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Undergraduate Bulletin

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Course Descriptions - Electrical and Computer Engineering

Professors C. Berry, F. Berry, Black, Doering, Eccles, Ferguson, Goldman, Grigg, Herniter, Hoover, Hudson, Moore, Mu, Padgett, Radu, Rostamkolai, Simoni, Song, Throne, Walter, Wheeler, and Yoder.

ECE 130 Introduction to Logic Design 4R-0L-4C F,W,S
Combinational logic design, Boolean algebra, logic minimization, Karnaugh maps, static and dynamic hazards, multiplexers and memories in combinational design, flip-flops, registers and counters, finite state machine design. Use of logic simulator for several design problems.

ECE 200 Circuits & Systems 3R-3L-4C F,W,S Pre: ES 203 with a grade of C or better, MA 221, Co: MA 222
Review of d-c, time-domain, and sinusoidal steady-state analysis. Formal solution techniques and useful tools. Laplace transforms. s-domain systems representation. Power in a-c circuits. Integral laboratory includes circuit design problems.

ECE 206 Elements of Electrical Engineering I 4R-0L-4C F,W,S Pre: MA 221
A course designed for engineers (other than electrical or computer) covering analysis of passive DC circuits, introduction to digital circuits, steady-state sinusoidal circuit analysis and power in AC systems. EE or CPE majors may not take this course as a free elective.

ECE 207 Elements of Electrical Engineering II 4R-0L-4C F,W Pre: ES 205
A course designed for engineers (other than electrical or computer) covering transient response of passive circuits, analog devices and systems, power devices, motors and systems. EE or CPE majors may not take this course as a free elective.

ECE 250 Electronic Device Modeling 3R-3L-4C F,S Pre: ECE 200, MA 222
Modeling, analysis, and simulation of electronic circuits that contain two-terminal and three-terminal semiconductor devices. Large-signal, biasing, and small-signal analysis models. Introduction to wave shaping circuits, switching circuits, and amplifiers. Integral laboratory.

ECE 300 Signals & Systems 3R-3L-4C F,W,S Pre: MA 222, ECE 200
System and signal modeling. Convolution. Fourier series and Fourier transforms. Filters. Sampling. Use of numerical analysis software. Integral laboratory.

ECE 310 Communication Systems 3R-3L-4C F,S Pre: ECE 300
Transmission of information over bandlimited, noisy communication channels. Line codes, probability of error, intersymbol interference. Modulation techniques, synchronization and frequency conversion. Discussion of a current ethical issue. Integral laboratory.

ECE 320 Linear Control Systems 3R-3L-4C F,S Pre: ES 205, ECE 200
Analysis of linear control systems using classical and modern control theories. Plant representation, closed loop system representation, time response, frequency response, concept of stability, and root locus method. Computer modeling and simulation of feedback systems. Integral laboratory.

ECE 331 Embedded System Design 3R-3L-4C F,S Pre: CSSE 232, ECE 333

Microcontroller system design. Assembly language and architecture, I/O peripheral programming and interfacing, handshaking and interrupts, real-time programming, high-level programming, bus protocols, and embedded system timing analysis. Integral laboratory. Credit cannot be obtained for both ECE 331 and ECE 430.

ECE 332 Computer Architecture II 4R-0L-4C F,S Pre: CSSE 232

Pipelining, memory hierarchy, busses, instruction level parallelism, cost-performance tradeoffs, and review of new topics in areas of computer architecture or parallel processing. Team research project. Complements CS 332.

ECE 333 Digital Systems 3R-3L-4C F,W,S Pre: ECE 130, ECE 250

Capabilities, limitations, and design of digital (TTL/CMOS) logic devices. Design and evaluation of combinational and sequential logic circuits using programmable logic devices. Personal computer tools for design entry, timing simulation, and mapping to target devices. Troubleshooting using laboratory instrumentation. Laboratory notebooks. Informal reports. Integral laboratory.

ECE 340 Electromagnetic Fields 4R-0L-4C F,W Pre: ES 203, MA 222

Behavior of resistors, capacitors, inductors, magnetic circuits, and relays in terms of electromagnetic fields; field intensities, potential gradients, line integrals, flux densities, surface integrals; constituent properties; incremental elements; numeric and analytic solution techniques; energy and power; technical reports that extend basic concepts of the course.

