**Electrical and Computer Engineering (ECEN)**

**ECEN 102 Introduction to Electrical Engineering**
**Prerequisites:** Open to first year students only or by permission.
**Description:** An overview of the electrical engineering field. Introduction to some basic concepts and skills needed in electrical engineering. Professionalism and ethics are addressed as well as the need for lifelong learning experiences. Information on professional careers available upon graduation.
**Credit Hours:** 2
**Max credits per semester:** 2
**Max credits per degree:** 2
**Grading Option:** Graded

**ECEN 103 Electrical and Computer 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
**Grading Option:** Graded with Option
**Offered:** FALL/SPR
**Prerequisite for:** ECEN 106; ECEN 123; ECEN 213; ECEN 220; 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
**Grading Option:** Graded with Option
**Prerequisite for:** ECEN 224; ECEN 313; ECEN 327; 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
**Grading Option:** Graded with Option

**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
**Grading Option:** Graded with Option

**ECEN 123 Introduction to Electrical and Computer Engineering**
**Prerequisites:** ECEN 103/(UNO)1030 or parallel; CSCE155A/CSCE 155E/(UNO) CIST 1400 or parallel. Open to first year students only.
**Description:** Laboratory design projects introducing some basic concepts and skills needed in electrical and computer engineering.
**Credit Hours:** 1
**Max credits per semester:** 1
**Max credits per degree:** 1
**Grading Option:** Graded

**ECEN 192 Individual Study in Computer and Electronics Engineering I**
**Notes:** Requires a ECE departmentally approved proposal.
**Description:** Individual study in a selected electrical, computer, or electronics engineering area under the supervision and guidance of an electrical and computer engineering faculty member.
**Credit Hours:** 1-3
**Min credits per semester:** 1
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded with Option

**ECEN 194 Special Topics in Electrical and Computer Engineering I**
**Prerequisites:** Freshman standing.
**Description:** Special topics in the emerging areas of electrical, computer, and electronics 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
**Grading Option:** Graded with Option

**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
**Grading Option:** Graded with Option

**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
**Grading Option:** Graded with Option
**Prerequisite for:** AGEN 325, BSEN 325; AREN 320; AREN 322; ECEN 231; MECH 350

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ECEN 213 Electrical Circuits I
Prerequisites: ECEN 103 or (UNO) ECEN 1030; ECEN 225 or (UNO) ECEN 2250; MATH 221/221H/821 or (UNO) MATH 2350, or parallel.
Description: Electrical circuit theory, Kirchhoff'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
Grading Option: Graded with Option
Offered: FALL/SPR
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
Grading Option: Graded with Option
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
Grading Option: Graded with Option
Prerequisite for: ECEN 216; ECEN 235; ECEN 306

ECEN 216 Electronics and Circuits II
Prerequisites: ECEN 215/(UNO) ECEN 2150 with a grade of "C" or better. Prerequisite or parallel: MATH 221/(UNO) MATH 2350 or MATH 221H.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: ECEN 304; ECEN 316; ECEN 338

ECEN 217 Electrical Circuits III
Prerequisites: ECEN 213 or (UNO) ECEN 2130
Notes: This course is for computer engineering majors only.
Description: Analysis of first and second order RLC circuits using differential equations and Laplace transforms. Variable frequency network performance analysis.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option

ECEN 218 Electrical Circuits Laboratory
Prerequisites: ECEN 213/(UNO) ECEN 2130 or parallel.
Notes: Lab to accompany ECEN 213/(UNO) ECEN 2130.
Description: 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.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option
Prerequisite for: ECEN 214; ECEN 222

ECEN 220 Introduction to Embedded Systems
Prerequisites: CSCE 155E; ECEN 103 or CSCE 230
Description: 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.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: CSCE 488; ECEN 307; ECEN 327

