ELECTRICAL AND COMPUTER ENGINEERING

The Electrical and Computer Systems Engineering department administers the ABET-accredited Bachelor of Science degree program in Electrical Engineering, as well as a graduate program granting the Master of Science in Electrical and Computer Engineering. The undergraduate electrical engineering program also offers a computer engineering option.

These programs support the mission of the University by providing students with appropriate curricula and educational experiences.

For the first year of study, all our engineering programs place major emphasis on the fundamentals of engineering and computer science, mathematics, and the basic sciences to provide the background for later engineering science and design courses. Following preparatory work, the fundamentals of electrical, computer, mechanical, and materials engineering concepts are developed. Advanced courses in electrical and computer engineering further develop knowledge in these engineering disciplines. Students may specialize in a specific area of interest to them, and in accord with their specific career objectives, by taking elective courses that provide depth in that area.

Programs

- Electrical Engineering Major (https://catalog.fairfield.edu/undergraduate/engineering/electrical-computer-engineering/bs-electrical-engineering)
    - Computer Engineering Option
- Electrical and Computer Engineering Five-Year Dual Degree Bachelor and Master of Science Program (https://catalog.fairfield.edu/undergraduate/engineering/electrical-computer-engineering/electrical-computer-engineering-five-year-dual-degree-bs-ms)

Courses

Computer Engineering

CR 0245 Digital Design I **3 Credits**
Corequisite: CR 0245L.
An introduction to computer hardware design. Topics include: digital design principles, Boolean algebra, combinational logic design, sequential logic design, registers, counters, memory, multiplexers, finite state machines, radix conversion, and programmable logic devices. Students learn to write, implement, and simulate elementary digital design.

CR 0245L Digital Design I Lab **1 Credit**
Fee: $80 Engineering Lab Fee
Corequisite: CR 0245.
This lab course covers the practical aspects of digital logic design. Students design and implement logic circuits using techniques taught in CR 0245. Students gain experience using state of the art design software and development boards, which use modern field programmable gate array (FPGA) technology.

CR 0246 Digital Electronics Design II **3 Credits**
Prerequisite: CR 0245.
This course examines computer architecture implemented using a hardware design language and programmable logic devices. Students learn the VHDL hardware description language, and learn to use modern design, simulation, and synthesis software. Students design, verify, build and test digital logic circuits using industry standard development boards, and field programmable gate array (FPGA) technology.

CR 0320 Computer Networks **3 Credits**
Prerequisites: CS 0131, MA 0351.
This course covers principles of networking and network programming. Topics include OSI layers, elementary queuing theory, protocol analysis, multi-threading, command-line interpreters, and monitors. Students write a distributed computing system and check their performance predictions with experiments.

CR 0325 Computer Graphics **3 Credits**
Prerequisite: CS 0131.
This course supports the visualization and computer systems domain, offering an introductory treatment to two-dimensional and three-dimensional computer graphics concepts. Students write computer games and employ their knowledge to imbue them with realism. High performance rendering uses the latest in cutting edge hardware-accelerated graphics processors.

CR 0331 Biomedical Signal Processing **3 Credits**
Prerequisites: CS 0131 or CS 0142 or SW 0407; MA 0146.
This course presents an overview of different methods used in biomedical signal processing. Signals with bioelectric origin are given special attention and their properties and clinical significance are reviewed. In many cases, the methods used for processing and analyzing biomedical signals are derived from a modeling perspective based on statistical signal descriptions. The purpose of the signal processing methods ranges from reduction of noise and artifacts to extraction of clinically significant features. The course gives each participant the opportunity to study the performance of a method on real, biomedical signals.

CR 0332 Biomedical Imaging **3 Credits**
Prerequisite: CR 0331.
The course presents the fundamentals and applications of common medical imaging techniques, for example: x-ray imaging and computed tomography, nuclear medicine, magnetic resonance imaging, ultrasound, and optical imaging. In addition, as a basis for biomedical imaging, introductory material on general image formation concepts and characteristics are presented, including human visual perception and psychophysics.

CR 0333 Biomedical Visualization **3 Credits**
Prerequisite: CS 0131.
This course is an introduction to 3-D biomedical visualization. Various technologies are introduced, including UltraSound, MRI, CAT scans, PET scans, etc. Students will learn about spatial data structures, computational geometry and solid modeling with applications in 3-D molecular and anatomical modeling.

CR 0346 Computer System Architecture **3 Credits**
Prerequisite: CR 0245.
This course introduces the machine language and various components of a computer hardware in modern computer systems. The course focuses on CPU, memory, bus, cache, I/O module, internal data representation, and instruction set design. It also covers pipelining, superscalar architecture, reduced instruction set computers, parallel architectures, and interconnection networks.

CR 0382 Independent Study **3 Credits**
This course includes supervised reading and research. Available only by pre-arrangement with the instructor.

Electrical Engineering

EE 0213 Introduction to Electric Circuits **3 Credits**
Prerequisites: MA 0146, PS 0116, PS 0116L.
This course introduces engineering students to the analysis of linear electric circuits. The course covers the basic laws of circuit behavior and analysis techniques, including descriptions of circuit elements and electronic variables, and considers circuit theorems and principles for insightful analysis of electrical circuits. The course introduces basic concepts and analysis of networks.

