

# ELECTRICAL & COMPUTER ENGINEERING (ECE)

# Course numbers with the # symbol included (e.g. #400) have not been taught in the last 3 years.

## ECE 401 - Perspectives in Electrical and Computer Engineering

**Credits:** 4

An introductory course for electrical and computer engineering majors that introduces incoming students to the fundamental concepts of analysis and design. Concepts are presented through an examination of real-world problems. Students are introduced to electrical and computer engineering problem solving and design through active learning techniques in lecture and in a laboratory setting. Provides a context for the electrical engineering and computer engineering curriculum and introduces the profession and activities of electrical and computer engineering. Lab.

**Attributes:** Inquiry (Discovery)

## ECE 444 - Bionics: Technology from Nature

**Credits:** 4

Bionics is the study of living systems with the intention of applying their principles to the design of useful technology for mankind. Students learn strategies to discover bio-inspired technology. The student investigates the fields of bio-inspired cyborgs, defense and attack mechanisms in biology leading to military applications including non-lethal weapons, bio-inspired sensors including brain-computer interfaces, bio-inspired robots, and animal and plants that generate energy for technology. Writing Intensive. Lab.

**Attributes:** Biological Science(Discovery); Discovery Lab Course; Inquiry (Discovery); Writing Intensive Course

## ECE 537 - Introduction to Electrical Engineering

**Credits:** 0 or 4

Fundamentals of electrical engineering. Topics are circuit elements; signal waveforms; circuit laws and theorems; transfer functions; free, forced, and steady state responses; power calculations; amplifiers; and magnetic circuits. Non-ECE majors only. Prereq: PHYS 408. Pre- or Coreq: MATH 527. Lab.

**Equivalent(s):** EE 537

## ECE 541 - Electric Circuits

**Credits:** 0 or 4

Linear passive circuits beginning with resistive circuits, power and energy relations, mesh and node analysis. Transient and steady-state behavior of simple circuits containing energy storage elements (capacitors, inductors). Introduction to linear active circuits using dependent source models and ideal op amps. Introduction to transfer function and frequency response concepts. For ECE majors only. Pre- or Coreq: MATH 426; PHYS 408. Lab.

**Equivalent(s):** EE 541

## ECE 543 - Introduction to Digital Systems

**Credits:** 0 or 4

Fundamental analysis and design principles. Number systems, codes, Boolean algebra, and combinational and sequential digital circuits. Lab: student-built systems using modern integrated circuit technology and an introductory design session on a CAD workstation. Lab.

**Equivalent(s):** EE 543

## ECE 548 - Electronic Design I

**Credits:** 0 or 4

Introduction to electronic design for analog signal processing. Linear op amp circuits for amplification and filtering. Use of Laplace techniques for filter specification; simple passive and op amp filter realizations. Discrete active devices (FET and BJT): operating characteristics, biasing considerations, canonical amplifier configurations including differential amplifiers. Prereq: ECE 541. Lab.

**Equivalent(s):** EE 548

## ECE 562 - Computer Organization

**Credits:** 0 or 4

Basic computer structure, including arithmetic, memory, control, and input/output units; the trade-offs between hardware, instruction sets, speed, and cost. Laboratory experiments involving machine language programming and I/O interfacing using microcomputers. Prereq: CS 410 or CS 415; ECE 543. Lab.

## ECE 583 - Designing with Programmable Logic

**Credits:** 4

Design methodologies for implementing digital systems in programmable logic. Covers topics related to the design, implementation, and testing of programmable logic devices. Students are introduced to the Very-High-Speed Hardware Description Language (VHDL) entry language and simulation procedures, along with common logic synthesis tools. Programmable logic families, device architectures, and testing procedures are covered in detail. Laboratory exercises lead the student through the complete programmable logic design cycle. Each student is required to prototype a digital system starting with VHDL entry, functional and timing simulations, logic synthesis, device programming, logic probing, and systems verification. Prereq: ECE 562. Lab.

**Equivalent(s):** ECE 523, EE 523

## ECE 602 - Engineering Analysis

**Credits:** 4

Analyze and solve engineering problems using linear algebra and integral and differential calculus of functions of several variables. Boundary-value problems in mechanics, fluid dynamics, and electrostatics. Examination of electrostatics, magnetostatics, and fluid and wave mechanics using vector differential and integral calculus. Introduction of approximation and error analysis methods as fundamental engineering tools. Prereq: MATH 527. Pre- Coreq: MATH 645.

**Equivalent(s):** ECE 544, EE 544

## ECE 603 - Electromagnetic Fields and Waves I

**Credits:** 4

Maxwell's equations in integral and differential form with applications to static and dynamic fields. Uniform plane waves in free space and material media. Boundary conditions; simple transmission line theory; parallel plate and rectangular waveguides; simple radiating systems. Prereq: PHYS 408; ECE 602.