ECEN 222 Electronic Circuits I
Prerequisites: ECEN 213/(UNO) ECEN 2130 with a grade of "C" or better; ECEN 218/(UNO) ECEN 2184
Description: Analysis and design of modern electronic circuits. Diode circuits, bipolar and field effect transistor switching and amplifier circuits, and operational amplifier circuits.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Offered: FALL/SPR
Prerequisite for: ECEN 310; ECEN 325; ECEN 347; ECEN 352; ECEN 494

ECEN 224 Introduction to Signal Processing
Prerequisites: ECEN 106 or (UNO) ECEN 1060; CSCE 155A, 155E, 155H, 155N, 155T or (UNO) CIST 1400; MATH 107/107H or (UNO) MATH 1960.
Description: 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.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
ECEN 225 Electrical and Computer Engineering Seminar
Prerequisites: ECEN 103 or (UNO) ECEN 1030 or parallel
Description: An overview of electrical, 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.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option
Prerequisite for: ECEN 213

ECEN 231 Electrical Engineering Laboratory
Prerequisites: Prerequisite or parallel: ECEN 211/(UNO) ECEN 2110.
Description: Laboratory accompanying ECEN 211/(UNO) ECEN 2110.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option

ECEN 235 Introductory Electrical Laboratory I
Prerequisites: Prerequisite or parallel: ECEN 215/(UNO) ECEN 2150.
Description: Laboratory accompanying ECEN 215/(UNO) ECEN 2150.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option
Prerequisite for: ECEN 236

ECEN 236 Introductory Electrical Laboratory II
Prerequisites: ECEN 235/(UNO) ECEN 2350; Prerequisite or parallel: ECEN 216/(UNO) ECEN 2160.
Description: Laboratory accompanying ECEN 216/(UNO) ECEN 2160.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded with Option
Prerequisite for: ECEN 307

ECEN 292 Individual Study in Electrical and Computer Engineering II
Prerequisites: Sophomore standing.
Notes: Requires a ECE departmentally approved proposal.
Description: Individual study in a selected electrical, computer or electronics engineering area under the supervision and guidance of an electrical and computer engineering faculty member.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: ECEN 307

ECEN 294 Special Topics in Electrical and Computer Engineering II
Prerequisites: Sophomore standing.
Description: Special topics in the emerging areas of electrical, computer, and electronics 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
Grading Option: Graded with Option

ECEN 298 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
Grading Option: Graded with Option
Prerequisite for: ECEN 494

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
Grading Option: Graded with Option
Prerequisite for: ECEN 494

ECEN 305 Probability Theory and Statistics for Electrical and Computer Engineers
Prerequisites: MATH 208/(UNO) MATH 1970.
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
Grading Option: Graded with Option
Prerequisite for: ECEN 494

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) MATH 2350.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: ECEN 494

ECEN 307 Electrical Engineering Laboratory I
Prerequisites: ECEN 220 or (UNO) ECEN 1060 and ECEN 236 or (UNO) ECEN 220; prereq or parallel ECEN 370 or (UNO) ECEN 3700 or (UNO) ECEN 3130; 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
Grading Option: Graded with Option
Offered: FALL/SPR
ECEN 310 Digital Design and Interfacing
Prerequisites: ECEN 222/(UNO) ECEN 2220; ECEN 313/(UNO) ECEN 3130, or parallel.
Notes: 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
Grading Option: Graded with Option

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
Grading Option: Graded with Option
Prerequisite for: ECEN 310; ECEN 494

ECEN 316 Electronics and Circuits III
Prerequisites: ECEN 216/(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
Grading Option: Graded with Option
Prerequisite for: ECEN 347; ECEN 361

ECEN 317 Electrical Engineering Laboratory II
Prerequisites: ECEN 304/(UNO) ECEN 3040 and ECEN 307/(UNO) ECEN 3070; prereq 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
Grading Option: Graded with Option

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
Grading Option: Graded with Option

ECEN 327 Discrete Systems Laboratory
Prerequisites: ECEN 106/1060 or ECEN 220/2200
Description: Laboratory work on discrete systems.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded

