnetic Field Theory
Prerequisites: ECEN 215 or (UNO) ECEN 2130 with a grade of "C" or better, PHYS 212 or (UNO) PHYS 2120, MATH 208 or (UNO) MATH 1970, MATH 221 or (UNO) 2350.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 307 Electrical Engineering Laboratory I
Prerequisites: ECEN 220 or (UNO) ECEN 1060 and ECEN 236 or (UNO) ECEN 2370 or (UNO) ECEN 310; admission to the College of Engineering.
Description: Laboratory work on circuits and systems, digital and analog electronic circuits.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LAB
Offered: FALL/SPR

ECEN 310 Digital Design and Interfacing
Prerequisites: ECEN 222/(UNO) ECEN 2220; ECEN 313/(UNO) ECEN 3130, or parallel.
Notes: ECEN 310/3100 lab exercises provide practical experience with design tools and the design process.
Description: Digital design from both the circuit and system perspectives. The structure and analysis of digital integrated circuits, interface signal integrity, Field Programmable Gate Array (FPGA) design and synthesis, and software simulation.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

ECEN 313 Switching Circuits Theory
Prerequisites: ECEN 106 or (UNO) ECEN 1060.
Description: Combinational circuit analysis and design. State machine analysis and design. Synchronous/clock mode circuits and asynchronous sequential circuits. Minimization, race, and hazard elimination are covered. Circuits are implemented in discrete logic and in CPLD and FPGA devices. VHDL hardware description language is used to describe circuits. Circuits are implemented in discrete logic and in CPLD/FPGA devices.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

ECEN 316 Electronics and Circuits III
Prerequisites: ECEN 215/(UNO) ECEN 2160 with a grade of "C" or better.
Description: Kirchhoff's laws and circuit analysis theorems applied to steady state transistor circuits. Frequency response of filters and amplifiers. Basic power amplifier types. Advanced operational amplifier circuits. Introduction to the fundamentals of semiconductor theory and their application to p-n junction and field devices.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ECEN 317 Electrical Engineering Laboratory II
Prerequisites: ECEN 304/(UNO) ECEN 3040 and ECEN 307/(UNO) ECEN 3070; prerequisite or parallel ECEN 306/(UNO) ECEN 3060 and ECEN 316/(UNO) ECEN 3160; admission to the College of Engineering.
Description: Lab work on electromagnetic fields and waves, solid state devices, discrete systems, control systems, and communications.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LAB
Prerequisite for: ECEN 494

ECEN 325 Communications Systems
Prerequisites: ECEN 222/(UNO) ECEN 2220; MATH/STAT 380/(UNO) STAT 3800.
Description: Relevant communications systems; principles of transmission and reception; amplitude; frequency and phase modulation. Sampling theorem, pulse-code modulation and delta modulation.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

ECEN 328 Applied Fields and Lines I
Prerequisites: MATH 208/208H or (UNO) MATH 1970; MATH 221/821 or (UNO) MATH 2350.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 329

ECEN 329 Applied Fields and Lines II
Prerequisites: ECEN 328 or (UNO) ECEN 3280.
Description: Metallic wave guides with rectangular, circular, and coaxial cross section, antennas, free space, propagation in free space, applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3

Format: LEC

ECEN 332 Assembly Language Programming
Prerequisites: ECEN 106 or (UNO) ECEN 1060
Description: Introduction to the architecture and assembly language programming of 80 x 86 microprocessors. Assemblers and debugging tool utilization.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LAB

ECEN 338 Introduction to Power and Energy Systems
Prerequisites: ECEN 216 or (UNO) ECEN 2160 or ECEN 214 or (UNO) ECEN 2140 with a grade of "C" or better.
Description: Energy sources, environmental impacts, power systems principles, three-phase circuits, transmission lines, transformers, per unit analysis, generators, loads, and power system modeling.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Offered: FALL/SPR

