Electrical and Computer Engineering


ECE 101 Foundations of Electrical and Computer Engineering (2 cr)
Course is geared toward freshmen ECE students with little or no fundamental electrical/computer engineering knowledge and is highly interactive and hands-on; includes introductory coverage of basic signal characteristics, amplifier applications and design, fundamental circuit analysis, data analysis, digital logic and computer architecture, electromagnetics, semiconductor physics and solar cells, and VLSI, etc.; nontechnical topics relevant to freshmen will also be included.
Coreq: Math 143 or Math 170

ECE 204 (s) Special Topics (cr arr)

ECE 210 Electrical Circuits I (3 cr)
Intro to d.c. and transient electrical circuits; mesh and nodal analysis; dependent sources; circuit theorems; transient analysis with differential equations. Three lec and one recitation a wk.
Coreq: Math 310 and Phys 212

ECE 211 Electrical Circuits Lab I (1 cr)
Lab to accompany ECE 210. Lab experiments and computer simulations. One 3-hr lab a wk.
Coreq: ECE 210 and Phys 212

ECE 212 Electrical Circuits II (3 cr)
Continuation of ECE 210. Intro to sinusoidal steady state circuits; time and frequency domain analysis; Laplace transforms; Fourier series; transfer functions; Bode plots, filters. Three lec and one recitation a wk.
Prereq: ECE 210, Math 310, and Phys 212
Coreq: ECE 213

ECE 213 Electrical Circuits II Lab (1 cr)
Lab to accompany ECE 212. Continuation of ECE 211. Lab experiments and computer simulations. One 3-hr lab a wk.
Prereq: ECE 211 and Phys 212
Coreq: ECE 212

ECE 240 Digital Logic (3 cr)
Number systems, truth tables, logic gates, flip-flops, combinational and synchronous sequential circuits using SSI, MSI, and programmable devices; intro to digital systems and basic microprocessor architecture; certification exam not reqd.
Prereq: Phys 212
Coreq: ECE 241

ECE 241 Logic Circuit Lab (1 cr)
Open lab to accompany ECE 240. Design and construction of combinational and synchronous sequential logic circuits; certification exam not reqd.
Prereq: Phys 212
Coreq: ECE 240

ECE 292 Sophomore Seminar (0 cr)
Curriculum options, elective courses, preparation for graduate study, professional ethics, and current technical topics. Field trip may be reqd. Graded P/F.

ECE 310 Fundamentals of Electronics (3 cr)
Operational amplifier fundamentals and applications, introduction to electronic devices such as diodes, bipolar junction and field effect transistors, large and small-signal modeling of non-linear electronic devices, DC and small-signal analysis of circuits with non-linear electronic devices, biasing of electronic circuits, introduction to the analysis, design, and applications of electronic circuits such as rectifiers, power supplies, and low-frequency single-stage amplifiers. Practical limitations of amplifiers of electronic circuits.
Prereq: ECE 212 and 213
Coreq: ECE 311

ECE 311 Fundamentals of Electronics Lab (1 cr)
Lab to accompany ECE 310.
Coreq: ECE 310

ECE 314 Analog and Digital Engineering (3 cr)
Laplace transforms, filters, transducers, grounding, digital logic, A/D and D/A converters, microcontroller systems.
Prereq: Engr 240

ECE 320 Energy Systems I (3 cr)
Single-phase AC measurements, transformer parameters, transformer performance, rotating DC machines, DC-DC PE converters.

Three lec a wk.
Prereq: ECE 212 and Phys 212
Coreq: ECE 321

**ECE 321 Energy Systems I Laboratory (1 cr)**
Lab to accompany ECE 320. Lab experiments and computer simulations. One 3-hr lab a wk.
Prereq: ECE 213, Phys 212, Math 310
Coreq: ECE 320

**ECE 330 Electromagnetic Theory (3 cr)**
Vector mathematics; charge and current; fields as forces; work, potential and electro-motive force; Faraday's law of induction; Gauss's and Ampere's laws; material modeling; waves in isotropic media.
Prereq: Math 275, 310, and Phys 212
Coreq: ECE 331

**ECE 331 Electromagnetics Laboratory (1 cr)**
Lab to accompany ECE 330. Lab experiments and computer simulations. One 3-hr lab a wk.
Prereq: Math 275, 310; Phys 212
Coreq: ECE 330

