

ELECTRICAL, COMPUTER & ENERGY ENGINEERING

Electrical engineering offers study of the basic science and technology of information and energy. Its areas of knowledge include information theory and communications systems, computers and digital systems, signal processing and instrumentation, feedback systems and automatic control, electrical and electronic devices and systems, power electronics and renewable energy, electromagnetics and microwave devices, optics and photonic systems, and embedded systems engineering. Students learn how this basic knowledge is applied to such modern technologies as computers, telecommunications, biomedical systems, and remote sensing. The curriculum accommodates a variety of student interests including design, production, testing, consulting services, research, teaching, and management. Graduates pursue careers in a large variety of fields in the computer, telecommunications, instrumentation, biomedical, aerospace, energy, materials, and semiconductors industries, as well as academia. Some go on to careers in other professions such as law or medicine.

Electrical and computer engineering offers the same curriculum as electrical engineering, except that required courses in computer hardware and software replace some upper-division electives. As with electrical engineering, it accommodates broad student interests from design to service, and from research to management. Its graduates take positions in fields as diverse as those listed above for electrical engineering.

Course code for this program is ECEN.

Bachelor's Degree

- Electrical and Computer Engineering - Bachelor of Science (BS) (catalog.colorado.edu/undergraduate/colleges-schools/engineering-applied-science/programs-study/electrical-computer-energy-engineering/electrical-computer-engineering-bachelor-science-bs)
- Electrical Engineering - Bachelor of Science (BS) (catalog.colorado.edu/undergraduate/colleges-schools/engineering-applied-science/programs-study/electrical-computer-energy-engineering/electrical-engineering-bachelor-science-bs)

Minor

- Computer Engineering - Minor (catalog.colorado.edu/undergraduate/colleges-schools/engineering-applied-science/programs-study/electrical-computer-energy-engineering/computer-engineering-minor)
- Electrical Engineering - Minor (catalog.colorado.edu/undergraduate/colleges-schools/engineering-applied-science/programs-study/electrical-computer-energy-engineering/electrical-engineering-minor)
- Signals and Systems - Minor (catalog.colorado.edu/undergraduate/colleges-schools/engineering-applied-science/programs-study/electrical-computer-energy-engineering/signals-systems-minor)

While many faculty teach both undergraduate and graduate students, some instruct students at the undergraduate level only. For more information, contact the faculty member's home department.

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Williamson, James A.
Lecturer

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Zabotin, Nikolay (https://experts.colorado.edu/display/fisid_127038)
Research Professor

Courses

ECEN 1030 (1-4) Special Topics

Special topics class.

ECEN 1100 (1) Exploring ECE

Introduces students to areas of emphasis with the ECE department through seminars presented by faculty and outside speakers. Emphasizes career opportunities, professional ethics and practices, history of the profession, and resources for academic success. Several sessions promote team building and problem solving, and provide opportunities for first year students to meet their classmates.

Requisites: Restricted to College of Engineering (ENGRU) undergraduates only.

Additional Information: Departmental Category: General

ECEN 1310 (4) C Programming for ECE

Introduces fundamental programming concepts with engineering applications using C at a lower level of abstraction and MATLAB at a higher, application-focused level. Teaches the use of pointers, control flow, and data types. Example engineering applications include signal processing and the numerical computations. Includes a weekly computer lab session.

Equivalent - Duplicate Degree Credit Not Granted: CSCI 1300 or CSPB 1300 or CSCI 1310 or CSCI 1320

Requisites: Restricted to College of Engineering (ENGRU) undergraduates only.

Recommended: Prerequisite APPM 1350.

Additional Information: Departmental Category: General

ECEN 1400 (3) Introduction to Digital and Analog Electronics

Introduces fundamental concepts in electrical and computer engineering such as Ohm's Law, capacitors, LEDs and 7-segment displays, transformers and rectifiers, digital logic, Fourier decomposition, frequency analysis. Lab work exposes students to commonly used instrumentation. Includes a final project. Skills in wiring, soldering and wire-wrapping are developed.

Requisites: Restricted to students with 0-56 (Freshmen or Sophomore) College of Engineering majors only.