ECE 341 Electromagnetic Waves 4R-0L-4C F,S Pre: ECE 340

Distributed parameters; Maxwell□s equations; quasistatic analysis, TEM plane waves in space, power flow, lossy materials, reflections; steady-state reflection coefficients, impedance, VSWR, Smith chart, transmission line matching techniques.

ECE 342 Introduction to Electromagnetic Compatibility 3R-3L-4C F,S Pre: ECE 200 and Computer Engineering Major

Electromagnetic compatibility (EMC) regulations and measurement. Frequency behaviors of passive components. Electromagnetic field and wave. Dipole and monopole Antennas. Four coupling mechanisms: electrical and magnetic fields common impedance, and electromagnetic wave. Transmission lines. Conducted emission. Radiated emission. Electromagnetic shielding and grounding. Electrostatic discharge (ESD).

ECE 351 Analog Electronics 3R-3L-4C F,W,S Pre: ECE 250

Amplifier design and analysis including discrete and integrated circuit topologies. Cascaded amplifier, input and output stages, frequency response. Linear and non-linear op-amp circuits. Introduction to the non-ideal properties of op-amps. Integral laboratory.

ECE 361 Engineering Practice 1R-3L-2C F,W Pre: ECE 200

Creativity, project design specifications, team roles, effective conduct of team meetings, written and oral communication skills, ethics and professionalism, completion of team project(s).

ECE 362 Principles of Design 4R-0L-4C W,S Pre: ECE 361, RH330

System engineering, team project involving conception, design specifications, conceptual design, scheduling, project management, business plan, market survey, and budgeting that culminates in a written proposal and oral presentation requesting funds for development of a product.

ECE 370 Machines & Power 3R-3L-4C W,S Pre: ECE 300, ECE 340

Applications of single-phase and three-phase systems. Power factor correction. Non-ideal transformer modeling and determination of the

equivalent circuit. Principles and types of DC machines and induction motors. Integral laboratory.

ECE 380 Discrete Time & Continuous Systems 4R-0L-4C W,S Pre: ECE 300

System properties: linearity and time-invariance. Sampling and reconstruction. Convolution in continuous and discrete-time systems. Z-transform, FIR and IIR filters. Discrete-time filter design. Discrete Fourier transform. Literature search. Credit cannot be obtained for both ECE 280 and ECE 380.

ECE 398 Undergraduate Projects 1-4C Arranged Pre: Consent of instructor

Special design or research projects.

ECE 410 Communication Networks 4R-0L-4C Pre: Senior standing or consent of instructor

Layered architectures. Circuit and packet switching. ISO Reference Model. Point-to-point protocols, error control, framing. Accessing shared media, local area networks. Virtual circuits, datagrams, routing, congestion control. Reliable message transport, internetworking.

ECE 414 Wireless Systems 4R-0L-4C Pre: ECE 310

Introduction to mobile radio communications with application to cellular telephone systems, wireless networks, and personal communication systems. System design, propagation, modulation, spread spectrum, coding, and multiple-access techniques.

ECE 415 Wireless Electronics 2R-6L-4C Pre: Consent of instructor

Design, fabrication, and testing of a high frequency transmitter-receiver system including but not limited to oscillators, mixers, filters, amplifiers, and matching networks. Integral laboratory.

ECE 416 Introduction to MEMS: Fabrication and Applications 3R-3L-4C S Pre: JR or SR standing

Properties of silicon wafers; wafer-level processes, surface and bulk micromachining, thin-film deposition, dry and wet etching, photolithography, process integration, simple actuators. Introduction to microfluidic systems. MEMS applications: capacitive accelerometer, cantilever and pressure sensor.

ECE 418 Fiber Optic Systems 4R-0L-4C W Pre: ECE 310 or consent of instructor

Analysis and design of common photonic systems such as fiber optic communication links, optical sensing systems, and optical s8ignal processors. Topics include component overview, basic system design, and expected degradations along with mitigation techniques. An oral presentation of a research project is required.

ECE 419 Advanced MEMS: Modeling and Packaging 3R-3L-4C F Pre: PH410 or equivalent course

Design process, modeling; analytical and numerical. Actuators; dynamics and thermal issues. Use of software for layout and simulation. Characterization and reliability of MEMS devices. Electrical interfacing and packaging of MEMS. Microsensors, microfluidic systems, applications in engineering, biology, chemistry, and physics.

