

Electrical and Computer Engineering (ECE)

Courses

ECE 407. Pattern Recognition I. 3 or 4 hours.

The design of automated systems for detection, recognition, classification and diagnosis. Parametric and nonparametric decision-making techniques. Applications in computerized medical and industrial image and waveform analysis. Course Information: Same as BME 407. 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ECE 341 or BME 339 or IE 342 or STAT 381.

ECE 410. Advanced Circuit Analysis. 3 or 4 hours.

Matrix algebra for network analysis, network parameters, macromodeling, high-frequency measurements, network functions and theorems. Topics in computer-aided analysis. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): MATH 310 and grade of C or better in ECE 310.

ECE 412. Introduction to Filter Synthesis. 3 or 4 hours.

Fundamentals of network synthesis, filter approximations and frequency transformations. Active filter synthesis using bi-linear and bi-quad circuits. Topics in computer-aided design. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): Grade of C or better in ECE 310.

ECE 415. Image Analysis and Computer Vision I. 3 or 4 hours.

Image formation, geometry and stereo. Two-dimensional image analysis by Fourier and other 2-D transforms. Image enhancement, color, image segmentation, compression, feature extraction, object recognition. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): Grade of C or better in ECE 310.

ECE 417. Digital Signal Processing II. 0-5 hours.

Computer-aided design of digital filters; FFT algorithms and applications; multirate signal processing and wavelets; random signals and Wiener filtering; basics of 2-D DSP. Course Information: 4 undergraduate hours. 5 graduate hours. Prerequisite(s): ECE 317. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

ECE 418. Statistical Digital Signal Processing. 3 or 4 hours.

Stochastic signal models, LMS identification, identification of signals from noise, Wiener filtering, blind separation of mixed signal, discrete Wavelet Transforms, compression and denoising, cepstral analysis. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ECE 317 and ECE 341.

ECE 421. Introduction to Antennas and Wireless Propagation. 3 or 4 hours.

Potential, antenna parameters, radiation from linear wires and loops, impedance, arrays, communication links and path loss, tropospheric propagation, fading and diversity. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ECE 225 and ECE 322.

ECE 423. Electromagnetic Compatibility. 0-5 hours.

EMC requirements for electronic systems. Nonideal behavior of components. Radiated and conducted emissions. Susceptibility. Coupling and shielding. Electrostatic discharge. System design for EMS. Course Information: Prerequisite(s): MATH 310 and ECE 322. To be properly registered, students must enroll in one Lecture-Discussion and one Laboratory.

ECE 424. RF and Microwave Engineering. 0-5 hours.

Transmission lines, Smith chart, strip, active RF devices and components, power amplifiers, voltage-controlled oscillators, mixers, wireless communication and radar systems, resonators, two-port parameters, power and energy considerations. Course Information: 4 undergraduate hours. 5 graduate hours. Prerequisite(s): ECE 225 and ECE 322. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

ECE 432. Digital Communications. 3 or 4 hours.

Source coding, quantization, signal representation, channel noise, optimum signal reception, digital modulation: ASK, PSK, FSK, MSK, M-ary modulation. Probability of error. Inter-symbol interference. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): MATH 310, ECE 311 and ECE 341.

ECE 434. Multimedia Systems. 3 or 4 hours.

Multimedia systems; compression standards; asynchronous transfer mode; Internet; wireless networks; television; videoconferencing; telephony; applications. Course Information: 3 undergraduate hours. 4 graduate hours. Extensive computer use required. Prerequisite(s): ECE 310.

ECE 436. Computer Communication Networks II. 3 or 4 hours.

Explores integrated network architecture of service, control signaling and management, examples of high-speed LAN/WAN, next generation Internet and mobile wireless network. Course Information: 3 undergraduate hours. 4 graduate hours. Extensive computer use required. Prerequisite(s): ECE 333.

ECE 437. Wireless Communications. 3 or 4 hours.

Cellular concept, frequency reuse, mobile radio propagation, channel fading, noise in analog communications, mobile radio channel equalization, multiple access techniques (FDMA, TDMA, CDMA), wireless networking. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ECE 311 and ECE 341.

ECE 440. Nanoelectronics. 3 or 4 hours.

Wave-particle duality, Schrodinger equation, atomic orbitals, band theory of solids. Semiconductor and carbon nanoelectronic materials. Nanostructure device fabrication. Nanoelectromechanical systems. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ECE 346; or consent of the instructor.

ECE 442. Power Semiconductor Devices and Integrated Circuits. 0-5 hours.