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
Grading Option: Graded with Option
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
Grading Option: Graded with Option

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
Grading Option: Graded with Option

ECEN 333 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
Grading Option: Graded with Option

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
Grading Option: Graded with Option
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
Grading Option: Graded with Option

ECEN 347 Electrical Engineering Laboratory II
Prerequisites: ECEN 316/3160 or ECEN 222/2220
Description: Lab work on electromagnetics, fields and waves, solid state devices and control systems.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded

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
Grading Option: Graded with Option

ECEN 352 Electronics Circuits II
Prerequisites: ECEN 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
Grading Option: Graded with Option
Prerequisite for: ECEN 362

ECEN 355 Signals and Linear Systems
Prerequisites: ECEN 214/(UNO) ECEN 2140
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
Grading Option: Graded with Option

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
Grading Option: Graded

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
Grading Option: Graded with Option

ECEN 370 Digital Logic Design
Crosslisted with: CSCE 335
Prerequisites: ECEN 103/(UNO) ECEN 1030 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
Grading Option: Graded
Prerequisite for: ECEN 307

ECEN 392 Individual Study in Electrical and Computer Engineering III
Prerequisites: Junior standing.
Notes: Requires a ECE departmentally approved proposal.
Description: Individual study in a selected electrical, computer or electronics engineering area under the supervision and guidance of an electrical and computer engineering faculty member.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 394 Special Topics in Electrical and Computer Engineering III
Prerequisites: Junior standing
Description: Special topics in the emerging areas of electrical, computer, and electronics 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
Grading Option: Graded with Option
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
Grading Option: Graded with Option

ECEN 399 Undergraduate Research
Prerequisites: Electrical engineering seniors.
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
Grading Option: Graded with Option

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
Grading Option: Graded with Option

ECEN 400 Electronic Instrumentation
Crosslisted with: ECEN 800
Prerequisites: Senior standing in engineering
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
Grading Option: Graded

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 (circuits 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
Grading Option: Graded
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
Grading Option: Graded

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
Grading Option: Graded

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
Grading Option: Graded
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, semiconductive, and dielectric materials.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

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
Grading Option: Graded
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Crosslisted with</th>
<th>Prerequisites</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECEN 420</td>
<td>Plasma Processing of Semiconductors</td>
<td>ECEN 820</td>
<td>Senior or graduate standing.</td>
<td>Provides a solid background in electronic devices and converter circuitry.</td>
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<tr>
<td>ECEN 421</td>
<td>Principles of Semiconductor Materials and Devices I</td>
<td>ECEN 821</td>
<td>PHYS 213/(UNO) PHYS 2130</td>
<td>Introduces the fundamentals of semiconductor materials, including charge carrier transport, energy bands, and recombination. PN junctions, static and dynamic, and special PN junction diode devices.</td>
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<td>ECEN 422</td>
<td>Introduction to Physics and Chemistry of Solids</td>
<td>ECEN 822</td>
<td>PHYS 213 or CHEM 481/881, MATH 221/821.</td>
<td>Introduces the basis of electrical, thermal, and chemical properties of solids, including bonding in molecules and electron states in solids. Principles of molecular design of materials and solid-state devices.</td>
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<td>ECEN 424</td>
<td>Digital Signal Processing</td>
<td>ECEN 824</td>
<td>ECEN 355 or (UNO) ECEN 3550.</td>
<td>Introduces the fundamental concepts of digital signal analysis and design, including multi-rate digital signal processing techniques.</td>
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<td>ECEN 428</td>
<td>Power Electronics</td>
<td>ECEN 828</td>
<td>ECEN 304/(UNO) ECEN 3040 and ECEN 316/(UNO) ECEN 3160.</td>
<td>Provides a solid background in electronic devices and converter circuitry.</td>
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<td>ECEN 430</td>
<td>Wind Energy</td>
<td>ECEN 830</td>
<td>Senior standing</td>
<td>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.</td>
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<td>ECEN 432</td>
<td>Microprocessor System Design</td>
<td>ECEN 833</td>
<td>ECEN 310 or (UNO) ECEN 3100 with a grade of &quot;C&quot; or better; ECEN 332</td>
<td>Introduces the fundamentals of microprocessor-based systems, including architecture, design, and interfacing.</td>
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<td>or (UNO) ECEN 3320 with a grade of &quot;C&quot; or better.</td>
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<td>ECEN 433</td>
<td>Embedded Microcontroller Design</td>
<td>ECEN 835</td>
<td>ECEN 433/833 or (UNO) ECEN 4330/8336 with a grade of &quot;C&quot; or better.</td>
<td>Introduces the fundamentals of microcontroller architecture, design, programming, and interfacing for embedded systems. Timing issues, memory interfaces, serial and parallel interfacing, and functions for common microcontrollers.</td>
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<tr>
<td>ECEN 435</td>
<td>Wind Energy</td>
<td>ECEN 836</td>
<td>Senior standing</td>
<td>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.</td>
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<tr>
<td>ECEN 436</td>
<td>Electric Machines</td>
<td>ECEN 830</td>
<td>Important to the field of electronics and related sciences.</td>
<td>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.</td>
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**Credit Hours:**
- ECEN 420: 3
- ECEN 421: 3
- ECEN 422: 3
- ECEN 424: 3
- ECEN 428: 3
- ECEN 430: 3
- ECEN 432: 3
- ECEN 433: 4
- ECEN 435: 4
- ECEN 436: 4
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
Grading Option: Graded with Option

