

# ELECTRICAL & COMPUTER ENGINEERING (ECE)

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

## **ECE 804 - 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).

**Equivalent(s):** EE 804

## **ECE 811 - Digital Systems**

**Credits: 4**

Principles and 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 811

## **ECE 814 - Introduction to Digital Signal Processing**

**Credits: 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. Lab.

**Equivalent(s):** EE 814

## **ECE 815 - 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.

**Equivalent(s):** EE 815

## **ECE 817 - Introduction to Digital Image Processing**

**Credits: 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. Lab.

**Equivalent(s):** EE 817

## **ECE 824 - 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.

## **ECE #834 - Network Data Communications**

**Credits: 4**

Introduces the basic concepts related to data transmission equipment and physical interfaces, data communication protocols, and the Open Systems Interconnection (OSI) Reference Model. Course material focuses on the physical, layer hardware, signaling schemes, protocol packets, computer interfaces, error detection, and signal integrity. Data transmission protocols relative to both wired and wireless networks. An introduction to both local and wide-area networks, and how a networking system is constructed, tested, and managed. Network design and testing exercises reinforce the material presented in course lectures. Lab.

## **ECE 857 - 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, performing analysis of digital and analog signaling in additive noise channels, carrier and symbol timing synchronization methods. Lab.

**Equivalent(s):** EE 857

## **ECE 858 - Communication System Design**

**Credits: 4**

System and circuit level design and implementation of communication hardware including: mixers, RF amplifiers, filters, oscillators and frequency synthesizers, modulators and detectors, carrier and symbol timing recovery subsystems. Issues in software-defined radio transmitter and receiver implementation. Communication link engineering including antenna selection and channel impairment effects. Lab.

**Equivalent(s):** EE 858

## **ECE #860 - Introduction to Fiber Optics**

**Credits: 4**

Basic physical and geometric optics; solution of Maxwell's equations for slab waveguides and cylindrical waveguides, of both step index and graded index profiles; modes of propagation and cutoff; polarization effects; ground and phase velocity; ray analysis; losses; fabrication; sources; detectors; couplers; splicing; cabling; applications; system design. Lab.

**Equivalent(s):** EE 860

## **ECE 872 - Control Systems**

**Credits: 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. (Also offered as ME 872.) Lab.

**Equivalent(s):** EE 872, ME 872

**ECE 875 - 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. Lab.

**Equivalent(s):** EE 875

**ECE 884 - 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. Lab.

**Equivalent(s):** EE 884

**ECE 896 - Special Topics in Electrical or Computer Engineering**

**Credits:** 1-4

New or specialized courses and/or independent study. Some sections may use credit/fail grading.

**Equivalent(s):** EE 896

**ECE 899 - Master's Thesis**

**Credits:** 1-6

May be repeated up to a maximum of 6 credits. Cr/F.

**Repeat Rule:** May be repeated for a maximum of 6 credits.

**Equivalent(s):** EE 899

**ECE 900A - Research and Development from Concept to Communication I**

**Credits:** 2

The course will introduce students to the general tools of scientific research and technical development. The course will also introduce students to tools and practices for reading, writing and reviewing documents that describe completed or proposed scientific research and technical development, as well as tools and practices for giving oral presentations about such documents to different types of audiences. Part one of a two course sequence.

**Repeat Rule:** May be repeated for a maximum of 4 credits.

**Equivalent(s):** ECE 900

**ECE 900B - Research and Development from Concept to Communication 2**

**Credits:** 2

The course will introduce students to the general tools of scientific research and technical development. The course will also introduce students to tools and practices for reading, writing and reviewing documents that describe completed or proposed scientific research and technical development, as well as tools and practices for giving oral presentations about such documents to different types of audiences. Part two of a two course sequence.

**Repeat Rule:** May be repeated for a maximum of 4 credits.

**Equivalent(s):** ECE 900

**ECE 901 - Electromagnetic Wave Theory I**

**Credits:** 3

Maxwell's equations; plane wave propagation; reflection and refraction; guided wave propagation; waveguides; simple resonators; elements of microwave circuits, linear and aperture antennas, arrays of dipoles; receiving antennas.

**Equivalent(s):** EE 901

**ECE 903 - Antennas**

**Credits:** 3

This course covers the fundamentals of antenna theory, and how to use and understand a contemporary computer modeling tool to analyze and design antennas or other types of microwave devices. Participants in the class are expected to complete a radiation-related project, whether it be a modeling project or a project involving the construction and analysis of an actual antenna (team efforts are encouraged as well).

**ECE 915 - Advanced Active Circuits**

**Credits:** 3

Investigation of devices and techniques used in advanced circuit design using discrete solid-state devices and integrated circuits. Oscillators, phase-lock systems, low noise techniques, etc.