Additional Information: Departmental Category: General

ECEN 1500 (3) Sustainable Energy

Explores how energy is generated and used in today's society. Through collaborative discussion and hands-on data collection, students will analyze the engineering challenges, fundamental limits, and potential solutions to meeting our energy needs sustainably. Students will learn to analyze numerical data, estimate orders of magnitude, and apply mathematical methods in their own lives and in the ongoing energy debate. Basic algebra required.

Requisites: College of Engineering majors are excluded from this course.

Additional Information: Arts Sci Core Curr: Quant Reasn Mathmat Skills

Arts Sci Gen Ed: Quantitative Reasoning Math

Departmental Category: General

ECEN 1840 (1-6) Independent Study

Provides an opportunity for freshmen to do independent, creative work. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Additional Information: Departmental Category: General

ECEN 2010 (1-5) Special Topics

Repeatable: Repeatable for up to 6.00 total credit hours.

Additional Information: Departmental Category: General

ECEN 2020 (1-5) Special Topics

Repeatable: Repeatable for up to 6.00 total credit hours.

Additional Information: Departmental Category: General

ECEN 2050 (1-5) Special Topics

Additional Information: Departmental Category: General

ECEN 2060 (1-5) Special Topics

Repeatable: Repeatable for up to 6.00 total credit hours.

Additional Information: Departmental Category: General

ECEN 2250 (3) Introduction to Circuits and Electronics

Introduces linear circuit analysis and design, including OP-Amps. Presents DC networks, including node and mesh analysis with controlled sources. Analysis of RL and RC circuits for both transient and sinusoidal steady-state responses using phasors.

Requisites: Requires prerequisite course of APPM 1360 or MATH 2300 and PHYS 1120 (all minimum grade C-), and corequisite course of APPM 2360. Restricted to College of Engineering majors only.

Recommended: Prerequisite ECEN 1310 or CSCI 1300.

Additional Information: Departmental Category: General

ECEN 2260 (3) Circuits as Systems

Continues basic circuit analysis of ECEN 2250: Laplace transform techniques, transfer functions, frequency response, Bode diagrams, resonant circuits, Fourier series expansions, and convolution.

Requisites: Requires prerequisite course of ECEN 2250 and APPM 2360 (minimum grade C-). Restricted to College of Engineering students only.

Recommended: Corequisite ECEN 2270.

Additional Information: Departmental Category: General

ECEN 2270 (3) Electronics Design Lab

Provides an introduction to analysis, modeling, design, and testing of analog electronic circuits in a practical laboratory setting. The laboratory is centered around a robot platform and includes design, SPICE simulations, prototyping and testing of circuits necessary to drive and remotely control the robot.

Requisites: Requires prerequisite course of ECEN 2260 or corequisite course of ECEN 2260. Restricted to College of Engineering majors only.

Additional Information: Departmental Category: General

ECEN 2310 (1) Programming with Mathematical Software

Applies mathematical software to the solution of engineering applications, using numerical and symbolic techniques. Typical applications include the manipulation of acoustic signals and the study of the dynamics of simple continuous and discrete systems.

Requisites: Requires prerequisites ECEN 1310 or CSCI 1300 or CSCI 1320 (all minimum grade C-). Restricted to College of Engineering students.

Grading Basis: Letter Grade

ECEN 2350 (3) Digital Logic

Covers the design and applications of digital logic circuits, including both combinational and sequential logic circuits. Introduces hardware descriptive language, simulating and synthesis software, and programming of field programmable arrays (FPGAs).

Requisites: Requires prerequisite course of ECEN 1310, CSCI 1300, or CSCI 1320 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: General

ECEN 2410 (3) Renewable Sources and Efficient Electrical Energy Systems

Introduces electrical power generation and renewable energy, including solar, wind, micro, hydro, coal, nuclear and natural gas and some of the issues in integrating renewable energy sources in the grid.

Requisites: Requires prerequisite course of PHYS 1120 (minimum grade C-). Requires corequisite course of ECEN 2250. Restricted to College of Engineering majors only.

Additional Information: Departmental Category: General

ECEN 2420 (3) Electronics for Wireless Systems

Explores fundamental principles behind the operation of a radio, including a practical introduction to circuit elements. Covers the components and operation of a radio (transmitter and receiver) with simple signals. Students learn lab exercises the operation principles behind components of a complete practical radio system.

Requisites: Requires prerequisite course of PHYS 1120 and APPM 1360 or MATH 2300 (all minimum grade C-). Requires corequisite course of ECEN 2250. Restricted to Electrical and Computer Engineering (ECEN) or Electrical Engineering (EEEN) majors only.