EE 0213L Electric Circuits Lab **1 Credit**
Fee: $80 Engineering Lab Fee
Corequisite: EE 0213.
Students use common electrical laboratory instruments (oscilloscopes, meters, and signal generators) and elemental circuit components to construct and analyze basic electrical circuits. They study the application of circuit theorems and circuit elements (RL and RC); conduct experiments with transient, steady state, and frequency response; and use software applications to simulate and analyze circuit performance.

EE 0221 Frequency Domain Circuit Analysis **3 Credits**
Prerequisites: MA 0245, EE 0213.
Students perform frequency domain analysis of passive and active circuits, study transient and AC circuit analysis manually and with computer-aided applications, and examine the transient response of first and second order circuits. The course introduces pole and zero concepts and applies them to circuit analysis, and introduces computer methods of circuit analysis and design.

EE 0231 Introduction to Electronics Circuits and Devices **3 Credits**
Prerequisite: EE 0213.
This first course in electronics teaches basic principles and technologies to understand, analyze, and design electronic circuits. The course reviews the properties of semiconductor materials used in the fabrication of diodes, bipolar junction transistors, and field effect transistors. Students analyze amplifier biasing techniques and develop circuit models of semiconductor devices that are used to analyze and design electronic circuits. Computer simulations of circuits are used to illustrate the fundamental principles.

EE 0231L Electronics Circuits Lab **1 Credit**
Fee: $80 Engineering Lab Fee
Corequisite: EE 0231.
Prerequisite: EE 0213L.
Students build and test circuits using diodes, bipolar junction transistors, and MOSFETs. They use the principles developed in EE 0231 to analyze, build, and test amplifier and oscillator circuits.

EE 0301 Signal and Systems I **3 Credits**
Corequisite: MA 0251.
Prerequisite: EE 0221.
This course studies and classifies continuous and discrete signals and systems. It presents time domain and discrete analysis of signals using the Fourier series, Laplace transforms, Fourier transforms, z-transforms, and fast Fourier transforms (e.g., differential equations, convolution, concept and meaning of impulse response); and examines frequency domain analysis, the Fourier series, and the Fourier transform as an alternative to time domain analysis. Students gain further insights into signal and system properties through the Laplace transform methods and the concept of the transfer function.

EE 0315 Nanoelectronics I **3 Credits**
Prerequisite: EG 0212.
Building on the two introductory courses in nanotechnology, this course is the first of two that describe how nanotechnology can be integrated into the electronics industry. The unique electrical, mechanical, and optical properties of structures in the nanometer range and how they may be applied to electronics products are discussed. Principles of electronic materials, semiconductor devices, and microfabrication techniques will be extended to the nanoscale. Students will increase their knowledge of electronic structure, quantum mechanics, and the behavior of optoelectronic and low-dimensional systems. Students make extensive use of the available literature to seek out potential applications of nanotechnology. Intended for students interested in the minor in nanotechnology/nanoelectronics track. Also open to interested graduate students in ECE.

EE 0331 Analog Electronics Design **3 Credits**
Prerequisites: EE 0221, EE 0231.
This advanced course in electronics examines high frequency response of bipolar junction transistor and field-effect transistor amplifiers using hybrid two-port active device models. Students consider the effect of feedback and frequency compensation techniques on the amplifier response and study a variety of analog circuits with respect to their analysis and applications, including active filters, oscillators, waveform generation and shaping, voltage regulator, and communication circuits. The course introduces basic power electronics device components.

EE 0331L Analog Electronics Lab **1 Credit**
Corequisite: EE 0331.
Prerequisite: EE 0231L.
This advanced lab provides insight into the functions of various application-specific electronic circuits. Experiments characterize functioning of various analog systems, such as oscillators, active filters, waveform generation and shaping circuits, and voltage regulator circuits.

EE 0335 Microelectronics **3 Credits**
Prerequisite: EE 0331.
This course covers three methods of fabricating high-density interconnection structures for manufacturing microelectronic assemblies: thick films, thin films, and printed circuit boards. The thick and thin film technologies use substrates of metalized ceramic to make the interconnections between components and are capable of fabricating integrated resistors with high precision and stability. The printed circuit board technology uses organic materials with copper laminates to etch the interconnection patterns. The individual layers are laminated to produce the multilayer structure, but do not include integrated resistors. Each of the technologies is examined to determine the electrical and physical properties of the structures. Such parameters as distributed capacitance and how they affect circuit performance are discussed. In the laboratory accompanying the course, students have the opportunity to fabricate thick and thin film circuits and to examine the structure of printed circuit boards.

