ELECTRICAL AND COMPUTER ENGINEERING (ECEN)

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
Prerequisite for: ECEN 214

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

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
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

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
Format: LEC
Prerequisite for: ECEN 307

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
Format: LEC
Prerequisite for: ECEN 304; ECEN 316; ECEN 338

ECEN 218 Electrical Circuits Laboratory
Prerequisites: ECEN 213/(UNO) ECEN 2130 or parallel.
Notes: ECEN 218/(UNO) ECEN 2184 is a 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
Format: LAB
Prerequisite for: ECEN 214; ECEN 222

ECEN 220 Introduction to Embedded Systems
Prerequisites: ECEN 122/(UNO) ECEN 1220 or CSCE 230, and CSCE 155E, or working knowledge of C programming.
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
Format: LEC
Prerequisite for: ECEN 307

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
Format: LEC
Offered: FALL/SPR
Prerequisite for: ECEN 310; ECEN 325

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
Format: LEC

ECEN 225 Computer and Electronics Engineering Seminar
Prerequisites: ECEN 103 or (UNO) ECEN 1030.
Description: 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.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC
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
Format: LAB
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
Format: LAB
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
Format: LAB
Prerequisite for: ECEN 236
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 Computer and Electronics 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 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
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.
Description: Mathematical modeling of physical systems and signals.
Representation of signals in terms of basis functions. Fourier series
expansions, Fourier Transforms, Laplace and z-Transforms. Input-output
relations, convolution. Transfer functions. System Stability. Poles/zeros
and s- and z-plane methods. Applications.
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.
Description: Complex vectors. Maxwell's equations. Uniform plane
waves. Wave reflection and transmission at interfaces. Waveguides and
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 2220; 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
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
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
<th>Description</th>
<th>Credit Hours</th>
<th>Format</th>
<th>Max credits per semester</th>
<th>Max credits per degree</th>
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</thead>
<tbody>
<tr>
<td>ECEN 313</td>
<td>Switching Circuits Theory</td>
<td>ECEN 106 or (UNO) ECEN 1060</td>
<td>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.</td>
<td>4</td>
<td>LEC</td>
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<tr>
<td>ECEN 316</td>
<td>Electronics and Circuits III</td>
<td>ECEN 216/(UNO) ECEN 2160 with a grade of 'C' or better.</td>
<td>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.</td>
<td>3</td>
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<tr>
<td>ECEN 317</td>
<td>Electrical Engineering Laboratory II</td>
<td>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.</td>
<td>Lab work on electromagnetic fields and waves, solid state devices, discrete systems, control systems, and communications.</td>
<td>2</td>
<td>LAB</td>
<td>2</td>
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<tr>
<td>ECEN 325</td>
<td>Communications Systems</td>
<td>ECEN 222/(UNO) ECEN 2220; MATH/STAT 380/(UNO) STAT 3800.</td>
<td>Relevant communications systems; principles of transmission and reception; amplitude; frequency and phase modulation. Sampling theorem, pulse-code modulation and delta modulation.</td>
<td>4</td>
<td>LEC</td>
<td>4</td>
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</tr>
<tr>
<td>ECEN 329</td>
<td>Applied Fields and Lines II</td>
<td>ECEN 328 or (UNO) ECEN 3280.</td>
<td>Metallic wave guides with rectangular, circular, and coaxial cross section, antennas, free space, propagation in free space, and applications.</td>
<td>3</td>
<td>LEC</td>
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<tr>
<td>ECEN 332</td>
<td>Assembly Language Programming</td>
<td>ECEN 106 or (UNO) ECEN 1060</td>
<td>Introduction to the architecture and assembly language programming of 80 x 86 microprocessors. Assemblers and debugging tool utilization.</td>
<td>1</td>
<td>LAB</td>
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<tr>
<td>ECEN 338</td>
<td>Introduction to Power and Energy Systems</td>
<td>ECEN 216 or (UNO) ECEN 2160 or ECEN 214 or (UNO) ECEN 2140 with a grade of &quot;C&quot; or better.</td>
<td>Energy sources, environmental impacts, power systems principles, three-phase circuits, transmission lines, transformers, per unit analysis, generators, loads, and power system modeling.</td>
<td>3</td>
<td>LEC</td>
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<tr>
<td>ECEN 345</td>
<td>Mobile Robotics I</td>
<td>ECEN 106 or (UNO) ECEN 1060, ECEN 213 or (UNO) ECEN 2130.</td>
<td>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.</td>
<td>4</td>
<td>LEC</td>
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<tr>
<td>ECEN 350</td>
<td>Electrical Engineering Internship or Co-op</td>
<td>Open to Electrical Engineering majors only. Approval of faculty sponsor prior to the internship or Co-op is required. Internship/Co-op occurs. Weekly communication and/or final report required. Must be taken during or after the semester in which the Internship/Co-op occurs.</td>
<td>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.</td>
<td>1-3</td>
<td>IND</td>
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</tbody>
</table>
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 combinatorial 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 a computer and 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