Additional Information: Departmental Category: General

ECEN 2440 (3) Application of Embedded Systems

Introduces embedded systems and key computer architecture concepts through a variety of projects involving programming a microcontroller in C. Provides students hands-on projects that combine the knowledge gained in their digital and analog coursework in order to engineer hardware, firmware and application software design solutions. Includes a weekly lecture and two weekly laboratory sessions.

Requisites: Requires a prerequisite course of ECEN 1310, CSCI 1300 or CSCI 1320 (minimum grade C-). Requires corequisite course of ECEN 2250.

Additional Information: Departmental Category: General

ECEN 2703 (3) Discrete Mathematics for Computer Engineers

Emphasizes elements of discrete mathematics appropriate for computer engineering. Topics: logic, proof techniques, algorithms, complexity, relations, and graph theory.

Requisites: Requires prerequisite courses of ECEN 1310 or CSCI 1300 or CSCI 1320 and APPM 1360 or MATH 2300 (all minimum grade C-). Restricted to College of Engineering students only.

Additional Information: Departmental Category: Computer and Digital Systems

ECEN 2830 (1-5) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

Repeatable: Repeatable for up to 9.00 total credit hours. Allows multiple enrollment in term.

Additional Information: Departmental Category: General

ECEN 2840 (1-6) Independent Study

Offers an opportunity for sophomores to do independent, creative work. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Additional Information: Departmental Category: General

ECEN 3002 (3-5) Special Topics

Additional Information: Departmental Category: Digital Signal Processing Communications

ECEN 3003 (3-5) Special Topics

Additional Information: Departmental Category: Computer and Digital Systems

ECEN 3004 (3-5) Special Topics

Additional Information: Departmental Category: Electromagnetics and Remote Sensing

ECEN 3010 (3) Circuits and Electronics for Mechanical Engineers

Covers analysis of electrical circuits by use of Ohm's law, network reduction, node and loop analysis, Thevenin's and Norton's theorems, DC and AC signals, transient response of simple circuits, transfer functions, basic diode and transistor circuits, and operational amplifiers. Includes introductory digital electronics and microprocessors/microcontrollers.

Equivalent - Duplicate Degree Credit Not Granted: MCEN 3017

Requisites: Requires prereq course of PHYS 1120 (min grade C). Requires a prereq or coreq course of APPM 2360. Restricted to students with 57-180 credits (Jr or Sr) Mechanical Engr (MCEN) or Engineering Plus (GEEN) majors only.

Additional Information: Departmental Category: General

ECEN 3030 (3) Electrical/Electronic Circuits Non-Major

For students not majoring in electrical engineering. Covers analysis of electric circuits by use of Ohm's law; network reduction; superposition; node analysis; Thevenin's and Norton's theorems; sinusoidal signals; phasors; power in AC circuits; transient response, operation of simple circuits; rectifiers; transformers; 3-phase circuits; motors and generators.

Requisites: Requires prereq course of APPM 2360 (min grade C-).

Electrical Computer Engineering (ECEN), Electrical Engineering (EEEN), Electrical Computer Engineering and Electrical Engineering Concurrent Degree (C-ECEN/EEEN) mjrs are excluded from this course

Additional Information: Departmental Category: General

ECEN 3070 (3) Edges of Science

Examines the evidence for paranormal phenomena, reasons for skepticism, and physical models that could account for the data. Reviews controversial scientific theories that overcame barriers to acceptance, and how worldviews shift. Considers the scientific method and ways uncontrolled factors might influence experiments. Develops skills in statistical analysis of data. Includes group projects testing for anomalous and parapsychological effects. Not accepted as a technical elective for engineering majors.

Additional Information: Departmental Category: General

ECEN 3170 (3) Electromagnetic Energy Conversion 1

Real and reactive power in single phase circuits, power triangle, balanced three-phase circuits, wye and delta connections, introduction to electromagnetic machines, transformers (single and three-phase) and their equivalent circuits, AC-machinery fundamentals, synchronous generator from a magnetic field point of view, synchronous motors and condensers, three-phase induction motors, DC machinery fundamentals, DC motors, single phase motors. Matlab/Simulink will be used.