ECEN 345 Mobile Robotics I
Prerequisites: ECEN 106 or (UNO) ECEN 1060, ECEN 213 or (UNO) ECEN 2130.
Description: Introduction to the primary issues spanning the field of mobile robotics, including robotics history, robot components (sensors, actuators), robot system design considerations, low-level control (feedback control) and robotics control architectures. The lab focuses on the practical implementation of autonomous robot control on a real mobile robot using behavior-based methods in the C language.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

ECEN 350 Electrical Engineering Internship or Cooperative Education
Prerequisites: Open to Electrical Engineering majors only. Approval of faculty sponsor prior to the internship or Co-op is required.
Description: For Internships or Cooperatives primarily technical in nature lasting 4.5 months or greater. Weekly communication and/or final report required. Must be taken during or after the semester in which the Internship/Co-op occurs.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Format: IND

ECEN 352 Electronics Circuits II
Prerequisites: CEEN 222/(UNO) CEEN 2220.
Description: Operational amplifier circuit design and analysis feedback and stability. Design and analysis of large signal power amplifiers. Other integrated devices such as: regulators, comparators, Schmitt triggers, oscillators, and active filters.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: ECEN 362

ECEN 355 Signals and Linear Systems
Prerequisites: ECEN 214/(UNO) ECEN 2140; MATH/STAT 380/(UNO) STAT 3800, or parallel.
Description: Continuous and discrete representations of signals. System modeling and analysis using differential and difference equations. Fourier, Laplace, and Z transforms. State description of continuous and discrete time transfer functions. The primary mathematical tools used in the analysis of continuous and discrete time systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ECEN 361 Advanced Electronics and Circuits
Prerequisites: ECEN 316/(UNO) ECEN 3160.
Description: Analog and digital electronics for discrete and integrated circuits. Multistage amplifiers, frequency response, feedback amplifiers, simple filters and amplifiers, MOS and bipolar logic gates and families, A/D and D/A converters.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 361

ECEN 362 Data and Telecommunications Transceivers
Prerequisites: ECEN 352 or (UNO) ECEN 3520; ECEN 325 or (UNO) ECEN 3250, or parallel; and ECEN 328 or (UNO) ECEN 3280, or parallel.
Description: Noise and signal distortions in communication systems, impedance matching techniques, high frequency measurement techniques, design of high frequency amplifiers and oscillators, PLL and frequency synthesizers, data synchronization and multiplexing techniques, Antennas and their arrays.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

ECEN 370 Digital Logic Design
Crosslisted with: CSCE 335
Prerequisites: ECEN 121/(UNO) ECEN 1210 or CSCE 230
Description: Combinational and sequential logic circuits. MSI chips, programmable logic devices (PAL, ROM, PLA) used to design combinational and sequential circuits. CAD tools. LSI and PLD components and their use. Hardware design experience.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 307

ECEN 392 Individual Study in Computer and Electronics Engineering III
Prerequisites: Junior standing.
Description: Individual study in a selected computer or electronics engineering area under the supervision and guidance of an instructor and an electronics engineering faculty member.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Format: IND

ECEN 394 Special Topics in Computer and Electronics Engineering III
Prerequisites: Junior standing
Description: Special topics in the merging areas of electrical & computer engineering which may not be covered in other courses in the Electrical & Computer Engineering curriculum.
Credit Hours: 1-4
Min credits per semester: 1
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Prerequisite for: ECEN 957

ECEN 398 Special Topics in Electrical Engineering III
Prerequisites: Permission.
Description: Offered as the need arises to treat electrical engineering topics for third-year students not covered in other courses.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Format: LEC

ECEN 399 Undergraduate Research
Prerequisites: Electrical engineering seniors or approval.
Description: Research accompanied by a written report of the results.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Format: IND