**Equivalent(s):** ECE 667, EE 603

## ECE 617 - Junior Laboratory I

**Credits:** 0 or 4

Application of laboratory instrumentation to the investigation of active and passive circuit characteristics; introduction to computer-aided design, analysis, and testing; development of report writing and oral presentation skills. Pre- or Coreq: ECE 633; ECE 651. Writing intensive.

**Attributes:** Writing Intensive Course

**Equivalent(s):** EE 617

**ECE 618 - Junior Laboratory II****Credits:** 0 or 4

Laboratory exercises in the design and analysis of active circuits, techniques of signal processing, and the properties of distributed circuits. Continued development of report writing and oral presentation skills. Prereq: ECE 617. Pre- or Coreq: ECE 603. Writing intensive.

**Attributes:** Writing Intensive Course**Equivalent(s):** EE 618**ECE 633 - Signals and Systems I****Credits:** 3

Mathematical characterization of continuous-time systems using time- and frequency-domain concepts. Properties of linear systems described by ordinary differential equations. Fourier analysis of signals and system frequency response functions. Applications to communication and control systems. Introduction to system simulation using computer methods. Prereq: MATH 527. Pre- or Coreq: MATH 645.

**Equivalent(s):** ECE 633H, EE 633**ECE 633H - Signals and Systems I/Honors****Credits:** 4

Mathematical characterization of continuous-time systems using time- and frequency-domain concepts. Properties of linear systems described by ordinary differential equations. Fourier analysis of signals and system frequency response functions. Applications to communication and control systems. Introduction to system simulation using computer methods. Honors students will attend an additional one-hour meeting each week. Prereq: MATH 527. Pre- Coreq: MATH 645. permission required.

**Attributes:** Honors course**Equivalent(s):** EE 633, EE 633H**ECE 634 - Signals and Systems II****Credits:** 3

Transient response analysis of linear systems using Laplace transforms, application to feedback control systems. Introduction to discrete-time linear systems; system response determination using Z-transform; elementary design of digital filters and controllers. State variable formulation of dynamical systems. Prereq: ECE 633.

**Equivalent(s):** EE 634**ECE 647 - Random Processes and Signals in Engineering****Credits:** 0 or 3

Emphasis on applied engineering concepts such as component failure, quality control, noise propagation. Topics include random variables, probability distributions, mean and variance, conditional probability, correlation, power spectral density. Prereq: MATH 426; ECE 602.

**Equivalent(s):** EE 647**ECE 647H - Random Processes and Signals/Honors****Credits:** 4

Emphasis on applied engineering concepts such as component failure, quality control, noise propagation. Topics include random variables, probability distributions, mean and variance, conditional probability, correlation, power spectral density. Honors students attend an additional one-hour meeting each week. Prereq: MATH 426; ECE 602, permission required.

**Attributes:** Honors course**ECE 649 - Embedded Microcomputer Based Design****Credits:** 4

An in-depth treatment of the design of embedded microcomputer systems. Topics include advanced architectures for embedded processors, hardware and software aspects of interfacing, handling interrupts, advanced programming including debugging of real time systems, embedded application implementations. Laboratory studies are required to reinforce theoretical and applied concepts in an actual embedded architecture. Prereq: ECE 583. Lab.

**ECE 651 - Electronic Design II****Credits:** 4

Design of fundamental circuit blocks in electronic systems. Multistage amplifiers; feedback systems and stability; power amplifiers. Nonlinear electronic circuits: oscillators, function generators; clippers and peak detectors; A/D and D/A conversion. Switching mode and logic circuits. Prereq: ECE 548.

**Equivalent(s):** EE 651**ECE 704 - Electromagnetic Fields and Waves II****Credits:** 4

Provides an overview of electromagnetics modeling by covering commonly-used numerical solutions to electromagnetics problems. Computational approaches to be covered include the Method of Moments (MoM) for both static and dynamic fields, iterative solutions to Laplace's equations. Finite Element Methods, high-frequency solutions, and the Finite-Difference, Time-Domain techniques (FDTD). Prereq: ECE 603.

**Equivalent(s):** EE 704**ECE #711 - Digital Systems****Credits:** 0 or 4

Principles, procedures and tools related to the design, implementation and testing of microprocessor-based embedded systems. Students prototype a complete embedded system using CAD tools, application specific integrated circuits, printed circuit board technology, and modern diagnostic/testing procedures and tools. Projects are designed to introduce diverse digital technologies. Lab.

**Equivalent(s):** EE 711**ECE 714 - Introduction to Digital Signal Processing****Credits:** 0-4

Introduction to digital signal processing theory and practice, including coverage of discrete time signals and systems, frequency domain transforms and practical spectral analysis, digital filter terminology and design, and sampling and reconstruction of continuous time signals. Laboratory component providing an introduction to DSP design tools and real-time algorithm implementation. Prereq: ECE 634. Lab.

**Equivalent(s):** ECE 714H, EE 714**ECE 715 - Introduction to VLSI****Credits:** 4

Principles of VLSI (Very Large Scale Integration) systems at the physical level. CMOS circuit and logic design, CAD tools, CMOS system case studies. Students exercise the whole development cycle of a VLSI chip: design and layout with the up-to-date commercial EDA tools. An IA (continuous grading) grade is given at the end of semester I. Lab.