Requisites: Requires prerequisite courses of ECEN 2260 and PHYS 1120 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Power

ECEN 3250 (3) Microelectronics

Develops a basic understanding of active semiconductor devices. Focuses on building an understanding of BJT and CMOS devices in both digital and analog applications.

Requisites: Requires prerequisite course of ECEN 2260 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: General

ECEN 3300 (3) Linear Systems

Characterization of linear time-invariant systems in time and frequency domains. Continuous time systems are analyzed using differential equations and Laplace and Fourier transforms. Discrete time systems are analyzed using difference equations, Z-transforms and discrete time Fourier transforms. Sampling and reconstruction of signals using the sampling theorem. Applications of linear systems include communications, signal processing, and control systems.

Requisites: Requires prerequisite course of ECEN 2260 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: General

ECEN 3303 (3) Introduction to Robotics

Introduces students to fundamental concepts in autonomous robotics: mechanisms, locomotion, kinematics, control, perception and planning. Consists of lectures and lab sessions that are geared toward developing a complete navigation stack on a miniature mobile robotic platform.

Equivalent - Duplicate Degree Credit Not Granted: CSCI 3302

Requisites: Requires prerequisite courses of (CSCI 2270 or CSCI 2275) and (APPM 3170 or CSCI 2824 or ECEN 2703 or MATH 2001) and (APPM 2360 or APPM 3310 or CSCI 2820 or MATH 2130 or MATH 2135) (all minimum grade C-).

Additional Information: Departmental Category: Computer and Digital Systems

ECEN 3320 (3) Semiconductor Devices

Highlights the fundamentals of semiconductor materials and devices. Topics include the electrical and optical properties of semiconductors, the theory of Pn junctions, bipolar and field-effect transistors, and optoelectronic devices.

Requisites: Requires prerequisite course of ECEN 3250 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: General

ECEN 3350 (3) Programming Digital Systems

Explores how computers and programmable hardware in general are used to implement digital systems by looking at the capabilities of central processing units, the use and control of various input/output (I/O) devices, memory organization, and concurrency management. Topics include computer architecture, instruction sets, I/O device programming, interrupts, data transfer mechanisms, semaphores, and memory management.

Requisites: Requires prerequisite course of ECEN 2350 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Computer and Digital Systems

ECEN 3360 (3) Digital Design Laboratory

Introduces digital system design, including system software and hardware building blocks, and system software-hardware integration. Emphasizes hands-on system development and debugging. Uses mainstream electronic system design platforms, including FPGAs, embedded and mobile computing platforms, and Assembly/C/Java/Verilog programming languages.

Requisites: Requires prerequisite course ECEN 3350 (minimum grade C-) or corequisite of ECEN 3350. Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Computer and Digital Systems

ECEN 3400 (3) Electromagnetic Fields and Waves

Electromagnetic fields are covered at an introductory level, starting with electrostatics and continuing with DC current, magnetostatics, time-varying magnetic fields, waves on transmission lines, Maxwell's equations and the basics of plane waves. The use of fields in inductors, capacitors, resistors, transformers, and energy and power concepts are studied.

Requisites: Requires prerequisites (APPM 2350 or MATH 2400) and APPM 2360 and PHYS 1120 and ECEN 2250 (all minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: General

ECEN 3410 (3) Electromagnetic Waves and Transmission

Covers reflected and transmitted plane waves in layered media, Poynting's theorem of electromagnetic power, two-conductor transmission line theory and practice, Smith chart usage and impedance matching, waveguides, and elements of antenna theory.

Requisites: Requires prerequisite course ECEN 3400 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Electromagnetics and Remote Sensing

ECEN 3810 (3) Introduction to Probability Theory

Covers the fundamentals of probability theory, and treats the random variables and random processes of greatest importance in electrical engineering. Provides a foundation for study of communication theory, control theory, reliability theory, and optics.

Equivalent - Duplicate Degree Credit Not Granted: MATH 4510 or APPM 3570

Requisites: Requires prerequisite course of APPM 2350 or MATH 2400 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: General

ECEN 3840 (1-6) Independent Study

Offers an opportunity for juniors to do independent, creative work. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Additional Information: Departmental Category: General

ECEN 3841 (1-6) Independent Study

Offers an opportunity for juniors to do independent, creative work.

Repeatable: Repeatable for up to 6.00 total credit hours.