**Equivalent(s):** EE 915

**ECE 920 - Wireless Communication Systems**

**Credits:** 3

Principles of wireless communication systems including analysis of radio wave propagation and modeling, large scale and small scale signal fading, cellular communication architectures, multi-access systems, advanced modulation techniques, signal diversity systems, multiple antenna communications, cognitive radio, and software defined radio.

**ECE 924 - Ubiquitous Computing**

**Credits:** 3

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 ubiquitous computing through the review of recent research literature. Topics include the visions of ubicomp and some of its applications, software and hardware for ubicomp, human-computer interaction, context awareness, privacy, and security. Students undertake a ubicomp research project inspired by the literature review.

**ECE 939 - Statistical Theory of Communications**

**Credits:** 3

Introduction to probability theory and random waveforms leading to a discussion of optimum receiver principles. Topics include random variables, random processes, correlation, power spectral density, sampling theory, and optimum decision rules.

**Equivalent(s):** EE 939

**ECE 940 - Information Theory**

**Credits:** 3

Introduction to information theory concepts. Topics include message sources, entropy, channel capacity, fundamentals of encoding, Shannon's theorems. Prereq: ECE 939 or permission.

**Equivalent(s):** EE 940

**ECE 941 - Digital Signal Processing**

**Credits:** 3

Discrete-time stochastic signals, signal modeling, parameter estimation, optimal filtering and decision making, with application to adaptive filters, echo cancellation, channel equalization and parametric spectral estimation. Requires prior coursework in discrete-time LTI systems, analysis and design of recursive and non-recursive linear digital filters, and Fourier based spectral estimation.

**Equivalent(s):** EE 941

**ECE 944 - Nonlinear Control Systems****Credits:** 4

Analysis and design of nonlinear control systems from the classical and modern viewpoints. Liapunov's stability theory, phase space methods, linearization techniques, simulation, frequency response methods, generalized describing functions, transient analysis utilizing functional analysis, and decoupling of multivariable systems. (Also offered as ME 944.)

**Equivalent(s):** EE 944, ME 944**ECE 951 - Advanced Control Systems I****Credits:** 3

State-space representation of multivariable systems, analysis using state transition matrix. Controllability and observability, pole placement using state and output feedback, Luenberger observers. Introduction to computer-controlled systems (sampling, discrete state representation, hybrid systems), nonlinear analysis (Liapunov, Popov, describing function). (Also offered as ME 951.)

**Equivalent(s):** EE 951, ME 951**ECE 952 - Advanced Control Systems II****Credits:** 3

Special topics in control theory: continuous and discrete systems; optimal control systems, including calculus of variations, maximum principle, dynamic programming, Weiner and Kalman filtering techniques, stochastic systems, and adaptive control systems. (Also offered as ME 952.)

**Equivalent(s):** EE 952, ME 952**ECE 960 - Computer Architecture****Credits:** 3

Advanced topics in computer organization. Parallel and pipeline processing, associative and stack computers, microprogramming, virtual memory, current topics.

**Equivalent(s):** EE 960**ECE #961 - Test Engineering and Testable Design****Credits:** 3

Circuit failures, fault models, test pattern generation, logic and fault simulation. Parametric, structural, and functional characterization of components and subsystems. Test methods, strategies, planning, and economics. Design for testability, scan design, test interfaces, design for built-in self-test (BIST), and design for manufacturability. Test equipment hardware and software. Lab.

**ECE 965 - Introduction to Pattern Recognition****Credits:** 3

Machine classification of data, feature space representation, multispectral feature extraction, Bayes decision theory, linear discrimination functions, parameter estimation, supervised and unsupervised learning, clustering, scene analysis, associative memory techniques, and syntactic methods of recognition.

**Equivalent(s):** EE 965**ECE 966 - Robust Integrated Circuit Design and Verification****Credits:** 3

This course covers the typical hardware failure causes, error control coding theories and their application in integrated circuit designs, fault tolerance techniques, hardware Trojan detection methods, and the principles of secure chip design. Prereq: Digital Circuits, Computer Organization.

**ECE 992 - Advanced Topics in Electrical Engineering****Credits:** 1-3

Example of a recent topic: analog VLSI design. May be repeated.

**Equivalent(s):** EE 992**ECE 993 - Advanced Topics in Computer Engineering****Credits:** 1-3

Example of recent topic: wireless communication networks. May be repeated.

**Equivalent(s):** EE 993**ECE 994 - Advanced Topics in Systems Engineering****Credits:** 1-4

Examples of recent topics: neural networks, advanced digital telecommunications. May be repeated.

**Equivalent(s):** EE 994**ECE 998 - Independent Study****Credits:** 1-3

Independent theoretical and/or experimental investigation of an electrical engineering problem under the guidance of a faculty member.

**Equivalent(s):** EE 998**ECE 999 - Doctoral Research****Credits:** 0

Cr/F.

**Equivalent(s):** EE 999