**ECE 340 Microcontrollers (3 cr)**
Introduction to use of embedded microcontrollers and microprocessors; processor architecture; assembly language programming; use of development systems and/or emulators for system testing and debugging; software and hardware considerations of processor interfacing for I/O and memory expansion; programmed and interrupt driven I/O techniques. Three lec a wk.
Prereq: ECE 240, ECE 241, and CS 112 or CS 120
Coreq: ECE 341

**ECE 341 Microcontrollers Lab (1 cr)**
Lab to accompany ECE340.
Coreq: ECE 340

**ECE 350 Signals and Systems I (3 cr)**
Prereq: ECE 212 and Math 310
Coreq: ECE 351

**ECE 351 Signals and Systems I Lab (1 cr)**
Laboratory to accompany ECE 350. Software and hardware laboratories. Introduction to Matlab.
Coreq: ECE 350

**ECE 398 Electrical Engineering Cooperative Internship (1-3 cr, max arr)**
Supervised internship in industry in professional engineering settings, integrating academic study with work experience; requires weekly progress reports, a final written report, and a talk/presentation and additional details to be worked out with the faculty supervisor. Cannot be counted as a technical elective toward the B.S.E.E. or B.S.Comp.E. Graded P/F.
Prereq: Permission

**ECE 404 (s) Special Topics (cr arr)**

**ECE 410 Advanced Electronics (3 cr)**
Introduction to analog integrated circuit implementation and design, differential and common-mode signal concepts, differential amplifiers, multistage amplifiers, operational amplifier design, frequency response of electronic circuits, feedback in electronic circuits, large-signal amplifiers.
Prereq: ECE 310 and 311

**ECE 411 Advanced Electronics Laboratory (1 cr)**
Lab to accompany or follow ECE 410.
Prereq or Coreq: ECE 410

**ECE J412/J512 Analog Filter Design (3 cr)**
Second order, Butterworth, Chebychev, Elliptic and Bessel filter functions and active realizations for highpass, lowpass, bandpass, notch and all-pass filters; frequency and impedance scaling; frequency transformations; phase and group delay; filter sensitivity to passive and active elements; introduction to switched capacitor filters. Additional projects/assignments reqd for grad cr.
Prereq: ECE 310 or Permission

**ECE J413/J513 Communication Circuits (3 cr)**
Impedance transforms and matching networks, small-signal high frequency amplifiers, distortion in amplifiers, noise calculations and considerations, sinewave oscillators, mixers and frequency translators, phase-locked loops, and power amplifiers. Additional projects/assignments reqd for grad cr.

Prereq: ECE 410 or Permission

ECE J415/J515 Analog Integrated Circuit Design (3 cr)
Analog integrated circuit analysis, design, simulation, and layout, advanced biasing techniques, voltage references, operational amplifiers, compensation techniques, and comparators. Additional projects/assignments required for graduate credit.

Prereq: ECE 410 or Permission

ECE 416 Applications of Linear Integrated Circuits (3 cr)
Theory and practical implementation of operational amplifiers, comparators, voltage regulators, and selected integrated circuits. Non-ideal characteristics of op-amps and comparators and circuit considerations, stability and compensation, active filters, non-linear circuits.

Prereq: ECE 310 or Permission

ECE J417/J517 Pulse and Digital Circuits (3 cr)
Electronic switching, timing, and pulse-shaping techniques; logic functions, realization with diodes, transistors, and FETs. Additional projects/assignments reqd for grad cr.

Prereq: ECE 410 or Permission

ECE J418/J518 Introduction to Electronic Packaging (3 cr)
This course serves as an introduction to electronic packaging and “back-end” microelectronic processes. Topics include substrate design & fabrication, SMT & first level assembly, clean room protocol, thermal design, simulation, and process considerations. Additional project work will be required for students enrolled in 518.

Prereq: ECE 310

ECE 420 Energy Systems II (3 cr)
Three-phase systems, three-phase transformers, regulating transformers, winding theory, rotating waves, synchronous machines, short and medium line models, Ybus, power flow.

Prereq: ECE 320 and ECE 321

ECE 423 Power Systems Analysis (3 cr)
Calculation of transmission line parameters, high frequency transmission line models, balanced and unbalanced faults, Zbus methods, transient generator models, stability analysis, and economic operation of power systems.

Prereq: ECE 420

ECE 425 Power Electronics Lab (1 cr)
Measurement of operating characteristics of power semiconductors; experiments include testing of typical power converter circuits with emphasis on control, gating, protection requirements, and measurement techniques.