Encompasses fundamentals of primarily silicon based power semiconductors with regard to basic physical principles, breakdown mechanisms, high voltage bipolar and insulated gate devices, and basic packaging issues. Course Information: 4 undergraduate hours. 5 graduate hours. Credit is not given for ECE 442 if the student has credit for EECS 442. ECE 442 is a supplement for ECE 445 and ECE 545. Prerequisite(s): ECE 346. Class Schedule Information: To be properly registered, students must enroll in one Laboratory-Discussion and one Lecture-Discussion.

ECE 445. Analysis and Design of Power Electronic Circuits. 0-5 hours.

Analysis of different isolated and non-isolated power-converter topologies, understanding of power-converter components, switching schemes. Course Information: 4 undergraduate hours. 5 graduate hours. Prerequisite(s): ECE 342. Class Schedule Information: To be properly registered, students must enroll in one Laboratory-Discussion and one Lecture-Discussion.

ECE 448. Transistors. 3 or 4 hours.

Bipolar junction transistors, electronic processes in surface-controlled semiconductor and dielectric devices. Metal oxide semiconductor field effect transistors, surface and interface effects, diode lasers, integrated optoelectronic devices. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ECE 346.

ECE 449. Microdevices and Micromachining Technology. 0-5 hours.

Microfabrication techniques for microsensors, microstructures, and microdevices. Selected examples of physical/chemical sensors and actuators. Simulation experiments. Course Information: Same as ME 449. 4 undergraduate hours. 5 graduate hours. Laboratory. Prerequisite(s): ECE 347; or consent of the instructor. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture-Discussion.

ECE 451. Control Engineering. 3 or 4 hours.

Continuous-and discrete-time state-space models; solutions to state equations; stability; reachability/controllability, state feedback, tracking; observability, observers, output feedback; optimal control and estimation. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ECE 350; and Grade of C or better in MATH 310.

ECE 452. Robotics: Algorithms and Control. 3 or 4 hours.

Kinematic and dynamic modeling of robots; configuration space; motion planning algorithms; control of robots; sensors and perception; reasoning; mobile robots. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): Grade of C or better in ECE 310; and MATH 310.

ECE 454. Mechatronic Embedded Systems Design. 0-5 hours.

Design and fabrication of scaled-down autonomous vehicles, from an embed system perspective; mechatronic components such as motors, microcontrollers, power supply, sensors, control algorithms, project oriented, culminating in racing competition. Course Information: 4 undergraduate hours. 5 graduate hours. Prerequisite(s): ECE 266 and ECE 310 and ECE 340; or consent of the instructor. Recommended Background: ECE 350 and ECE 412 and ECE 451. Class Schedule Information: To be properly registered, students must enroll in one Laboratory and one Lecture.

ECE 458. Electromechanical Energy Conversion. 0-4 hours.

Electromagnetic forces and torque; magnetic circuits and transformers; DC machines; three-phase AC synchronous and induction machines; laboratory-demonstrations. Projects are required. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): Grade of C or better in ECE 225. Class Schedule Information: To be properly registered, students must enroll in one Laboratory-Discussion and one Lecture-Discussion.

ECE 464. Testing and Reliability of Digital Systems. 3 or 4 hours.

Theory, practice and recent innovations in the testing and reliability of modern digital systems. Topics: fault modeling / simulation, automatic test pattern generation, built-in self-test, fault tolerance. Course Information: 3 undergraduate hours. 4 graduate hours. Extensive computer use required. Prerequisite(s): CS 251; and ECE 366.

ECE 465. Digital Systems Design. 3 or 4 hours.

Switching algebra, combinational circuits, Mux, ROM, DCD, PLA-based designs, advanced combinational circuit minimization techniques, synchronous and asynchronous sequential circuit synthesis (minimization, hazards, races, state assignment) testing. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): Grade C or better in PHYS 142; and ECE 366.

ECE 466. Computer Architecture. 3 or 4 hours.

Design principles of computer architecture. Topics include: instruction set architecture, pipelining, instruction-level parallelism, caches, main memory, and thread-level parallelism. Course Information: Same as CS 466. 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ECE 366 or CS 261.

ECE 467. Introduction to VLSI Design. 0-5 hours.

MOS, CMOS circuits VLSI technology, CMOS circuit characterization and evaluation. Static and dynamic MOS circuits, system design, faults, testing, and symbolic layout. Laboratory. Course Information: 4 undergraduate hours. 5 graduate hours. Prerequisite(s): ECE 340. Class Schedule Information: To be properly registered, students must enroll in one Laboratory-Discussion and one Lecture-Discussion.