ECE 420 Nonlinear Control Systems 3R-3L-4C Pre: ECE 320

Modeling nonlinear systems. Use of modeling software to design nonlinear control systems. Intuitive control strategies. Fuzzy control, computer and hardware implementation of fuzzy controllers, adaptive fuzzy control. Integral laboratory.

ECE 430 Microcomputers 3R-3L-4C Pre: ECE 130

Basic computer organization. Computer-aided microprocessor system

development. Assembly language programming. Instruction types and addressing modes. Subroutines. Assembler usage. Programming techniques. Design of interfacing. Microprocessor-based system. Formal final report and oral presentation. CAD tools. Integral laboratory. Credit cannot be obtained for both ECE 331 and ECE 430.

ECE 442 High-Speed Digital Design 3R-3L-4C Pre: ECE 200
Distributed-circuit effects in high-speed switching circuits. Transient behavior of transmission lines is introduced, leading to such topics as interfacing reactive and nonlinear elements, design of circuit-board transmission lines, electromagnetic coupling, and signal integrity. Integral laboratory.

ECE 451 Nonlinear Electronics 3R-3L-4C Pre: ECE 351
Analysis and design of Class C and D amplifiers, high-power switching amplifiers, negative-resistance oscillators, low-noise transistor and operational amplifier circuits, and parametric amplifiers. Emphasis on nonlinear and time-varying circuit analysis and design techniques. Integral laboratory.

ECE 452 Power Electronics 3R-3L-4C Co: ECE 351
Analysis and design of networks that use electronic devices as power switches. Silicon-controlled rectifiers, power transistors, and power MOSFETS are used to form phase-controlled rectifiers, AC voltage controllers, choppers, and inverters. Integral laboratory.

ECE 454 System Level Analog Electronics 3R-3L-4C W Pre: ECE 351
Analysis and design of Op-Amp circuits: wave shaping circuits, Schmitt triggers, power amplifiers, high power buffers, controlled current sources, peak detectors, sample and hold circuits. Precision Op-Amp Circuits. Non-ideal properties of Op-Amps. Integral laboratory.

ECE 460 Engineering Design I 2R-6L-4C F,W Pre: ECE 362, senior standing and completion of at least seven of the EE or CPE core courses.
The third in a sequence of formal design courses that emphasizes completion of a client-driven project using the design process. Student teams carry a project from inception to completion to satisfy the need of a client. Integral laboratory.

ECE 461 Engineering Design II 4R-6L-6C W,S Pre: ECE 460
Continuation of the design project from ECE 460. Offered over two terms; no credit will be granted for the first term alone. Six credits will be granted after completion of the second term. Integral laboratory.

ECE 466 Consulting Engineering Seminar 2R-0L-2C Pre: Junior class standing
Discussion problems in the field of consulting engineering; seminars presented by practicing consulting engineers.

ECE 470 Power Systems I 3R-3L-4C Pre: ECE 370
Per-unit concepts. Modeling and analysis of synchronous machines. Configuration of transmission and distribution lines. Modeling of power system components. Formulation of power flow equations. Computer solutions of the load-flow problem. Fault-level evaluation by symmetrical components. Principles of grounding. Integral laboratory.

ECE 471 Industrial Power Systems 4R-0L-4C Pre: ECE 370
Design and analysis techniques for low and medium voltage power distribution systems. Harmonics, transients, system coordination, reliability and economics. A design project is carried throughout the course.

ECE 472 Power Systems II 3R-3L-4C Pre: ECE 470
Power system protection and stability. Design and application of relaying schemes for protection of transformers, buses, distribution lines, transmission lines, generators, motors, capacitors, and reactors. Power system stability and

generator rotor dynamics phenomenon with use of the equal-area criterion. Integral laboratory.

ECE 480/PH 437 Introduction to Image Processing 3R-3L-4C Pre: MA 222 and Junior standing

Basic techniques of image processing. Discrete and continuous two-dimensional transforms such as Fourier and Hotelling. Image enhancement through filtering and histogram modification. Image restoration through inverse filtering. Image segmentation including edge detection and thresholding. Introduction to image encoding. Integral laboratory. Same as PH 437.