ECE 427 Power Electronics and Drives (3 cr)
Characteristics, limitations, and application of solid state power devices; induction machines; analysis and application of AC and DC drives; practical aspects of power electronic converter design, including rectifiers and inverters; choppers, AC phase control, device gating techniques, and snubbers.

Prereq: ECE 420

ECE 430 Microwave and Millimeter Wave Circuits (3 cr)
Telegrapher's and wave equations; characteristic impedance, wave velocity and wave number; physical transmission lines, including coax, microstrip and stripline; circuit analysis techniques, reflection coefficient and power flow; impedance analysis, impedance matching techniques and Smith Chart; S-parameters; Wilkinson power dividers, circulators and hybrid couplers; transformers and filters.

Prereq: ECE 330 or Permission

ECE 432 Propagation of Wireless Signals (3 cr)
Maxwell's Equations, including Poynting's vector and Poynting's theorem; Wave equation with solutions, Helmholtz equation, plane waves; Reflection and refraction; Theory of guided waves, ray theory and mode theory; Atmospheric and ionospheric effects on wave propagation; Multipath effects and fading; Ground waves and surface waves. Course will be offered every third semester.

Prereq: ECE 330 or Permission

ECE ID&WS433 Numerical Solutions to Electromagnetic Problems (3 cr)  WSU E E 417

ECE 434 Antenna Principles and Design (3 cr)
Maxwell's equations, vector potential theory, radiation patterns, antenna efficiency and bandwidth, polarization, dipole and loop antennas, line sources, patch antennas, lineal arrays, antenna systems, radar equation.

Prereq: ECE 330 or Permission

ECE 440 Digital Systems Engineering (3 cr)
Design of digital systems using a hardware description language and field-programmable gate arrays; projects emphasize a top-down design process using software tools; topics include datapath optimization, pipelining, static and dynamic memory, technology issues, intra-system communication, and design for testability.

**Prereq:** ECE 240, 241, or Permission

**ECE J441/J541 Advanced Computer Architecture (3 cr)**
See CS J451/J551.

**Prereq:** ECE 240

**ECE 443 Distributed Processing and Control Networks (3 cr)**
This course has three major parts: real-time computing, distributed processing, and control networks. Analysis of hardware and software performance with respect to speed, accuracy, and reliability. Investigation ways of maximizing the three essential processors resource, member, CPU Time, and Input/output. Methods for writing error free programs and designing fault tolerant computing systems.

**Prereq:** ECE 340, 341, 350, and 351

**ECE 445 Introduction to VLSI Design (3 cr)**
Principles of design of very large scale integrated circuits; CMOS logic design; transistor sizing and layout methodologies; intro to IC CAD tools.

**Prereq:** ECE 310, 240 or Permission

**ECE J449/J549 Fault-Tolerant Systems (3 cr)**
See CS J449/J549

**ECE 450 Signals and Systems II (3 cr)**

**Prereq:** ECE 350 and Math 330

**ECE J451/J551 Electroacoustic Sensors and Systems (3 cr)**
Review linear systems. Derive and solve wave equation for strings, membranes, plates, acoustic waveguides. Radiation, reflection, transmission of sound. Analogies among electrical, magnetic, mechanical, acoustical systems. Strong emphasis on 2-port networks. Modeling transducers: loudspeakers, microphones, hydrophones. Sound perception and models of human hearing. Applications to voice communication systems, medical imaging, sonar, spatial listening, seismology, hearing protectors and hearing aids, materials inspection, room acoustics, etc. Additional projects/assignments required for grad credit. (Fall only)

**Prereq:** ECE 350 or ME 313 or Permission

**ECE ID&WS452 Communication Systems (3 cr)**
WSU EE 451
Introduction to modern communication systems; baseband pulse and data communication systems; communication channels and signal impairments; filtering and waveform shaping in the time and frequency domain; carrier-modulation for AM and FM transmission; bandpass digital and analog communication systems; comparison of system performance.

**Prereq:** ECE 450 (Alt/hrs)

**ECE 453 Communication Systems Laboratory (1 cr)**
Test and measurement techniques for communication systems and signal processing; experiments in the modulation and demodulation of information bearing signals. Three hrs of lab a wk.

**Coreq:** ECE 452

**ECE 455 Information and Coding Theory (3 cr)**
Introduction to information theory; information content of messages; entropy and source coding; data compression; channel capacity data translation codes; fundamentals of error correcting codes; linear block and convolutional codes; introduction to trellis-coded modulation.