ECE 468. Analog and Mixed - Signal Integrated Circuits. 0-5 hours.

Review of basic analog concepts; Sampling and mixed-signal interface circuits; analytical analysis and CAD-based design/simulation; emphasis on compact modeling, design tradeoffs, and intuitive design approaches. Course Information: 4 undergraduate hours. 5 graduate hours. Prerequisite(s): ECE 342. Class Schedule Information: To be properly registered, students must enroll in one Laboratory-Discussion and one Lecture-Discussion.

ECE 469. Hardware Description Language Based Digital and Computer System Design. 0-5 hours.

Hardware description language (HDL) introduction; digital system design including arithmetic circuit, datapath and control; basic processor architecture and design; use of CAD tools for simulation, synthesis, and verification. Course Information: 4 undergraduate hours. 5 graduate hours. Prerequisite(s): CS 366; and ECE 465. Class Schedule Information: To be properly registered, students must enroll in one Lecture and one Laboratory.

ECE 491. Seminar. 1-4 hours.

Topics of mutual interest to a faculty member and a group of students. Offered as announced by department bulletin or the Timetable. Course Information: May be repeated. Prerequisite(s): Consent of the instructor.

ECE 493. Special Problems. 1-5 hours.

Special problems or reading by special arrangement with the faculty. Course Information: No graduation credit for students in the following: MS in Electrical and Computer Engineering or PhD in Electrical and Computer Engineering. Prerequisite(s): Consent of the instructor.

ECE 496. Undergraduate Senior Design Thesis I. 0-8 hours.

Introduction to engineering design and research methods: design tools, product conception and development, simulation, prototyping, technical reports and presentations, literature survey and undergraduate thesis. Course Information: Credit for ECE 496 only given to non-degree students. No graduation credit is given for ECE 496 to students enrolled in any degree program in Engineering. Extensive computer use required. Prerequisite(s): Consent of the instructor.

ECE 497. Undergraduate Senior Design Thesis II. 0-8 hours.

Introduction to engineering design and research methods: design tools, product conception and development, simulation, prototyping, technical reports and presentations, literature survey and undergraduate thesis. Course Information: Credit only given to non-degree students. No graduation credit given to students enrolled in Engineering. Extensive computer use required. Prerequisite(s): Consent of the instructor.

ECE 499. Professional Development Seminar. 0 hours.

Graduating seniors will be provided with information regarding future career paths and will provide information regarding the program to be used for assessment purposes. Course Information: Satisfactory/Unsatisfactory grading only. Prerequisite(s): Open only to seniors; and approval of the department. Must be taken in the student's last semester of study.

ECE 508. Convex Optimization. 4 hours.

Convex sets, functions, and optimization problems; duality theory; optimization algorithms: gradient method, Newton's method, interior-point methods; applications to machine learning, and signal processing. Course Information: Prerequisite(s): MATH 310; and ECE 341; or consent of the instructor.

ECE 510. Advanced Network Analysis. 4 hours.

Characterizations of networks. The indefinite-admittance matrix. Active two-port networks. Theory of feedback amplifiers. Stability of feedback amplifiers. Multiple-loop feedback amplifiers. Course Information: Prerequisite(s): ECE 410.

ECE 515. Image Analysis and Computer Vision II. 4 hours.

Image analysis techniques, 2D and 3D shape representation, segmentation, camera and stereo modeling, motion, generic object and face recognition, parallel and neural architectures for image and visual processing. Course Information: Prerequisite(s): ECE 415; or consent of the instructor.

ECE 516. Adaptive Digital Filters. 4 hours.

Properties of signals; optimal filters, Wiener and Kalman filters; signal modeling, adaptive filters channel equalizing, echo canceling, noise canceling, and linear prediction; filter properties. Course Information: Prerequisite(s): ECE 317 and ECE 341; and MATH 310 or MATH 320.

ECE 517. Digital Image Processing. 4 hours.

Operations on 2-D digital images: transforms, enhancement, restoration, warping, segmentation, registration, compression, water marking, steganography, and reconstruction from projection. Course Information: Prerequisite(s): ECE 317 and ECE 341.

ECE 520. Electromagnetic Field Theory. 4 hours.