ECEN 399R Undergraduate Research
Description: Independent research project executed under the guidance of a member of the faculty of the Department of Electrical Engineering which contributes to the advancement of knowledge in the field. Culminates in a written thesis or report and an oral presentation. For electrical engineering majors selecting the research option. ECEN 399/ (UNO) ECEN 3990 and ECEN 399R/(UNO) 3990R should be taken in consecutive semesters.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: IND

ECEN 400 Electronic Instrumentation
Crosslisted with: ECEN 800
Prerequisites: Senior standing in engineering or permission.
Description: Applications of analog and digital devices to electronic instrumentation. Includes transducers, instrumentation amplifiers, mechanical and solid-state switches, data acquisition systems, phase-lock loops, and modulation techniques. Demonstrations with working circuits and systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 406 Power Systems Analysis
Crosslisted with: ECEN 806
Prerequisites: ECEN 338/(UNO) ECEN 3380 or ECEN 838/(UNO) ECEN 8386.
Description: Symmetrical components and fault calculations, power system stability, generator modeling (circuit view point), voltage control system, high voltage DC transmission, and system protection.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 957
ECEN 407 Power Systems Planning
Crosslisted with: ECEN 807
Prerequisites: ECEN 305/(UNO) ECEN 3050
Description: Economic evaluation, load forecasting, generation planning, transmission planning, production simulation, power plant reliability characteristics, and generation system reliability.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 408 Engineering Electromagnetics
Crosslisted with: ECEN 808
Prerequisites: ECEN 306/(UNO) ECEN 3060
Notes: Laboratory experiments.
Description: Applied electromagnetics: Transmission lines in digital electronics and communication. The quasistatic electric and magnetic fields: electric and magnetic circuits and electromechanical energy conversion. Guided waves: rectangular and cylindrical metallic waveguides and optical fibers. Radiation and antennas: line and aperture antennas and arrays.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 410 Multivariate Random Processes
Crosslisted with: ECEN 810
Prerequisites: ECEN 305/(UNO) ECEN 3050
Description: Probability space, random vectors, multivariate distributions, moment generating functions, conditional expectations, discrete and continuous-time random processes, random process characterization and representation, linear systems with random inputs.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 911; ECEN 912; ECEN 915; ECEN 946

ECEN 416 Materials and Devices for Computer Memory, Logic, and Display
Crosslisted with: ECEN 816
Prerequisites: PHYS 212/(UNO) PHYS 2120
Description: Survey of fundamentals and applications of devices used for memory, logic, and display. Magnetic, superconductive, semiconductor, and dielectric materials.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 417 Semiconductor Fundamentals II
Crosslisted with: ECEN 817
Prerequisites: ECEN 421/(UNO) ECEN 4210 or ECEN 821/(UNO) ECEN 8216.
Description: Analysis of BJT’s and MOSFET’s from a first principle materials viewpoint. Static and dynamic analysis and characterization. Device fabrication processes.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 420 Plasma Processing of Semiconductors
Crosslisted with: ECEN 820
Prerequisites: Senior or graduate standing.
Description: Physics of plasmas and gas discharges developed. Includes basic collisional theory, the Boltzman equation and the concept of electron energy distributions. Results are related to specific gas discharge systems used in semiconductor processing, such as sputtering, etching, and deposition systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 421 Principles of Semiconductor Materials and Devices I
Crosslisted with: ECEN 821
Prerequisites: PHYS 213/(UNO) PHYS 2130
Description: Introduction to semiconductor fundamentals, charge carrier concentration and carrier transport, energy bands, and recombination. PN junctions, static and dynamic, and special PN junction diode devices.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 422 Introduction to Physics and Chemistry of Solids
Crosslisted with: PHYS 422, PHYS 822, ECEN 822
Prerequisites: PHYS 213 or CHEM 481/881, MATH 221/821, or permission.
Description: Introduction to structural, thermal, electrical, and magnetic properties of solids, based on concepts of atomic structure, chemical bonding in molecules, and electron states in solids. Principles underlying molecular design of materials and solid-state devices.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 424 Digital Signal Processing
Crosslisted with: ECEN 824
Prerequisites: ECEN 355 or (UNO) ECEN 3550.
Description: The temporal and spectral analysis of digital signals and systems, the design of digital filters and systems, and advanced systems including multi-rate digital signal processing techniques.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 815; ECEN 926