ECE 481 Electronic Music Synthesis 4R-0L-4C Pre: ECE 280 or ECE 380

Analog synthesis techniques. Instrument control using MIDI. FM, additive and subtractive synthesis. Physical modeling, and sound spatialization. Course project.

ECE 497 Special Topics in Electrical Engineering 1-4C arranged Pre: Consent of instructor and department head

Topics of current interest to undergraduate students.

ECE 498 Engineering Projects and Design 2R-6L-4C Pre: Senior standing

Aspects of design and design presentations. Development of preliminary design and proposal for hardware project. Formal proposal and component selection. Construction, testing, and performance demonstration of previously designed project. Formal final report and oral presentation.

UNDERGRADUATE-GRADUATE COURSES

ECE 510 Error Correcting Codes 4R-0L-4C Pre: Senior standing or consent of instructor

Coding for reliable digital communication. Topics to be chosen from: Hamming and BCH codes, Reed-Solomon codes, convolutional codes, Viterbi decoding, turbo codes, and recent developments, depending on interests of class and instructor. Mathematical background will be developed as needed.

ECE 511 Data Communications 4R-0L-4C Pre: ECE 310, MA 223 or MA 381

Design of digital communication systems. Topics to be chosen from: Channel characterization, data compression and source coding, baseband data transmission, noise modeling, probability of error, optimal receiver structures, modulation methods, synchronization.

ECE 516 Introduction to MEMS: Fabrication and Applications 3R-3L-4C S Pre: JR or SR standing

Properties of silicon wafers; wafer-level processes, surface and bulk micromachining, thin-film deposition, dry and wet etching, photolithography, process integration, simple actuators. Introduction to microfluidic systems. MEMS applications: capacitive accelerometer, cantilever and pressure sensor.

Students enrolled in PH510, ME516, ECE516, CHE505, BE516 must do project work on a topic selected by the instructor.

ECE 519 Advanced MEMS: Modeling and Packaging 3R-3L-4C F Pre: PH410 or equivalent course

Design process, modeling; analytical and numerical. Actuators; dynamics and thermal issues. Use of software for layout and simulation. Characterization and reliability of MEMS devices. Electrical interfacing and packaging of MEMS. Microsensors, microfluidic systems, applications in engineering, biology, chemistry, and physics.

Students enrolled in PH511, ME519, ECE519, CHE519, BE519 must do project work on a topic selected by the instructor.

ECE 520 Control Systems I 3R-3L-4C Pre: ECE 320

Digital control. Z-transform, sampling systems, sampled data control systems.

Digital compensator (filter) design. Compensator sign pre- and post-conditioning. Discrete state-variable model. Integral laboratory.

ECE 521 Control Systems II 3R-3L-4C Pre: ECE 320
State variable modeling of physical systems. Lagrangian formulations, applications of linear algebra, controllability, observability, state feedback design, design of observers. Laboratory projects emphasize control system design using state variable methods. Integral laboratory.

ECE 530 Advanced Microcomputers 3R-3L-4C Pre: ECE 430
Design of a microcomputer using a big honkin microprocessor. Architecture and assembly programming. Integral laboratory.

ECE 531 Microprogrammable Microcomputers 3R-3L-4C Pre: ECE 430
Architecture and application of microprogrammed CPUs. Microprogrammed control, hardwired control. Students will be required to develop their own microprogrammed CPU. Integral laboratory.

ECE 532 Advanced Computer Architecture 4R-0L-4C Pre: ECE 332 or both ECE 530 and ECE 531
Selected topics in computer architecture depending on interests of class and instructor. Projects investigating current issues in computer architecture.

ECE 533 Programmable Logic System Design 3R-3L-4C Pre: ECE 330 or ECE 333 or consent of instructor
Digital system-on-chip design techniques, including an advanced hardware description language, test-benches and verification, area and timing optimization, embedded microprocessors, and design for testing. Integral laboratory using contemporary CAD tools and FPGA devices.

ECE 540 Antenna Engineering 3R-3L-4C Pre: ECE 341
Electromagnetic radiation, antenna terminology and characteristics, dipole antennas, arrays, aperture antennas, measurements, computer-aided analysis, design projects and reports.

ECE 541 Microwave/Millimeter-Wave Engineering 4R-0L-4C Pre: ECE 341
Wave-guide structures, scattering parameters, passive components, active components, computer-aided design of amplifiers, oscillators and mixers, microwave/millimeter-wave systems, microwave and millimeter-wave integrated circuits.