Additional Information: Departmental Category: General

ECEN 4000 (1-3) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

Repeatable: Repeatable for up to 9.00 total credit hours. Allows multiple enrollment in term.

Additional Information: Departmental Category: General

ECEN 4001 (1-4) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

Repeatable: Repeatable for up to 9.00 total credit hours. Allows multiple enrollment in term.

Additional Information: Departmental Category: Bioengineering

ECEN 4002 (1-4) Special Topics

Credit and subject matter to be arranged. Department enforced prerequisite: varies

Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

Additional Information: Departmental Category: Digital Signal Processing Communications

ECEN 4003 (1-4) Special Topics

Credit and subject matter to be arranged. Department enforced prerequisite: varies

Repeatable: Repeatable for up to 12.00 total credit hours. Allows multiple enrollment in term.

ECEN 4004 (1-4) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

Repeatable: Repeatable for up to 9.00 total credit hours. Allows multiple enrollment in term.

ECEN 4005 (1-4) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

Repeatable: Repeatable for up to 9.00 total credit hours. Allows multiple enrollment in term.

ECEN 4006 (1-4) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

Repeatable: Repeatable for up to 9.00 total credit hours.

Additional Information: Departmental Category: Optics

ECEN 4007 (1-4) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

Repeatable: Repeatable for up to 9.00 total credit hours. Allows multiple enrollment in term.

ECEN 4009 (1-4) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

Repeatable: Repeatable for up to 9.00 total credit hours. Allows multiple enrollment in term.

Additional Information: Departmental Category: VLSI CAD Methods

ECEN 4011 (1-4) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

Equivalent - Duplicate Degree Credit Not Granted: ECEN 5011

Repeatable: Repeatable for up to 9.00 total credit hours.

Additional Information: Departmental Category: Bioengineering

ECEN 4012 (1-4) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

Additional Information: Departmental Category: Digital Signal Processing Communications

ECEN 4013 (1-4) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

Additional Information: Departmental Category: Computer and Digital Systems

ECEN 4016 (1-4) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

Additional Information: Departmental Category: Optics

ECEN 4017 (1-4) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

Additional Information: Departmental Category: Power

ECEN 4018 (1-4) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

Additional Information: Departmental Category: Dynamical Systems and Control

ECEN 4021 (1-4) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

Repeatable: Repeatable for up to 9.00 total credit hours.

Requisites: Restricted to students with 87-180 credits (Senior, Fifth Year Senior) College of Engineering majors only.

Additional Information: Departmental Category: Bioengineering

ECEN 4024 (1-4) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

Equivalent - Duplicate Degree Credit Not Granted: ECEN 5024

Additional Information: Departmental Category: Electromagnetics and Remote Sensing

ECEN 4028 (1-4) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

Additional Information: Departmental Category: Dynamical Systems and Control

ECEN 4031 (1-4) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

ECEN 4033 (3) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

Repeatable: Repeatable for up to 9.00 total credit hours. Allows multiple enrollment in term.

ECEN 4043 (1-4) Special Topics

Examines a special topic in Electrical, Computer and Energy Engineering.

ECEN 4053 (1-4) Special Topics

Special topics course.

Equivalent - Duplicate Degree Credit Not Granted: ECEN 5053

Repeatable: Repeatable for up to 4.00 total credit hours.

Additional Information: Departmental Category: Computer and Digital Systems

ECEN 4133 (3) Fundamentals of Computer Security

Practice thinking like an attacker by exploring several modern computer security attacks and defenses through hands-on programming projects. Topics include applied cryptography (encryption, authentication), web security (XSS, CSRF, SQL Injection), network security (TLS, MITM attacks), application security (shell injection, buffer overflows), and other current events and trends (government surveillance, botnets, cryptocurrencies).

Grading Basis: Letter Grade

ECEN 4138 (3) Control Systems Analysis

Analysis and design of continuous time control systems using classical and state space methods. Laplace transforms, transfer functions and block diagrams. Stability, dynamic response, and steady-state analysis. Analysis and design of control systems using root locus and frequency response methods. Computer aided design and analysis. Department enforced prerequisite: background in Laplace transforms, linear algebra, and ordinary differential equations.