ECEN 428 Power Electronics
Crosslisted with: ECEN 828
Prerequisites: ECEN 304/(UNO) ECEN 3040 and ECEN 316/(UNO) ECEN 3160
Description: Basic analysis and design of solid-state power electronic devices and converter circuitry.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 932
ECEN 430 Wind Energy
Crosslisted with: ECEN 830
Prerequisites: Senior standing or permission
Description: Engineering principles of both the mechanical/aero dynamical and electrical components and systems, along with economic and environmental considerations for citing and public policy, to appropriately cover the relevant topics associated with all scales of wind energy implementations.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 433 Microprocessor System Design
Crosslisted with: ECEN 833
Prerequisites: ECEN 310 or (UNO) ECEN 3100 with a grade of "C" or better; ECEN 332 or (UNO) ECEN 3320 with a grade of "C" or better.
Description: Microprocessor based systems: architecture, design; and interfacing. Hardware topics: memory design; input/output ports; serial communications; and interrupts. Software topics: generating assembly ROM code; assembly/C firmware generation; and designing device drivers.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Offered: FALL/SPR

ECEN 435 Embedded Microcontroller Design
Crosslisted with: ECEN 835
Prerequisites: ECEN 433/833 or (UNO) ECEN 4330/8336 with a grade of "C" or better; STAT/MATH 380 or (UNO) STAT 3800.
Description: Microcontroller architecture: design, programming, and interfacing for embedded systems. Timing issues, memory interfaces, serial and parallel interfacing, and functions for common microcontrollers.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC
Offered: FALL/SPR
Prerequisite for: ECEN 496

ECEN 436 Electric Machines
Crosslisted with: ECEN 836
Prerequisites: PHYS 212/(UNO) PHYS 2120 and ECEN 216/(UNO) ECEN 2160
Description: Provides a solid background in electric machine analysis, covering fundamental concepts, techniques, and methods for analysis and design. Discussion of transformers and presentation of some new systems and applications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 932

ECEN 437 Parallel and Distributed Processing
Crosslisted with: ECEN 837
Prerequisites: ECEN 435/835 or (UNO) ECEN 4350/8366
Description: Parallel and distributed processing concepts, principles, techniques, and machines.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 442 Basic Analytical Techniques in Electrical Engineering
Crosslisted with: ECEN 842
Prerequisites: MATH 221/(UNO) MATH 2350
Description: Applications of partial differential equations, matrices, vector analysis, complex variables, and infinite series to problems in electrical engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 444 Linear Control Systems
Crosslisted with: ECEN 844
Prerequisites: ECEN 304/(UNO) ECEN 3040
Description: Classical (transfer function) and modern (state variable) control techniques. Both time domain and frequency domain techniques are studied. Traditional proportional, lead, lag, and PID compensators are examined, as well as state variable feedback.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 448 Decision Analysis
Crosslisted with: ECEN 848
Prerequisites: ECEN 305/(UNO) ECEN 3050 or STAT 380/(UNO) STAT 3800
Description: Principles of engineering economy including time value of money, net present value and internal rate of return. Use of influence diagram and decision tree to structure and analyze decision situations under uncertainty including use of stochastic dominance, value of information, and utility theory. Fundamentals of two-person matrix games including Nash equilibrium.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

