

Electrical Engineering Course Descriptions

Course Title: Digital Signal Processing (ECEU666)

Course

Description: Presents the theory and practice of digital signal processing. Topics include review of discrete-time signals, systems, and the Z-transform; sampling and quantization; Fourier transforms (DTFT, DFT, and FFT) with applications to fast convolution; design techniques for FIR and IIR digital filters; realization structures for digital filters and finite precision effects; fundamentals of multirate signal processing and filter-banks; and DSP applications.

Course Title: Lab for ECE U666(ECEU667)

Course

Description: Accompanies ECE U666. Focuses on practical aspects of DSP by programming a digital signal processing chip in a high-level language using an integrated development and debugging environment. Topics include input/output operations via A/D and D/A converters, digital frequency synthesis, computation of discrete-time convolution, and design and implementation of both FIR and IIR filters.

Course Title: Electrical and Computer Engineering Capstone 2(ECEU792)

Course

Description: Continues ECE U790. Requires students to design and implement the project proposed in that earlier course. Expects students to evaluate progress with interim milestone reports and to present the final design project with written and oral reports.

Course Title: Professional Issues in Engineering(ECEU500)

Course

Description: Provides students with an opportunity to reflect on both academic and co-op experiences in the context of planning for the senior year and beyond. Issues include professional and ethical issues, resolving ethical conflicts, awareness of engineers as professionals in a diverse world, strengthening decision-making skills, career portfolios, and lifelong learning needs, goals, and strategies. Students reflect upon issues of diversity from their experience in the University and in their cooperative education placements. Explores the role of different work and learning styles and diverse personal characteristics on the workplace and the classroom. Professional issues include impact of the cultural context, both in the United States and around the world, on the client, government relations, and the workplace.

Course Title: Microwave Circuits and Networks(ECEU644)

Course

Description: Addresses novel applications of analytical and engineering techniques for RF/microwave circuits and networks. Presents fundamental concepts, essential mathematical formulas and theorems, and engineering applications. Emphasizes transmission lines and smith charts, microstrip lines, S-parameters and network theory, impedance matching and tuning, and novel RF devices such as resonators, power dividers, and filters. Introduces active networks. Provides ample examples to ensure that the participants fully appreciate the power of the materials described in the class.

Course Title: Communications Systems(ECEU572)

Course

Description: Introduces basic concepts of digital communication over additive white Gaussian noise (AWGN) channels. Reviews frequency domain signal analysis through treatment of noiseless analog communication. Reviews foundations of stochastic processes including stationarity, ergodicity, autocorrelation, power spectrum, and filtering. Provides an introduction to lossless and lossy source coding and introduces Huffman and Lempel-Ziv algorithms. Introduces optimal quantization and PCM and DPCM systems. Examines geometric representation of signals and signal space concepts, principles of optimum receiver design for AWGN channels, correlation and

matched filter receivers, and probability of error analysis for binary and M-ary signaling through AWGN channels, and performance of ASK, PSK, FSK, and QAM signaling schemes. If time permits, also covers digital PAM transmission through band-limited AWGN channels, zero ISI condition, system design in the presence of channel distortion, and equalization techniques.

Course Title: **Electrical and Computer Engineering Capstone 1(ECEU790)**

Course Description: Requires students to select a project requiring design and implementation of an electrical, electronic, and/or software system, form a team to carry out the project, and submit and present a detailed proposal for the work. Students must specify the materials needed for their project, provide cost analysis, and make arrangements with their capstone adviser to purchase and/or secure donation of equipment. Requires student to perform a feasibility study by extensive simulation or prototype design of subsystems to facilitate the second phase of the capstone design.

Course Title: **Electronics(ECEU402)**

Course Description: Introduces methods of design and analysis of modern electronic circuits. Focuses on using large- and small-signal models to understand the behavior of transistors as amplifiers and switches. Briefly introduces operation of the principal semiconductor devices: diodes, field-effect transistors, and bipolar junction transistors. Analog electronics topics extend to the frequency response of transistor amplifiers and the use of cascaded amplifiers to increase gain and bandwidth. Digital electronics topics include NAND and NOR CMOS logic gates, dynamic power dissipation, gate delay, and fan-out.

Course Title: **Lab for ECE U402(ECEU403)**

Course Description: Accompanies ECE U402. Includes experiments on characterization of diodes, BJTs, and MOSFETS and on design of circuits using these components. The circuits include multistage amplifiers and photoswitches.

Course Title: **Noise and Stochastic Processes(ECEU468)**

Course Description: Discusses probability, random variables, random processes, and their application to noise in electrical systems. Begins with the basic theory of discrete and continuous probabilities, then develops the concepts of random variables, random vectors, random sequences, and random processes. Continues with a discussion on the physical origins of noise and models of where it is encountered in electronic devices, signal processing, and communications. Defines the concepts of correlation, covariance, and power density spectra and uses them to analyze linear system operations in continuous time.

Course Title: **Wireless Communication Circuits(ECEU574)**

Course Description: Explores analog radio electronics through the design and construction of a 7 MHz radio transceiver (the NorCal 40A). Offers an overview of radio designs and components. Describes the phasor analysis of series and parallel resonant circuits. Presents transmission line concepts including phasor analysis for waves, the telegraphist's equations, dispersion, resonance, quality factor, and lines with loads. Introduces radio filter designs including ladder filters, band-pass filters, as well as filters using crystals and impedance inverters. Introduces working concepts of transformers and speakers. Describes transistor switches and Class B, C, D, E, and F amplifiers. Presents the fundamentals of oscillators and mixers. Also discusses antennas and propagation fundamentals including impedance, Friis's formula, and reciprocity. Dipole and whip antennae are used as practical examples.