Equivalent - Duplicate Degree Credit Not Granted: ECEN 5138

Requisites: Requires prerequisite course of ECEN 3300 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Dynamical Systems and Control

ECEN 4167 (3) Electromagnetic Energy Conversion 2

Introduction to electric machine drives, basic electric machine mechanics, structure and modeling of electric machines (DC, Synchronous, Linear, Induction), reference frame theory using d-q modeling based on the complex space vector and on matrix transformation, transient and steady state analysis of three-phase machine, design of speed regulators, vector control. Matlab/Simulink will be used.

Requisites: Requires prerequisite course of ECEN 3170 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Power

ECEN 4224 (3) High Speed Digital Design

Covers fundamentals of high-speed properties of logic gates, measurement techniques, transmission lines, ground planes and layer stacking, terminations, vias, power systems, connectors, ribbon cables, clock distribution and clock oscillators.

Equivalent - Duplicate Degree Credit Not Granted: ECEN 5224

Requisites: Requires prerequisite course of ECEN 3400 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Electromagnetics and Remote Sensing

ECEN 4242 (3) Communication Theory

Covers modern digital and analog communication systems. Analysis and design of communication signals, transmitters, channels, and receivers. Amplitude and angle modulation and demodulation are treated as well as theory and application of digital data transmission. Emphasis is also placed on the analysis and mitigation of the effects of noise through signal design at the transmitter and signal processing at the receiver.

Requisites: Requires prerequisite course of ECEN 3300 and ECEN 3810 or APPM 3570 or MATH 4510 (all minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Digital Signal Processing Communications

ECEN 4313 (3) Concurrent Programming

Introduces the theory and practice of multicore programming. The first part of the course presents foundations of concurrent programming: mutual exclusion, wait-free and lock-free synchronization, spin locks, monitors, memory consistency models. The second part presents a sequence of concurrent data structures and techniques used in their implementations (coarse-grained, fine-grained, optimistic and lock-free synchronization).

Requisites: Requires a prerequisite course of ECEN 1310 or CSCI 1300 or CSCI 1320 (all minimum grade C-).

Grading Basis: Letter Grade

ECEN 4322 (3) Data and Network Science

The course covers the theory and design of algorithms that are used to model, analyze, and extract information from large scale datasets and networks. The course includes a project.

Requisites: Requires prerequisite courses of APPM 2350 or MATH 2400 and APPM 2360 or MATH 3430 and CSCI 1200 or CSCI 1300 or CSCI 1320 or ECEN 1310 or INFO 1201 or ATLS 1300 or CHEN 1310 and ECEN 2703 or CSCI 2824 or APPM 3170 or MATH 2001 (all minimum grade C-).

ECEN 4341 (3) Bioelectromagnetics

Effects of electric and magnetic fields on biological systems are described with applications to therapy and safety. The complexity of biological systems is described to provide a better understanding of the distribution of fields inside the body. Risk analysis is also introduced.

Equivalent - Duplicate Degree Credit Not Granted: ECEN 5341

Requisites: Requires prerequisite courses of ECEN 3400 and ECEN 3810 or APPM 3570 or MATH 4510 (all minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Bioengineering

ECEN 4423 (3) Chaotic Dynamics

Explores chaotic dynamics theoretically and through computer simulations. Covers the standard computational and analytical tools used in nonlinear dynamics and concludes with an overview of leading-edge chaos research. Topics include time and phase-space dynamics, surfaces of section, bifurcation diagrams, fractal dimension and Lyapunov exponents.

Equivalent - Duplicate Degree Credit Not Granted: CSCI 5446 and CSCI 4446 and ECEN 5423

Requisites: Requires prerequisite courses of APPM 1360 or MATH 2300 and ECEN 1310 or CSCI 1300 and PHYS 1110 (all minimum grade C-). Restricted to College of Engineering majors only.

Recommended: Prerequisites PHYS 1120 and CSCI 3656 and MATH 2130.

Additional Information: Departmental Category: Computer and Digital Systems

ECEN 4517 (3) Power Electronics and Photovoltaic Power Systems Laboratory

Focuses on analysis, modeling, design and testing of electrical energy processing systems in a practical laboratory setting. Studies power electronics converters for efficient utilization of available energy sources, including solar panels and utility. Experimental projects involve design, fabrication and testing of a solar power system.