Maxwell's equations. Potentials. Constitutive relations. Special relativity. Boundary conditions. Green's functions. Polarization. Radiation from antennas and charged particles. Waveguides and resonators. Exterior boundary - value problems. Course Information: Prerequisite(s): ECE 421.

ECE 521. Computational Electromagnetics. 4 hours.

Finite-element, finite-difference solution. Computer aided solutions: integral equations, method of moments, transform and iterative solutions. FD-TD, singularity expansion method. Practical problems in radiation and scattering. Course Information: Prerequisite(s): ECE 520.

ECE 522. Advanced Microwave Theory. 4 hours.

Microwave integrated circuits: analysis, design. Microwave devices: filters, cavities and phase shifters. Millimeter waves: components and circuits, millimeter wave applications. Course Information: Prerequisite(s): ECE 420 and ECE 520.

ECE 523. Advanced Antenna Engineering. 4 hours.

Radiation from helix and spiral; aperture antennas; linear and planar array synthesis; Hallen's and other methods for impedance; design of array feeds; reflector and lens antennas. Course Information: Prerequisite(s): ECE 421 and ECE 520.

ECE 526. Electromagnetic Scattering. 4 hours.

Exact solutions of exterior boundary-value problems. Low-frequency expansions. High-frequency methods, including geometrical and physical theories of diffraction. Hybrid techniques. Radar cross-sections. Course Information: Prerequisite(s): ECE 520.

ECE 530. Random Signal Analysis. 4 hours.

Probability for communications, properties and series representations of random processes, random processes through linear and non-linear systems, minimum MSE and maximum SNR systems. Course Information: Prerequisite(s): ECE 341 or consent of the instructor.

ECE 531. Detection and Estimation Theory. 4 hours.

Bayes, Neyman-Pearson and minimax detection for discrete and continuous time random processes. Estimation of random and non-random signal parameters. Estimation of signals. Course Information: Prerequisite(s): ECE 418 or consent of the instructor.

ECE 532. Advanced Digital Communications. 4 hours.

Characteristics of digitally modulated signals; digital signals in additive noise; communication over fading channels and with intersymbol interference; source and channel coding; synchronization; spread spectrum techniques. Course Information: Prerequisite(s): ECE 432 or consent of the instructor.

ECE 533. Advanced Computer Communication Networks. 4 hours.

Computer and telecommunication networks; integrated (data, voice, and video) services; network performance; Quality of Service provisioning. Course Information: Prerequisite(s): ECE 333 and ECE 341; or consent of the instructor.

ECE 534. Elements of Information Theory. 4 hours.

Entropy and mutual information, fundamentals of coding theory, data compression, complexity of sources, channel mutual information and capacity, rate distortion theory, information theory applications. Course Information: Prerequisite(s): ECE 341 or consent of the instructor.

ECE 540. Physics of Semiconductor Devices. 4 hours.

Electrons in periodic lattice; equilibrium carrier distribution; energy band diagrams in junctions, in homogeneous semiconductors; recombination and generation; non-equilibrium processes, radiation and electric fields; diodes. Course Information: Same as PHYS 540. Prerequisite(s): ECE 346 or the equivalent.

ECE 541. Microelectronic Fabrication Techniques. 4 hours.

Current fabrication techniques of microelectronic technology; plasma and CVD processes; etching techniques; ion implantation; surface analytical methods. Course Information: Same as ME 541. Prerequisite(s): ECE 347 or ECE 449.

ECE 542. Advanced Semiconductor Devices. 4 hours.

Bipolar Transistor and Related Devices, MOSFET Transistor and Related Devices, MESFET and Related Devices, Quantum-Effect Devices, Photonic Devices. Course Information: Prerequisite(s): ECE 540.

ECE 545. Advanced Power-Electronics Design. 4 hours.

High-frequency-magnetics design and measurement, parasitics, modeling, estimation, and measurement, soft switching for DC-DC converters, distributed DC-DC converters, and design layout. Course Information: Prerequisite(s): ECE 445.

ECE 550. Linear Systems Theory and Design. 4 hours.

State variable description, linear operators, impulse response matrix, controllability, observability, reducible and irreducible realizations, state feedback, state observers and stability. Course Information: Prerequisite(s): ECE 350.

ECE 551. Optimal Control. 4 hours.

Optimal control of dynamic systems in continuous and discrete time, maximum principle, dynamic programming and constraints, learning systems. Course Information: Prerequisite(s): ECE 550 or consent of the instructor.

ECE 552. Nonlinear Control. 4 hours.