ECEN 450 Bioinformatics
Crosslisted with: ECEN 850
Prerequisites: Computer programming language and ECEN 305/(UNO) ECEN 3050 or IMSE 321 or STAT 380/(UNO) STAT 3800 or equivalent
Description: Examination of how information is organized in biological sequences such as DNA and proteins and computational techniques which make use of this structure. Various biochemical processes that involve these sequences are studied to understand how these processes affect the structure of these sequences. In the process bioinformatics algorithms, tools, and techniques which are used to explore genomic and amino acid sequences are also introduced.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Crosslisted with</th>
<th>Prerequisites</th>
<th>Description</th>
<th>Credit Hours</th>
<th>Max credits per semester</th>
<th>Max credits per degree</th>
<th>Format</th>
<th>Offered</th>
<th>Prerequisite for</th>
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<tbody>
<tr>
<td>ECEN 451</td>
<td>Introduction to VLSI System Design</td>
<td>ECEN 851</td>
<td>ECEN 310 or (UNO) ECEN 3100</td>
<td>The concepts, principles, and methodology at all levels of digital VLSI system design and focused on gate-level VLSI implementation.</td>
<td>3</td>
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<td>LEC</td>
<td>FALL/SPR</td>
<td>ECEN 977</td>
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<tr>
<td>ECEN 452</td>
<td>Introduction to Computer-Aided Digital Design</td>
<td>ECEN 852</td>
<td>ECEN 310 or (UNO) ECEN 3100</td>
<td>The concepts, simulation techniques and methodology in computer-aided digital design at system and logic levels.</td>
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<td>LEC</td>
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<td>ECEN 911</td>
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<tr>
<td>ECEN 454</td>
<td>Power Systems Operation and Control</td>
<td>ECEN 854</td>
<td>ECEN 338/(UNO) ECEN 3380</td>
<td>Characteristics and generating units. Control of generation, economic dispatch, transmission losses, unit commitment, generation with limited supply, hydrothermal coordination, and interchange evaluation and power pool.</td>
<td>3</td>
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<td>LEC</td>
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<td>ECEN 915</td>
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<tr>
<td>ECEN 460</td>
<td>Labview Programming</td>
<td>ECEN 860</td>
<td>Prior programming experience</td>
<td>Labview as a programming language and for applications to acquire and analyze data, to access the network, control lab instruments, and for video and sound applications.</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>LEC</td>
<td></td>
<td>ECEN 911; ECEN 912; ECEN 959</td>
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<tr>
<td>ECEN 461</td>
<td>Digital Communications Media</td>
<td>ECEN 861</td>
<td>ECEN 325 or (UNO) 3250 or ECEN 462 or (UNO) ECEN 4620</td>
<td>Topics related to the transport of bit streams from one geographical location to another over various physical media such as wire pairs, coaxial cable, optical fiber, and radio waves. Transmission characteristics, media interfacing, delay, distortion, noise, and error detection and correction techniques.</td>
<td>4</td>
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<td>3</td>
<td>LEC</td>
<td>FALL/SPR</td>
<td>ECEN 479, ECEN 879; ECEN 885; ECEN 977</td>
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<tr>
<td>ECEN 462</td>
<td>Communication Systems</td>
<td>ECEN 862</td>
<td>ECEN 304/(UNO) ECEN 3040 and ECEN 305/(UNO) ECEN 3050</td>
<td>Mathematical descriptions of signals in communication systems. Principles of analog modulation and demodulation. Performance analysis of analog communication systems in the presence of noise.</td>
<td>3</td>
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<td>LEC</td>
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<td>ECEN 911</td>
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<tr>
<td>ECEN 463</td>
<td>Digital Signal Processing</td>
<td>ECEN 863</td>
<td>ECEN 304/(UNO) ECEN 3040</td>
<td>Discrete system analysis using Z-transforms. Analysis and design of digital filters. Discrete Fourier transforms.</td>
<td>3</td>
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<tr>
<td>ECEN 464</td>
<td>Digital Communication Systems</td>
<td>ECEN 864</td>
<td>ECEN 462/(UNO) ECEN 4620</td>
<td>Principals of digital transmission of information in the presence of noise. Design and analysis of baseband PAM transmission systems and various carrier systems including ASK, FSK, PSK.</td>
<td>3</td>
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<td>LEC</td>
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<td>ECEN 911</td>
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<td>ECEN 465</td>
<td>Introduction to Data Compression</td>
<td>ECEN 865</td>
<td>ECEN 305/(UNO) ECEN 3050</td>
<td>Introduction to the concepts of Information Theory and Redundancy removal. Simulation of various data compression schemes such as Delta Modulation, Differential Pulse Code Modulation, Transform Coding and Runlength Coding.</td>
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<td>LEC</td>
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<td>ECEN 479, ECEN 879; ECEN 885; ECEN 977</td>
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<tr>
<td>ECEN 466</td>
<td>Telecommunications Engineering I</td>
<td>ECEN 866</td>
<td>ECEN 362 or (UNO) ECEN 3620; ECEN 461/861 or (UNO) ECEN 4610/8610, or parallel.</td>
<td>Standard telecommunications protocols, architecture of long distance integrated data networks, local area networks, wide area networks, radio and satellite networks. Network management, internetworking, system modeling and performance analysis.</td>
<td>4</td>
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<td>4</td>
<td>LEC</td>
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<td>ECEN 496</td>
</tr>
</tbody>
</table>
ECEN 467 Electromagnetic Theory and Applications
Crosslisted with: ECEN 867
Prerequisites: ECEN 306/(UNO) ECEN 3060
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 965