Equivalent - Duplicate Degree Credit Not Granted: ECEN 5517

Requisites: Requires prerequisite course of ECEN 4797 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Power

ECEN 4532 (3) Digital Signal Processing Laboratory

Develops experience in code development, debugging and testing of real-time digital signal processing algorithms using dedicated hardware. Applications include filtering, signal synthesis, audio special effects and frequency domain techniques based on the Fast Fourier Transform.

Equivalent - Duplicate Degree Credit Not Granted: ECEN 5532

Requisites: Requires prerequisite course of ECEN 4632 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Digital Signal Processing Communications

ECEN 4553 (3) Compiler Construction

Introduces the principles and techniques for compiling high-level programming languages to assembly code. Topics include parsing, instruction selection, register allocation, and compiling high-level features such as polymorphism, first-class functions, and objects. Students build a complete compiler for a simple language.

Equivalent - Duplicate Degree Credit Not Granted: ECEN 5523 and CSCI 4555 and CSCI 5525

Requisites: Requires prerequisite courses of ECEN 2703 and ECEN 3350 (all minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Computer and Digital Systems

ECEN 4555 (3) Principles of Energy Systems and Devices

Develops principles underlying electronic, optical and thermal devices, materials and nanostructures for renewable energy. Provides a foundation in statistical thermodynamics and uses it to analyze the operation and efficiency limits of devices for photovoltaics, energy storage (batteries & ultra-capacitors), chemical conversion (fuel cells and engines), solid state lighting, heat pumps, cooling and potentially harvesting zero-point energy from the vacuum.

Equivalent - Duplicate Degree Credit Not Granted: ECEN 5555

Requisites: Requires prerequisite courses of ECEN 3810 or APPM 3570 or MATH 4510 and PHYS 2130 or PHYS 2170 (all minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Nanostructures and Devices

ECEN 4583 (3) Software System Development

Lectures deal with techniques for product requirements definition, project planning, coding, verification, validation, performance evaluation, and maintenance of medium-scale (2-3000 line) systems. Primary emphasis is on practical application of these techniques to a specified software project. Students work in teams to produce appropriate documents for each phase and are responsible for project completion according to specification and schedule. Course project is written in C on a Unix look-alike system; prior knowledge of C or Unix is not required.

Requisites: Requires prerequisite course of CSCI 2270 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Computer and Digital Systems

ECEN 4593 (3) Computer Organization

Studies computer design at the gate level. Discusses instruction set architecture design, arithmetic and logic unit design, control logic, memory design and caches, simple pipelining, I/O and peripheral devices. Briefly covers aspects of modern computer architecture, such as multicore processors and cache coherence for these.

Equivalent - Duplicate Degree Credit Not Granted: CSCI 4593

Requisites: Requires prerequisite course of ECEN 3350 or CSCI 2400 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Computer and Digital Systems

ECEN 4606 (3) Undergraduate Optics Laboratory

Introduces fundamental concepts, techniques, and technology of modern optical and photonic systems. Individual labs cover particular fields of optical technology, including light sources such as lasers and LEDs, interferometers, fiber-optic communications, photodetection, spectrometers, and holography. Practical skills such as how to align an optical system will also be emphasized.

Requisites: Requires prerequisite course of ECEN 3400 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Optics

ECEN 4610 (3) Capstone Laboratory Part 1

Hands-on laboratory experience utilizing teams in the systematic proposal, design, integration, and testing of an electronic/computer based system. Results will be the prototype of a stand-alone analog/digital system. Must have completed all required Advanced Analog Core courses for major, except one course may be taken concurrently by petition. Must take ECEN 4620 to complete the sequence. Minimum required grade for this course and ECEN 4620 is C-.

Requisites: Requires prerequisites of ECEN 2270 ECEN 3360 (ECEN 3250 3300) or (ECEN 3250 3400) or (ECEN 3300 3400) (all min grade C-). Restricted to ECEN or EEEN or C-EEEN or C-ECENEEN or C-EEENP or C-ECENEENP or GEEN-BSEPL majors only.

Additional Information: Departmental Category: General

ECEN 4616 (3) Optoelectronic System Design

Examines optical components and electro-optic devices with the goal of integrating into well design optoelectronic systems. Sample systems include optical storage, zoom lenses and telescopes.

Equivalent - Duplicate Degree Credit Not Granted: ECEN 5616

Requisites: Requires prerequisite course of ECEN 3400 (minimum grade C-).