Nonlinear phenomena, linear and piecewise linear approximations, describing functions, servomechanisms, phase plane, limit cycles, Lyapunov's stability theory, bifurcation, bilinear control, vibrational control, learning systems. Course Information: Prerequisite(s): ECE 550 or consent of the instructor.

ECE 559. Neural Networks. 4 hours.

Mathematical neuron models, learning methods, the perceptron, basic nonlinear optimization, backpropagation algorithm, associative memory, hopfield networks, SVM, vector quantization, SOM, PCA, convolutional networks, deep learning. Course Information: Same as CS 559. Prerequisite(s): Consent of the instructor. - Knowledge of calculus, linear algebra, and the ability to write computer programs are assumed.

ECE 564. Hardware Security and Trust. 4 hours.

Hardware security based on physical disorder; hardware metering and watermarking; trusted embedded system design; countermeasures against invasive and non-invasive attacks; hardware trojan detection and prevention. Prerequisite(s): ECE 465; or consent of the instructor. Recommended background: An understanding of digital system design.

ECE 565. Physical Design Automation. 4 hours.

Computer-aided physical design of integrated circuits; circuit partitioning and placement; floorplanning; global and detailed routing; timing optimization; general optimization tools: local search, constraint relaxation. Course Information: Same as CS 565. Prerequisite(s): CS 401; and CS 466 or ECE 465.

ECE 566. Parallel Processing. 4 hours.

Parallel processing from the computer science perspective. Includes Architecture (bus based, lockstep, SIMD), Programming Languages (Functional, traditional and extensions), compilers, interconnection networks, and algorithms. Course Information: Same as CS 566. Prerequisite(s): CS 466 or ECE 466; and CS 401.

ECE 567. Advanced VLSI Design. 4 hours.

VLSI subsystem and system design: synthesis, design styles, design process, testing. Case Studies: switching networks, graphics engine, CPU. Projects use computer-aided design tools. Course Information: Prerequisite(s): ECE 467.

ECE 568. Advanced Microprocessor Architecture and Design. 4 hours.

Microprocessors; embedded control; processor core; system-on-chip; power-aware design; SMT design; Java processors; media processors; network processors; crypto processors; trusted processor architectures; architecture simulation. Course Information: Extensive computer use required. Prerequisite(s): ECE 466 and consent of the instructor.

ECE 569. High-Performance Processors and Systems. 4 hours.

Instruction-level parallelism, multiple-instruction issue, branch prediction, instruction and data prefetching, novel cache and DRAM organization, high-performance interconnect, compilation issues, case studies. Course Information: Same as CS 569. Prerequisite(s): CS 466 or ECE 466; and graduate standing.

ECE 572. Nanoscale Semiconductor Structures: Electronic and Optical Properties. 4 hours.

Electronic and optical properties of nanoscale semiconductors and devices, carrier interactions in dimensionally-confined nanostructures, deformation potential, piezoelectric potential, polar-optical-phonon interaction potential. Course Information: Prerequisite(s): PHYS 244 & ECE 346. Recommended background: Background in semiconductor device fundamentals such as covered in ECE 346 as well as the underlying physical principles as covered in PHYS 244.

ECE 591. Electrical and Computer Engineering Internship. 1 hour.

Provides students with the opportunity to apply the skills and knowledge gained in previous engineering courses within a professional, working environment. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated. A maximum of 2 hours awarded toward degree requirements. Prerequisite(s): Approval of the Department.

ECE 594. Special Topics. 4 hours.

Subject matter varies from term to term and section to section, depending on the specialities of the instructor. Course Information: May be repeated. Students may register in more than one section per term. Prerequisite(s): Consent of the instructor.

ECE 595. Departmental Seminar. 0 hours.

Seminar by faculty and invited speakers. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated.

ECE 596. Individual Study. 1-4 hours.

Individual study or research under close supervision of a faculty member. Course Information: May be repeated. Students may register in more than one section per term. No graduation credit for students in the following: MS in Electrical and Computer Engineering and PhD in Electrical and Computer Engineering. Prerequisite(s): Consent of the instructor.

ECE 598. M.S. Thesis Research. 0-16 hours.

M.S. thesis work under the supervision of a graduate advisor. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated. Students may register in more than one section per term. Prerequisite(s): Consent of the instructor. For ECE majors only.

ECE 599. Ph.D. Thesis Research. 0-16 hours.

Ph.D. thesis work under supervision of a graduate advisor. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated. Students may register in more than one section per term. Prerequisite(s): Consent of the instructor. For ECE majors only.