Course Title: Computer Architecture and Organization(ECEU324)

Course Description: Presents a range of topics that include assembly language programming, number systems, data representations, ALU design, compilation, and the hardware/software interface. Offers students the opportunity to program using assembly language and to use simulators and debugging tools. Covers the architecture of modern high-performance processors including datapath design, caching, memory management, I/O, pipelining, superscalar execution, multimedia extensions, and storage systems. Discusses the metrics and benchmarking techniques used for evaluating power and performance.

ECE 1360 Electromagnetic Fields and Waves

4 QH

Introduces electromagnetics and high frequency applications. Topics covered include: (1) transmission lines: transmission line model with distributed circuit elements, transmission line equations and solutions, one-dimensional traveling and standing waves, and applications; (2) electromagnetic field theory: Lorentz force equation, Maxwell's equations, Poynting theorem and application to the transmission line's TEM waves. Also, uniform plane wave propagation along a coordinate axis and along an arbitrary direction; equivalent transmission lines for TEM, TE, and TM waves; reflection and refraction of uniform plane waves by conducting and dielectric surfaces. Discusses applications to waveguides, resonators, and optical fibers; and radiation and elementary antennas. Introduces modern techniques (computational methods) and applications (optics, bioelectromagnetics, electromagnetic effects in high-speed digital systems). Prereq. MTH1223 and PHY1223 or equivalents. ECE1227 must be taken concurrently.

ECE 1333 Discrete Systems

4 QH

Begins with a discussion of A/D and D/A conversion, including aliasing and quantization. Discusses the analysis and realization of linear shift-invariant systems. Presentation includes such topics as convolution, causality, stability, DF-1 and DF-2 realization, system interconnections, and the system sinusoidal response. Presents Discrete-Time Fourier Series, the Discrete-Time Fourier Transform, and the Z-Transform. Lastly, the z-plane view is used to analyze system gain and phase-shift, causality, and stability. Prereq. ECE1246 and MTH1223. ECE1226 must be taken concurrently.

ECE 1227 Electromagnetic Fields Laboratory

1 QH

Supports class material related to microwave transmission and radiation. Experiments include microwave transmission line measurements and the determination of the properties of dielectric materials; transmission line electrical length measurement; reflection and impedance measurements of dipole antenna; frequency characteristics of antennas and waveguides; antenna mutual coupling; and radiation pattern determination. ECE1360 must be taken concurrently.

ECE 1226 Discrete Systems Laboratory

1 QH

Consists of four experiments that are closely integrated with the ECE1333 course lectures. The first two experiments are concerned with A/D aliasing and quantization, the third with gain and phase-shift, and the fourth with the Discrete-Time Fourier Transform. ECE1333 must be taken concurrently

ECE 1382 Digital Logic Design

4 QH

Discusses the implementation of digital systems at the logic gate level. Covers Boolean logic, logic minimization, combinational design, sequential circuits, state machines, datapath design, and finite state machine design. Students use commercial CAD logic tools to design and simulate circuits, building up to the design of a simple calculator. Prereq. GE1101 or C programming ability. ECE1229 must be taken concurrently.

ECE 1246 Circuits 2

4 QH

Presents the unilateral Laplace transform as a technique for solving differential equations with initial conditions that model linear circuit behavior, followed by the introduction of Laplace transform equivalent circuit models. Uses s-domain analysis for the solution of linear circuit problems, including node-voltage and mesh-current methods. Covers several topics connected to the use of network functions including pole/zero plots, frequency response, and a brief treatment of the synthesis of circuits to match given transfer functions. Considers circuits in the sinusoidal steady-state, first introducing phasor representations, then applying phasors to analyze resonance, ideal and linear transformers, and complex power and three-phase systems. Prereq. ECE1215, ECE1171, or ECE1178. ECE1241 must be taken concurrently.

ECE 1241 Circuits Laboratory

1 QH

Covers experiments reinforcing basic circuit theory topics such as equivalent circuits, voltage/current divider applications, potentiometers or the Wheatstone bridge, experimental verification of network theorems, operational amplifier behavior, and/or response of RL, RC, and RLC circuits. Prereq. ECE1215. ECE1246 must be taken concurrently.

ECE 1229 Digital Systems Laboratory

1 QH

Introduces aspects of the design of digital hardware design. During the quarter students implement a digital calculator. Covers skills such as combinational logic, sequential logic, and finite-state machine design. Students use computer-aided logic design tools and field programmable logic to implement their designs. ECE1382 must be taken concurrently.

ECE 1240 Introduction to Electrical Engineering Laboratory

1 QH

Provides a hands-on introduction to electronic circuits, devices, measurement techniques, and simulation studies. Emphasis is on active learning-by-doing. Students will design, assemble, and test a working electronic system and perform simulations to study electrical engineering concepts related to this system. Prereq. GE1102 and PHY1223 or equivalent.

ECE 1215 Circuits 1

4 QH

Introduces the basic laws and the basic signal and device models used in the study of linear circuits. Topics include basic circuit analysis with resistive networks, including node-voltage and mesh-current analysis, and the Thevenin and Norton Theorems. Introduces three-terminal and dependent source models, including the ideal operational amplifier model and related circuits. Discusses various common signal models, including step functions, exponentials and sinusoids, and the analysis of first- and second-order circuits and the solution of related differential equations. Prereq. MTH1125 and PHY1223 or equivalent. ECE1240 and MTH1225 must be taken concurrently.