**ECE 717 - Introduction to Digital Image Processing****Credits:** 0 or 4

Digital image representation; elements of digital processing systems; multidimensional sampling and quantization; image perception by humans, image transformations including the Fourier, the Walsh, and the Hough Transforms; image enhancement techniques including image smoothing, sharpening, histogram equalization, and pseudo color processing; image restoration fundamentals; image compression techniques, image segmentation and use of descriptors for image representation and classification. Prereq: ECE 634; ECE 647. Lab.

**Equivalent(s):** EE 717**ECE 724 - Ubiquitous Computing Fundamentals****Credits:** 4

Ubiquitous computing, or ubicomp, explores embedded, interconnected computing devices that are part of everyday objects and activities. This course takes an interdisciplinary look at the foundations of ubiquitous computing. Topics include software and hardware for ubicomp, human-computer interaction in ubicomp, and issues related to privacy and security in ubicomp. Students undertake a research project inspired by the material. Registration by permission only.

**ECE 757 - Fundamentals of Communication Systems****Credits:** 0 or 4

Spectra of deterministic and random signals; baseband and bandpass digital and analog signaling techniques; transmitter and receiver architectures; performance analysis of digital and analog signaling in additive noise channels; carrier and symbol timing synchronization methods. Prereq: ECE 634; ECE 647. Lab.

**Equivalent(s):** EE 757**ECE 772 - Control Systems****Credits:** 0 or 4

Development of advanced control system design concepts such as Nyquist analysis; lead-lag compensation; state feedback; parameter sensitivity; controllability; observability; introduction to non-linear and modern control. Includes interactive computer-aided design and real-time digital control. Prereq: ECE 634. Lab. (Also offered as ME 772.)

**Equivalent(s):** EE 772, ME 772**ECE 775 - Applications of Integrated Circuits****Credits:** 0 or 4

Design and construction of linear and nonlinear electronic circuits using existing integrated circuits. Limitations and use of operational amplifiers. Laboratory course in practical applications of non-digital integrated circuit devices. Prereq: ECE 651. Lab.

**Equivalent(s):** EE 775**ECE 784 - Biomedical Instrumentation****Credits:** 4

Principles of physiological and biological instrumentation design including transducers, signal conditioning, recording equipment, and patient safety. Laboratory includes the design and use of instrumentation for monitoring of electrocardiogram, electromyogram, electroencephalogram, pulse, and temperature. Current research topics, such as biotelemetry, ultrasonic diagnosis, and computer applications. Prereq: ECE 651. Lab.

**Equivalent(s):** EE 784**ECE 791 - Senior Project I****Credits:** 2

First semester of the capstone design experience. Topics include creativity, design methodology, specification development, project management, ethics, safety, reliability and preparation for oral and written reports. Students develop project plans, and prepare and present written and oral project proposals. The project plans must include aspects of design, implementation and evaluation. At the end of the semester, students prepare a written progress report. Prereq: ECE senior standing. Writing intensive.

**Attributes:** Writing Intensive Course**Equivalent(s):** ECE 791H**ECE 791H - Senior Honors Project I****Credits:** 4

First semester of the capstone honors senior thesis research. Topics include creativity, design methodology, specification development, project management, ethics, safety, reliability and preparation for oral and written reports. Students develop project plans, and prepare and present written and oral project proposals. The project plans must include aspects of design, implementation and evaluation, similar to ECE 791. However, honors thesis research must also include independent research beyond the normal scope of ECE 791. At the end of the semester students prepare a written progress report. Prereq: ECE senior standing, permission required. Writing intensive.

**Attributes:** Honors course; Writing Intensive Course**Equivalent(s):** ECE 791**ECE 792 - Senior Project II****Credits:** 2

This course requires the completion of the capstone design experience begun in ECE 791. At the end of the semester students prepare written final project reports, and present their results in a research poster session. Prereq: ECE 791. Writing intensive.

**Attributes:** Writing Intensive Course**Equivalent(s):** ECE 792H**ECE 792H - Senior Honors Project II****Credits:** 4

This course requires the completion of the capstone honors thesis research begun in ECE 791H. At the end of the semester students prepare honors theses, and present their research results in a research poster session. ECE 791H/792H fulfills the requirement of one professional elective. Prereq: ECE 791H, permission required. Writing intensive.

**Attributes:** Honors course; Writing Intensive Course**Equivalent(s):** ECE 792**ECE 795 - Electrical and Computer Engineering Projects****Credits:** 1-4

Laboratory course. Student undertakes a project of mutual interest with an ECE faculty advisor. A written final report must be filed with the ECE Department. Prereq: permission.

**Equivalent(s):** EE 795**ECE 796 - Special Topics****Credits:** 1-4

New or specialized courses and/or independent study. Prereq: permission. 1 to 4 credits some sections may use credit/fail grading.

**Equivalent(s):** EE 796