**Prereq:** Math 330 and Stat 301

**ECE 460 Semiconductor Devices (3 cr)**
Introduction to semiconductor physics and basic semiconductor devices; intro to electro-optical devices.

**Prereq:** ECE 350

**ECE J462/J562 Semiconductor Theory (3 cr)**
Fundamental theory and behavior of modern semiconductor devices. Additional projects/assignments reqd for grad cr.

**Prereq:** ECE 350 or Permission

**ECE 470 Control Systems (3 cr)**
Same as ME 481. Analysis and design of feedback control systems using frequency and time domain methods, and computer-aided design tools.

**Prereq** for EE and CoE majors: ECE 350

**Prereq** for ME majors: ME 313
ECE 471 Digital Control Systems (3 cr)
Design of digital control systems; sampling, A/D, and D/A conversion issues; time domain, frequency domain, and state space design methods; use of computer-aided design tools. Three lec a wk and approximately three 3-hr labs.
Prereq: ECE 450, 470 or ME 481

ECE 476 Digital Filtering (3 cr)
Design methods for recursive and non-recursive filters; frequency domain characteristics; computer-aided design; applications.
Prereq: ECE 450

ECE 477 Digital Process Control (3 cr)
See ChE 445.

ECE 480 EE Senior Design I (3 cr)
The capstone design sequence for electrical engineering majors. Course topics include design, research, simulation, and experimental methods; specifications, prototyping, troubleshooting and verification; report writing, documentation and oral presentations. Topics are considered in the context of a major design project involving a team of students. Projects incorporate realistic engineering constraints; i.e. environmental, sustainability, manufacturability, ethical, safety, social and political considerations.
Prereq: ECE 240, 241, 310, 311, 320, 321, 340, 341, 350, 351 and Stat 301, or Permission

ECE 481 EE Senior Design II (3 cr)
May be used as core credit in J-3-d. The capstone design sequence for electrical engineering majors. Course topics include design, research, simulation, and experimental methods; specifications, prototyping, troubleshooting and verification; report writing, documentation and oral presentations. Topics are considered in the context of a major design project involving a team of students. Projects incorporate realistic engineering constraints; i.e. environmental, sustainability, manufacturability, ethical, safety, social and political considerations.
Prereq: ECE 330, 331 and 480, or Permission

ECE 482 Computer Engineering Senior Design I (3 cr)
The capstone design sequence for computer engineering majors. Application of formal software and hardware design techniques, hardware/software interface considerations, project management; specifications, prototyping, troubleshooting and verification; report writing, documentation and oral presentations. Topics are considered in the context of a major design project involving a team of students. Projects incorporate realistic engineering constraints; i.e. environmental, sustainability, manufacturability, ethical, safety, social and political considerations.
Prereq: CS 240, 270; ECE 240, 241, 310, 311, 340, 341, 350, 351 and Stat 301; or Permission
Coreq: ECE 440

ECE 483 Computer Engineering Senior Design II (3 cr)
May be used as core credit in J-3-d. The capstone design sequence for computer engineering majors. Application of formal software and hardware design techniques, hardware/software interface considerations, project management; specifications, prototyping, troubleshooting and verification; report writing, documentation and oral presentations. Topics are considered in the context of a major design project involving a team of students. Projects incorporate realistic engineering constraints; i.e. environmental, sustainability, manufacturability, ethical, safety, social and political considerations.
Prereq: ECE 440 and 482; or Permission

ECE 491 Senior Seminar (0 cr)
Technical topics, professional ethics, employment practice, and interviewing. One lec a wk; one 3-6 day field trip may be required. Graded P/F.

ECE 499 (s) Directed Study (cr arr)

ECE 500 Master's Research and Thesis (cr arr)

ECE 501 (s) Seminar (cr arr)

ECE 502 (s) Directed Study (cr arr)

ECE 504 (s) Special Topics (cr arr)

ECE 512 Analog Filter Design (3 cr)
See ECE J412/J512.

ECE 513 Communication Circuits (3 cr)
See ECE J413/J513.

ECE 515 Analog Integrated Circuit Design (3 cr)
See ECE J415/J515.
ECE 517  Pulse and Digital Circuits (3 cr)  
See ECE J417/J517.

ECE 518  Introduction to Electronic Packaging (3 cr)  
See ECE J418/J518.