ECEN 468 Microwave Engineering
Crosslisted with: ECEN 868
Prerequisites: ECEN 306/(UNO) ECEN 3060
Description: Applications of active and passive devices to microwave systems. Includes impedance matching, resonators, and microwave antennas.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 965

ECEN 469 Analog Integrated Circuits
Crosslisted with: ECEN 869
Prerequisites: ECEN 361/(UNO) ECEN 3610
Description: Analysis and design of analog integrated circuits both bipolar and MOS. Basic circuit elements such as differential pairs, current sources, active loads, output drivers used in the design of more complex analog integrated circuits.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 913

ECEN 470 Digital and Analog VLSI Design
Crosslisted with: ECEN 870
Prerequisites: ECEN 316/(UNO) ECEN 3160
Description: Introduction to VLSI design techniques for analog and digital circuits. Fabrication technology and device modelling. Design rules for integrated circuit layout. LSI design options with emphasis on the standard cell approach of digital and analog circuits. Lab experiments, computer simulation and layout exercises.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 926; ECEN 977

ECEN 471 Computer Communication Networks
Crosslisted with: ECEN 871
Prerequisites: ECEN 325 or (UNO) ECEN 3250
Description: High-speed access control protocols, routing protocols, traffic management, and network topologies. Giga-bit Ethernet, ATM, and TCP/IP. Performance modeling and simulation techniques.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

ECEN 473 Mobile and Personal Communications
Crosslisted with: ECEN 873
Prerequisites: ECEN 325 or (UNO) ECEN 3250
Description: Concepts on mobile and personal communications. Modulation techniques for mobile radio, equalization, diversity, channel coding, and speech coding.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

ECEN 474 Digital Systems
Crosslisted with: ECEN 874
Prerequisites: ECEN 370/(UNO) ECEN 3700
Description: Synthesis using state machines; design of digital systems; micro programming in small controller design; hardware description language for design and timing analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 477, ECEN 877

ECEN 475 Satellite Communications
Crosslisted with: ECEN 875
Prerequisites: ECEN 325 OR (UNO) ECEN 3250
Description: The fundamental concepts of satellite communications. Orbits, launching satellites, modulation and multiplexing, multiple access, earth stations, coding, interference and special problems in satellite communications.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Format: LEC

ECEN 476 Wireless Communications
Crosslisted with: ECEN 876
Prerequisites: Permission.
Description: The fundamental concepts of wireless communications. Basic communications concepts such as multiple access and spectrum. Propagation, radio standards and internetworking. Current issues in wireless communications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
Prerequisite for: ECEN 926; ECEN 977