Additional Information: Departmental Category: Optics

ECEN 4620 (3) Capstone Lab, Part 2

Hands-on laboratory experience for teams in the systematic proposal, design, build integration, test and documentation of an electronic/computer based system. Results will be a reliably operating, stand-alone analog/digital system, with publication quality technical documentation. Department enforced prerequisite: advanced analog core courses.

Requisites: Requires prerequisite course of ECEN 4610 (minimum grade C-). Restricted to Electrical and Computer Engineering (ECEN) or Electrical Engineering (EEEN) or ECEE concurrent (C-EEEN or C-ECENEEN) majors only.

Additional Information: Departmental Category: General

ECEN 4632 (3) Introduction to Digital Filtering

Covers both the analysis and design of FIR and IIR digital filters. Discusses implementations in both software and hardware. Emphasizes use of the FFT as an analysis tool. Includes examples in speech processing, noise canceling, and communications.

Requisites: Requires prerequisite course of ECEN 3300 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Digital Signal Processing Communications

ECEN 4634 (3) Microwave and RF Laboratory

Introduce RF and microwave measurement methods. A laboratory course whose experiments build on material learned in ECEN 3410: electromagnetic waves, transmission lines, waveguides, time-domain reflection, frequency-domain measurement, microwave networks, impedance matching, antenna pattern measurement, radar and simple nonlinear concepts such as harmonics, square-law detection, mixing and transmitter/receiver applications.

Equivalent - Duplicate Degree Credit Not Granted: ECEN 5634

Requisites: Requires prerequisite course of ECEN 3410 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Electromagnetics and Remote Sensing

ECEN 4638 (3) Control Systems Laboratory

Provides experience in control system design and analysis, using both real hardware and computer simulation. Covers the entire control system design cycle: modeling the system, synthesizing a controller, conducting simulations, analyzing the design to suggest modifications and improvements, and implementing the design for actual testing.

Requisites: Requires prerequisite course of ECEN 4138 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Dynamical Systems and Control

ECEN 4652 (3) Communication Laboratory

Analysis and design of realistic communication signals in a modern digital signal processing environment. Covers both analog and digital communication signals with and without noise and distortion. Pulse amplitude modulation is used initially at baseband and then combined with amplitude and phase/frequency modulation to produce the kind of bandpass signals that are used in cell phones and wireless data networks.

Requisites: Requires prerequisite course of ECEN 4242 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Digital Signal Processing Communications

ECEN 4753 (3) Computer Performance Modeling

Presents a broad range of system measurement and modeling techniques, emphasizing applications to computer systems. Covers topics including system measurement, workload characterization and analysis of data; design of experiments; queuing theory and queuing network models; and simulation.

Equivalent - Duplicate Degree Credit Not Granted: CSCI 5753 and CSCI 4753 and ECEN 5753

Requisites: Requires prerequisite course of CSCI 3753 (minimum grade C-). Restricted to College of Engineering majors only.

Recommended: Prerequisite a course in statistics.

Additional Information: Departmental Category: Computer and Digital Systems

ECEN 4797 (3) Introduction to Power Electronics

An introduction to switched-mode converters. Includes steady-state converter modeling and analysis, switch realization, discontinuous conduction mode and transformer-isolated converters. Ac modeling of converters using averaged methods, small-signal transfer functions, feedback loop design and transformer design.

Equivalent - Duplicate Degree Credit Not Granted: ECEN 5797

Requisites: Requires prerequisite course of ECEN 3250 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Power

ECEN 4827 (3) Analog IC Design

Covers the fundamentals of transistor-level analog integrated circuit design. Starting with motivations from application circuits, the course develops principles of dc biasing, device models, amplifier stages, frequency response analysis and feedback and compensation techniques for multi-stage operational amplifiers.

Equivalent - Duplicate Degree Credit Not Granted: ECEN 5827

Requisites: Requires prerequisite course of ECEN 3250 (minimum grade C-). Restricted to College of Engineering majors only.

Additional Information: Departmental Category: Power

ECEN 4840 (1-6) Independent Study

Offers an opportunity for seniors to do independent, creative work. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

Additional Information: Departmental Category: General

ECEN 4841 (1-6) Independent Study

Offers an opportunity for seniors to do independent, creative work.

Repeatable: Repeatable for up to 6.00 total credit hours.