ECE 542 Advanced Electromagnetics 4R-0L-4C Pre: ECE 341
Maxwells equations, power and energy, material properties, waves, reflections, radiation, EM field theorems, boundary value problems, skin effect.

ECE 543 Mathematical Methods of Electromagnetics 4R-0L-4C Pre: ECE 341
Perturbational and variational techniques, moment methods, integral equation and Wiener-Hopf techniques, development of computer programs.

ECE 550 Linear Active Networks 3R-3L-4C Pre: ECE 351
Indefinite admittance matrix and expansion of the two-port methods of linear network analysis and design. Brunes tests. Llewellyns stability criteria for two-port networks. Optimum terminations and mismatch design. Neutralization and unilateralization of amplifiers. Oscillators. Computer-aided design and analysis are emphasized. Integral laboratory.

ECE 551 VLSI I: Design and Testing 3R-3L-4C Pre: ECE 333 or ECE 330, and ECE 350 or ECE 351
Design, performance analysis, and physical layout of CMOS logic. Custom and standard cell methodologies. Use of commercial CAD tools. Design issues in VLSI such as interconnect, timing, and testing methods. Integral laboratory and project.

ECE 552 VLSI II: Mixed-Signal IC Design 3R-3L-4C Pre: ECE 551
Design, performance analysis, and physical layout of basic analog building blocks. Mixed-signal circuit design. Discussion of issues related to placing both analog and digital circuits on a single substrate. Integral laboratory and design project.

ECE 553 Advanced Topics in VLSI 3R-3L-4C Pre: ECE 551
Advanced topics in integrated circuit design. Discussion of leading-edge technologies. Topics could include memory design, sense amps, I/O pad design, MEMS, low- and high-power circuit design, and low-voltage circuit designs. Classroom presentations, informal reports. Integral laboratory.

ECE 554 Instrumentation 4R-0L-4C Pre: ECE 351
Transducers and their applications. Instrumentation amplifiers. A/D and D/A converters. Shock protection. Generation, recording and analysis of biological potentials (ECG, EMG, EEG). Ultrasound techniques and instrumentation. X-ray CAT techniques. Project involving the design of a significant instrument will run throughout the course. No laboratory, but emphasis on computer simulation of the circuits studied.

ECE 556 Power Electronics: DC Power Supplies 3R-3L-4C W Pre: ECE 351
Analysis and design of AC-DC and DC-DC converters. Linear, basic switching, charge-pump, and fly-back topologies. Introduction to devices used in a power switching supplies. Thermal management. Integral laboratory.

ECE 571 Control of Power Systems 3R-3L-4C Pre: ECE 470
Principles of interconnected operation of power systems. Optimum scheduling of generation using economic dispatch and unit commitment. Primary and secondary load-frequency control. Voltage and reactive-power flow control. Principles of state estimation. Integral laboratory.

ECE 580 Digital Signal Processing 4R-0L-4C Pre: ECE 380 or consent of instructor. MA 367 recommended
Digital filters. Fundamental concepts of digital signal processing. Analysis of discrete-time systems. Sampling and reconstruction. Theory and application of z-transforms. Design of recursive and nonrecursive digital filters. Window functions. Discrete Fourier transforms and FFT algorithm. Quantization effects. Design examples.

ECE 581 Digital Signal Processing Projects 2R-2L-2 or 4C Pre: ECE 580 or concurrent registration
Computer-aided design of digital filters and other DSP modules. Software and hardware realization using modern DSP chips. DSP chip architectures, assembly and C-language programming, and interfacing techniques. Optional advanced project may be done to earn four credit hours; otherwise two credit hours are given. Integral laboratory.

ECE 582/PH 537 Advanced Image Processing 3R-3L-4C Pre: ECE 480 or PH 437
Introduction to color image processing and image recognition. Morphological methods, feature extraction, advanced segmentation, detection and registration, recognition and interpretation. Integral laboratory. Same as PH 537.

ECE 597 Special Topics in Electrical Engineering 4C Pre: Consent of instructor
Special topics of current interest to graduate students and senior undergraduates.

ECE 598 Thesis Research 1-4C arranged
Thesis topic selected in consultation with adviser. Graduate students only.