ECEN 477 Digital Systems Organization and Design
Crosslisted with: ECEN 877
Prerequisites: ECEN 474/(UNO) ECEN 4740 or ECEN 874/(UNO) ECEN 8746
Description: Hardware development languages, hardware organization and realization, microprogramming, interrupt, intersystem communication, and peripheral interfacing.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Crosslisted with</th>
<th>Prerequisites</th>
<th>Description</th>
<th>Credit Hours</th>
<th>Max credits per semester</th>
<th>Max credits per degree</th>
<th>Format</th>
<th>Prerequisite for</th>
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| ECEN 479    | Optical Fiber Communications                     |                  | ECEN 879                            | Prerequisites: ECEN 461/861 or (UNO) ECEN 4610/8616.  
Description: Fundamentals of lightwave communication in optical fiber waveguides, physical description of fiber optic systems. Properties of the optical fiber and fiber components. Electro-optic devices: light sources and modulators, detectors and amplifiers; optical transmitter and receiver systems. Fiber optic link design and specification; fiber optic networks.  
Credit Hours: 4 | Max credits per semester: 4  
Max credits per degree: 4 | LEC | ECEN 979 |
| ECEN 480    | Introduction to Lasers and Laser Applications    |                  | ECEN 880, PHYS 480, PHYS 880        | Prerequisites: PHYS 213/(UNO) PHYS 2130  
Description: Physics of electronic transition production stimulated emission of radiation. Threshold conditions for laser oscillation. Types of lasers and their applications in engineering.  
Credit Hours: 3 | Max credits per semester: 3  
Max credits per degree: 3 | LEC | ECEN 986 |
| ECEN 482    | Antennas and Radio Propagation for Wireless      |                  | ECEN 882                            | Prerequisites: ECEN 328 or (UNO) ECEN 3280  
Description: Fundamental theory of antennas and radio propagation for wireless communications. Basic antenna characteristics and various antennas and antenna arrays. Basic propagation mechanisms and various channel models, such as Friis free space model, Hata model, lognormal distribution, and multipath model. Includes practical antenna design for high radio frequency (RF) with modeling software tools such as Numerical Electromagnetic Code (NEC) and Advanced Design System (ADS). Design projects will be assigned as the main part of course.  
Credit Hours: 4 | Max credits per semester: 4  
Max credits per degree: 4 | LEC | ECEN 986 |
| ECEN 484    | Network Security                                 |                  | ECEN 884                            | Prerequisites: ECEN 325 or (UNO) ECEN 3250  
Description: Network security and cryptographic protocols. Classical encryption techniques, block ciphers and stream ciphers, public-key cryptography, authentications digital signatures, key management and distributions, network vulnerabilities, transport-level security, IP security.  
Credit Hours: 4 | Max credits per semester: 4  
Max credits per degree: 4 | LEC | ECEN 986 |
| ECEN 486    | Applied Photonics                                |                  | ECEN 886                            | Prerequisites: ECEN 306/(UNO) ECEN 3060 or permission  
Description: Introduction to the use of electromagnetic radiation for performing optical measurements in engineering applications. Basic electromagnetic theory and light interaction with matter are covered with corresponding laboratory experiments conducted.  
Credit Hours: 3 | Max credits per semester: 3  
Max credits per degree: 3 | LEC | ECEN 986 |
| ECEN 488    | Wireless Security                                |                  | ECEN 888                            | Prerequisites: ECEN 325 or (UNO) ECEN 3250  
Description: A comprehensive overview on the recent advances in wireless network and system security. Covers security issues and solutions in emerging wireless access networks and systems as well as multihop wireless networks.  
Credit Hours: 4 | Max credits per semester: 4  
Max credits per degree: 4 | LEC | ECEN 986 |
| ECEN 491    | Special Topics in Computer and Electronics       |                  | ECEN 891                            | Prerequisites: Senior standing  
Description: Special topics in the emerging areas of electrical and computer engineering which may not be covered in other courses in the Electrical and Computer Engineering curriculum.  
Credit Hours: 1-4 | Min credits per semester: 1  
Max credits per semester: 4  
Max credits per degree: 4 | LEC | ECEN 986 |
| ECEN 492    | Individual Study in Computer and Electronics     |                  | ECEN 892                            | Prerequisites: Senior standing.  
Notes: ECEN 492 (UNO - ECEN 4920) requires a ECE departmentally approved proposal.  
Description: Individual study in selected electrical and computer engineering area under the supervision and guidance of an Electrical & Computer Engineering faculty member.  
Credit Hours: 1-3 | Min credits per semester: 1  
Max credits per semester: 3  
Max credits per degree: 3 | LEC | ECEN 986 |
ECEN 494 Capstone I
Prerequisites: ECEN 317/(UNO) ECEN 3170 or (UNO) ECEN 2220 and (UNO) ECEN 3040 and (UNO) ECEN 3060 and (UNO) ECEN 3130; completed ACE 1 requirement or (UNO) ENGL 3980 or permission; admission to the College of Engineering.
Notes: The first in a two semester capstone senior design course sequence.
Description: A substantial design project that allows application of electrical engineering skills to a multidisciplinary project. Requires project definition, planning and scheduling, effective written and oral communication of technical ideas, incorporation of realistic constraints and engineering standards, functioning effectively on a multidisciplinary team, and applying new ideas as needed to meet project goals.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LEC
Offered: FALL/SPR