ECEN 438 Integrated Systems Programming
Crosslisted with: ECEN 838
Prerequisites: ECEN 310 or (UNO) ECEN 3100 and ECEN 332 or (UNO) ECEN 3320
Description: Introduction to the basics of computer architectural details under the context of computer system programming. Topics include representing and manipulating information, machine level representation of programs, processor architecture and pipelining, compiling and linking, optimizing program performance from the system level, memory hierarchy, dynamic memory allocation and exceptional control flow. Linux system programming tool chain will also be introduced.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: ECEN 406, ECEN 806

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
Grading Option: Graded

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
Grading Option: Graded
ECEN 453 Computational and Systems Biology
Crosslisted with: ECEN 853
Prerequisites: By permission.
Notes: Basic knowledge of probability and statistics (e.g. ECEN 305 or STAT 380) and basic programming skills are recommended. This course is to be listed as ECEN 4530/8536 in the UNO catalog as it may also be taught as a distance course for the Omaha campus.
Description: Provides the required biology primer and covers functional genomics, transcriptomics, differential expression, clustering, classification, prediction, biomarker discovery, pathway analysis and network based approaches to high throughput biological data analysis. Includes the development of databases, algorithms, web-based and other tools regarding management and analysis of life science data. Areas of study include DNA, RNA, and protein sequence analysis, functional genomics and proteomics, 3D macromolecule structure prediction, and systems/network approach.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: SPRING

ECEN 454 Power Systems Operation and Control
Crosslisted with: ECEN 854
Prerequisites: ECEN 338/(UNO) ECEN 3380
Description: 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.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

ECEN 460 Labview Programming
Crosslisted with: ECEN 860
Prerequisites: Prior programming experience
Description: 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.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

ECEN 461 Digital Communications Media
Crosslisted with: ECEN 861
Prerequisites: ECEN 325 or (UNO) 3250 or ECEN 462 or (UNO) ECEN 4620
Description: 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.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
Offered: FALL/SPR
Prerequisite for: ECEN 466, ECEN 866; ECEN 479, ECEN 879; ECEN 885; ECEN 977

ECEN 462 Communication Systems
Crosslisted with: ECEN 862
Prerequisites: ECEN 304/(UNO) ECEN 3040 and ECEN 305/(UNO) ECEN 3050
Description: Mathematical descriptions of signals in communication systems. Principles of analog modulation and demodulation. Performance analysis of analog communication systems in the presence of noise.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: ECEN 911