EE 0346 Embedded Microcontrollers **3 Credits**
Prerequisite: CR 0245.
This course covers the architecture of microcontrollers, including how they are constructed internally and how they interface with external circuitry. Applications for microcontrollers in both complex and simple equipment are discussed. Students learn how to apply and how to select a microcontroller for a given application. Students will learn to program the microcontroller to develop programming skills. The software tools will be used to develop software code for practical applications such as servo motor control, sensor reading, and data display. An accompanying laboratory course covers the programming of microprocessors to do a specific task. An accompanying laboratory course covers the programming of microprocessors to do a specific task. This course covers the programming and application of the PIC microcontroller. Students are able to develop programming skills using assembly language and software tools such as MPLAB IDE and MultiSim MCU. These tools are used to develop software code for practical applications such as motor speed control and voltage regulation for power supplies.

EE 0346L Microcontroller Lab **1 Credit**
Fee: $80 Engineering Lab Fee
Corequisite: EE 0346.
This laboratory covers the basic operation and applications of a microcontroller. Students learn to program a microcontroller to control applications, such as motor speed, by the use of an emulator connected to a PC. They design a circuit using a microcontroller for a specific application and write a program to control the circuit. On completion of the program, they use the emulator to program an actual microcontroller for use in their circuits.

EE 0355 Sensor Design and Applications **3 Credits**
Prerequisite: EE 0213.
This course covers the design, fabrication, and properties of sensors intended to measure a variety of parameters, such as stress, temperature, differential pressure, and acceleration. Sensors of different types are used in a wide range of equipment, especially automated equipment, to detect changes in state and to provide the signals necessary to control various functions. Sensors are generally connected to electronics systems that process and distribute the signals. The support electronics must identify the signal, separate it from noise and other interference, and direct it to the appropriate point. These support electronics are a critical part of the sensor technology; students discuss their design and packaging in detail.

EE 0360 Power Electronics **3 Credits**
Prerequisites: EE 0301, EE 0221.
This course covers the design and operation of power electronics circuits, such as power supplies and motor controls. Using electronic circuit models for transistors and diodes developed in earlier courses, students analyze and design power circuits. Particular attention is paid to power dissipation and packaging. The accompanying laboratory course, EE 0360L, provides practical experience in conjunction with the lecture material.

EE 0361 Green Power Generation **3 Credits**
This course compares various methods of green power generation including solar power, wind power, water power, and several others. This course covers how power is generated from these sources, the startup costs, the efficiency, and the practicality. These methods are compared to the present most common method of using oil and gas to heat water into steam to turn turbines. The student does not necessarily need a background in engineering and any necessary background material will be covered to the understanding of all.

EE 0377 Power Security and Reliability **3 Credits**
Prerequisite: EE 0385.
This course focuses on Power System Protection and Relaying to allow the design of robust and reliable power systems. After reviewing the need for protection of power system elements (motors, generators, transformers, and transmission/distribution lines), the course: Explores developments in the creation of smarter, more flexible protective systems based on advances in the computational power of digital devices and the capabilities of communication systems that can be applied within the power grid, Examines the regulations related to power system protection and how they impact the way protective relaying systems are designed, applied, set, and monitored, Considers the evaluation of protective systems during system disturbances and describes the tools available for analysis, Addresses the benefits and problems associated with applying microprocessor-based devices in protection schemes' Contains an expanded discussion of internal protection requirements at dispersed generation facilities. MatLab is used to solve homework problems and do team design projects.

EE 0378 Electromagnetic Compatibility **3 Credits**
Prerequisites: EE 0231, EE 0301, PS 0271.
This course presents design techniques to minimize electromagnetic interference (EMI) from or to it. The various sources of Radio-frequency emissions from electronic systems, coupling paths for the transfer of undesired electromagnetic energy will be introduced. Electromagnetic Compatibility (EMC) requirements for electronic products will be presented along with techniques to measure EMI. High speed digital signal transmission integrity related issues and methods to overcome signal integrity will be introduced. Techniques to minimize conducted and radiated Emissions through filtering and grounding will be presented. System design for EMC will be presented.

EE 0379 Communication Systems **3 Credits**
Prerequisite: EE 0301.
This course focuses on analog and digital communication systems and the effects of noise on those systems. It includes analog modulation and demodulation techniques (amplitude, frequency, and phase modulation) and digital Modulation and demodulation techniques (ASK, FSK, PSK, PCM, and delta modulation). It discusses performance analysis of analog and digital communication systems under noise with applications of probability theory to the analysis. It discusses information measure, source coding, error correcting codes and Spread spectrum systems.

EE 0385 Power Generation and Distribution **3 Credits**
Prerequisite: EE 0221.
This course considers the generation and distribution of electrical power to large areas. Three-phase networks are described in detail, including both generators and loads. Methods of modeling distribution systems by per-unit parameters are covered, along with power factor correction methods. Fault detection and lightning protection methods are also described. Some economic aspects of power generation and distribution are presented.

EE 0386 Fault Analysis in Power Systems **3 Credits**
Prerequisite: EE 0385.
This course covers three types of faults in electrical power grids: open lines, lines shorted to ground, and lines shorted to each other. Methods of locating faults are covered along with an analysis of the effects of such faults. Methods of protection and fault isolation are also covered.

Faculty

Professors

Lyon

Associate Professors

Balaji

Assistant Professors

Belfadel

Professors of the Practice

Hoffman, *chair*

Lecturers

Cavallo
Fullman
Govil
Mathur
Romansky
Speretta
Wu