ECEN 495 Capstone II
Prerequisites: ECEN 494/(UNO) ECEN 4940 or permission; admission to the College of Engineering.
Notes: The second in a two semester capstone senior design course sequence.
Description: Continuation of a substantial design project that allows application of electrical engineering skills to a multidisciplinary project. A project that meets specifications and that is completed according to a pre-determined schedule and within budget. Requires effective written and oral communication of technical ideas, incorporation of realistic constraints and engineering standards, functioning effectively on a multidisciplinary team, and applying new ideas as needed to meet project goals.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC
ACE: ACE 10 Integrated Product

ECEN 496 Capstone I
Prerequisites: ECEN 313/(UNO) ECEN 3130 with a grade of "C" or better; ECEN 435/835/(UNO) ECEN 4350/8356 or ECEN 466/866/(UNO) ECEN 4660/8666, or parallel; and JGEN 300 or (UNO) ENGL 3980.
Notes: For Computer Engineering and Electronics Engineering students.
Description: Preliminary investigation into topics for the capstone course. Defining deliverables, scheduling, interdisciplinary team design.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LEC
Offered: FALL
Prerequisite for: ECEN 499

ECEN 498 Special Topics in Electrical Engineering IV
Crosslisted with: ECEN 898
Prerequisites: Permission.
Notes: ECEN 498/898 (UNO ECEN 4980/8986) is offered as the need arises for electrical engineering topics for fourth-year and graduate students not covered in other courses.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 18
Format: LEC

ECEN 499 Capstone II
Prerequisites: ECEN 496 or (UNO) ECEN 4960.
Description: ECEN 499/(UNO) ECEN 4990 requires the completion of a design project that demonstrates the ability to combine the knowledge from individual courses in the program to complete a design task. The capstone design course for the B.S. in computer engineering and electronics engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: IND
ACE: ACE 10 Integrated Product

ECEN 499H Honors Thesis
Prerequisites: Senior standing in electrical engineering; admission to the University Honors Program.
Description: Honors thesis research project meeting the requirements of the University Honors Program. Independent research project executed under the guidance of a member of the faculty of the Department of Electrical Engineering which contributes to the advancement of knowledge in the field. Culminates in the presentation of an honors thesis to the department and college.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Format: IND