ECEN 463 Digital Signal Processing
Crosslisted with: ECEN 863
Prerequisites: ECEN 304/(UNO) ECEN 3040
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: ECEN 915

ECEN 464 Digital Communication Systems
Crosslisted with: ECEN 864
Prerequisites: ECEN 462/(UNO) ECEN 4620.
Description: Principles 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.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: ECEN 911; ECEN 912; ECEN 959

ECEN 465 Introduction to Data Compression
Crosslisted with: ECEN 865
Prerequisites: ECEN 305/(UNO) ECEN 3050
Description: 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.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

ECEN 466 Telecommunications Engineering I
Crosslisted with: ECEN 866
Prerequisites: ECEN 362 or (UNO) ECEN 3620; ECEN 461/861 or (UNO) ECEN 4610/8610, or parallel.
Credit Hours: 4
Max credits per semester: 4
Max credits per degree: 4
Grading Option: Graded with Option
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
Grading Option: Graded
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 antennae.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
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
Grading Option: Graded
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
Grading Option: Graded

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
Grading Option: Graded

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
Grading Option: Graded with Option

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
Grading Option: Graded
Prerequisite for: ECEN 477, ECEN 877

ECEN 475 Satellite Communications
Crosslisted with: ECEN 875
Prerequisites: ECEN 325 or ECEN 462 or parallel
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
Grading Option: Graded with Option

ECEN 476 Wireless Communications
Crosslisted with: ECEN 876
Prerequisites: ECEN 325 or ECEN 462 or parallel
Description: The fundamental concepts of wireless communications. Basic communications concepts such as multiple access and spectrum. Propagation, radio standards and internet working. Current issues in wireless communications.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

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
Grading Option: Graded
ECEN 479 Optical Fiber Communications
Crosslisted with: 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
Grading Option: Graded with Option
Prerequisite for: ECEN 979

ECEN 480 Introduction to Lasers and Laser Applications
Crosslisted with: 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
Grading Option: Graded with Option

ECEN 482 Antennas and Radio Propagation for Wireless Communications
Crosslisted with: 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
Grading Option: Graded with Option

ECEN 484 Network Security
Crosslisted with: 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
Grading Option: Graded with Option

ECEN 486 Applied Photonics
Crosslisted with: ECEN 886
Prerequisites: ECEN 306/(UNO) ECEN 3060
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
Grading Option: Graded

ECEN 488 Wireless Security
Crosslisted with: 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
Grading Option: Graded with Option

ECEN 491 Special Topics in Electrical and Computer Engineering IV
Crosslisted with: ECEN 891
Prerequisites: Senior standing
Description: Special topics in the emerging areas of electrical, computer, and electronics 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
Grading Option: Graded with Option

ECEN 492 Individual Study in Electrical and Computer Engineering IV
Crosslisted with: ECEN 892
Prerequisites: Senior standing
Notes: Requires a ECE departmentally approved proposal.
Description: Individual study in a selected electrical, computer, or electronics engineering area under the supervision and guidance of an electrical and computer engineering faculty member.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
ECEN 494 Electrical Engineering Capstone I
Prerequisites: ECEN 2220, ECEN 3040, ECEN 3060, ECEN 3130, and (UNO) ENGL 1160.
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
Grading Option: Graded
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
Grading Option: Graded with Option
ACE: ACE 10 Integrated Product

ECEN 496 Computer Engineering Capstone I
Prerequisites: ECEN 4330; (UNO) ENGL 1160.
Notes: For Computer Engineering students.
Description: Preliminary investigation into topics for the capstone course. Defining deliverables, scheduling, and interdisciplinary team design.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Grading Option: Graded
Offered: FALL
Prerequisite for: ECEN 499

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
Grading Option: Graded with Option

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
Grading Option: Graded with Option

ECEN 498 Special Topics in Electrical Engineering IV
Crosslisted with: ECEN 898
Prerequisites: Permission
Notes: 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
Grading Option: Graded with Option