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
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
<th>Description</th>
<th>Crosslisted with</th>
<th>Credit Hours</th>
<th>Format</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECEN 400</td>
<td>Electronic Instrumentation</td>
<td>ECEN 800</td>
<td>Senior standing in engineering or permission.</td>
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<td>3</td>
<td>LEC</td>
<td>Senior standing in engineering or permission. 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.</td>
</tr>
<tr>
<td>ECEN 406</td>
<td>Power Systems Analysis</td>
<td>ECEN 806</td>
<td>ECEN 338/(UNO) ECEN 3380 or ECEN 838/(UNO) ECEN 8386.</td>
<td></td>
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<td>LEC</td>
<td>ECEN 957</td>
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<tr>
<td>ECEN 407</td>
<td>Power Systems Planning</td>
<td>ECEN 807</td>
<td>ECEN 305/(UNO) ECEN 3050</td>
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<td>LEC</td>
<td>ECEN 957</td>
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<tr>
<td>ECEN 408</td>
<td>Engineering Electromagnetics</td>
<td>ECEN 808</td>
<td>ECEN 306/(UNO) ECEN 3060</td>
<td>Laboratory experiments.</td>
<td>3</td>
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<tr>
<td>ECEN 410</td>
<td>Multivariate Random Processes</td>
<td>ECEN 810</td>
<td>ECEN 305/(UNO) ECEN 3050</td>
<td></td>
<td>3</td>
<td>LEC</td>
<td>ECEN 911; ECEN 912; ECEN 915; ECEN 946</td>
</tr>
<tr>
<td>ECEN 416</td>
<td>Materials and Devices for Computer Memory, Logic, and Display</td>
<td>ECEN 816</td>
<td>PHYS 212/(UNO) PHYS 2120</td>
<td></td>
<td>3</td>
<td>LEC</td>
<td>ECEN 946</td>
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<tr>
<td>ECEN 417</td>
<td>Semiconductor Fundamentals II</td>
<td>ECEN 817</td>
<td>ECEN 421/(UNO) ECEN 4210 or ECEN 821/(UNO) ECEN 8216.</td>
<td>Analysis of BJT’s and MOSFET’s from a first principle materials viewpoint. Static and dynamic analysis and characterization. Device fabrication processes.</td>
<td>3</td>
<td>LEC</td>
<td></td>
</tr>
<tr>
<td>ECEN 420</td>
<td>Plasma Processing of Semiconductors</td>
<td>ECEN 820</td>
<td>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.</td>
<td></td>
<td>3</td>
<td>LEC</td>
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</tr>
<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>
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<td>3</td>
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</tr>
<tr>
<td>ECEN 422</td>
<td>Introduction to Physics and Chemistry of Solids</td>
<td>PHYS 422, PHYS 822, ECEN 822</td>
<td>PHYS 213 or CHEM 481/881, MATH 221/821, or permission.</td>
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<td>3</td>
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</tbody>
</table>

**Notes:**
- ECEN 410: Prerequisite for: ECEN 911; ECEN 912; ECEN 915; ECEN 946
- ECEN 416: Prerequisite: ECEN 816
- ECEN 417: Prerequisites: ECEN 421/(UNO) ECEN 4210 or ECEN 821/(UNO) ECEN 8216.
- ECEN 420: Prerequisites: Senior or graduate standing.
- ECEN 421: Prerequisites: PHYS 213/(UNO) PHYS 2130
- ECEN 422: Prerequisites: PHYS 213 or CHEM 481/881, MATH 221/821, or permission.
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
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Crosslisted with</th>
<th>Prerequisites</th>
<th>Description</th>
<th>Prerequisite for</th>
<th>Credit Hours</th>
<th>Format</th>
<th>Offered</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECEN 448</td>
<td>Decision Analysis</td>
<td>ECEN 848</td>
<td>ECEN 305/(UNO) ECEN 3050 or STAT 380/(UNO) STAT 3800</td>
<td>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.</td>
<td>ECEN 862; ECEN 911; ECEN 912; ECEN 959</td>
<td>3</td>
<td>LEC</td>
<td>FALL/SPR</td>
</tr>
<tr>
<td>ECEN 450</td>
<td>Bioinformatics</td>
<td>ECEN 850</td>
<td>Computer programming language and ECEN 305/(UNO) ECEN 3050 or IMSE 321 or STAT 380/(UNO) STAT 3800 or equivalent</td>
<td>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.</td>
<td>ECEN 911</td>
<td>3</td>
<td>LEC</td>
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<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>ECEN 911</td>
<td>3</td>
<td>LEC</td>
<td></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>
<td>ECEN 911</td>
<td>3</td>
<td>LEC</td>
<td></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>ECEN 911</td>
<td>3</td>
<td>LEC</td>
<td></td>
</tr>
<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>ECEN 911</td>
<td>3</td>
<td>LEC</td>
<td></td>
</tr>
<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>ECEN 911</td>
<td>4</td>
<td>LEC</td>
<td>FALL/SPR</td>
</tr>
<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>ECEN 911</td>
<td>3</td>
<td>LEC</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>ECEN 911</td>
<td>3</td>
<td>LEC</td>
<td></td>
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</tbody>
</table>

*Electrical and Computer Engineering (ECEN)*
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
Format: LEC

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
Format: LEC
Prerequisite for: ECEN 496

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

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. Gigabit 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

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
Format: LEC
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
Format: LEC
Prerequisite for: ECEN 986

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
Format: LEC

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
Format: LEC

ECEN 486 Applied Photonics
Crosslisted with: 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
Format: LEC
Prerequisite for: ECEN 986

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
Format: LEC

ECEN 491 Special Topics in Computer and Electronics Engineering IV
Crosslisted with: 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
Format: LEC
ECEN 492 Individual Study in Computer and Electronics Engineering IV
Crosslisted with: 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
Format: IND

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: IND
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