ECE 520  Advanced Electrical Machinery (3 cr)  
Synchronous machines and transformers, machine transient and subtransient reactances, excitation and voltage regulation, power curves, transformer connections, impedance, harmonics, and impulse characteristics.  
Prereq: ECE 423

ECE 521  Power System Stability (3 cr)  
Understanding, modeling, and analysis of power system transient and voltage stability; techniques for improving power system stability; use of computer tools. (Alt/yr)  
Prereq: ECE 520 or Permission

ECE 522  Induction Machines (3 cr)  
Winding theory, reference frame theory, induction machine models, complex vector methods, small signal analysis, induction machine capability, simulation, introduction to variable speed drives.  
Prereq: ECE 350, ECE 423, or Permission

ECE 523  Symmetrical Components (3 cr)  
Concepts of symmetrical components, sequence impedances of devices and lines, circuit equivalents for unbalanced faults, management during faults.  
Prereq: ECE 423

ECE 524  Transients in Power Systems (3 cr)  
Voltage transients; overvoltages during faults; recovery voltage characteristics; arc restrikes, switching surges, ferroresonance, and nonlinear phenomena.  
Prereq: ECE 423

ECE 525  Power System Protection and Relaying (3 cr)  
Power system faults and applicable relay systems; review of symmetrical components as applied to fault current and consideration of lightning and voltage surge protection.  
Prereq: ECE 423 or Permission

ECE WS526  Protection of Power Systems II (3 cr)  WSU E E 511  
Protection of electrical equipment as related to electric power systems with emphasis on digital algorithms.  
Prereq: ECE 525 or Permission

ECE 527  Dynamics and Control of AC Drives (3 cr)  
Review of machine modeling techniques and simulation methods, principles of power converters for motor drive applications; analytical modeling and dynamic behavior of machine-drive systems; modulation, regulation, and control techniques; simulation of drive systems; case studies.  
Prereq: ECE 320 and 470, or Permission

ECE 528  Understanding Power Quality (3 cr)  
Electrical fundamentals in the context of power quality; origins and characterization of power quality problems on distribution systems; applications of standards; advanced ground techniques; case study approach to common situations.

ECE 529  Utility Applications of Power Electronics (3 cr)  
HVdc transmission, static VAr compensators, FACTS devices, Custom Power devices, electrical energy storage systems, power quality, harmonic compensation, and alternative energy supply interfacing.  
Prereq: ECE 423

ECE ID&WS530  Advanced Electromagnetic Theory (3 cr)  WSU E E 518  
Maxwell's equations, potential theory, wave propagation and scattering, canonical problems, guided wave theory, antenna concepts, boundary value problems.  
Prereq: ECE 432 or Permission

ECE ID&WS533  Antenna Theory (3 cr)  WSU E E 527  
Maxwell's equations, reciprocity, equivalence theorems, wire antennas, antenna arrays, aperture antennas; analysis and design techniques; hardware considerations.  
Prereq: ECE 432 or Permission

ECE WS536  Wave Propagation and Scattering (3 cr)  WSU E E 516
ECE R538  EM Simulation (3 cr)
Computer simulation of electromagnetics using the finite-difference time-domain (FDTD) method; theory of finite-difference simulation, techniques for modeling EM propagation in lossy and dispersive media, boundary conditions for time-domain simulation.
Prereq: Permission

ECE 539  Advanced Topics in Electromagnetics (3 cr)
Topics include computational and analytical methods, remote sensing, nonlinear optics, guided wave theory, antenna theory.
Prereq: ECE 530 or Permission

ECE ID540  Asynchronous Circuit Design (3 cr)  WSU E E 554
Design and analysis of asynchronous digital circuits and systems; topics include: delays and hazards, state encoding, speed-independent and delay-insensitive circuits, micropipelines, and signal transition graphs.
Prereq: ECE 440 or Permission

ECE 541  Advanced Computer Architecture (3 cr)
See ECE J441/J541.

ECE 542  Digital Systems Testing (3 cr)
Fundamentals of testing and design for testability of digital electronic systems at both the module and board level; topics include circuit simulation, fault modeling and simulation, test pattern generation, design for testability, and built-in self-test.
Prereq: ECE 440 or Equivalent

ECE 545  Advanced VLSI Design (3 cr)
CMOS circuit techniques, analysis, modeling, performance, processing, and scaling; design of CMOS logic, gate arrays, data and signal processors, and memory. May not be used with ECE 546 for graduation.
Prereq: ECE 445

ECE 549  Fault-Tolerant Systems (3 cr)
See CS J449/J549.

ECE 551  Electroacoustic Sensors and Systems (3 cr)
See ECE J451/J551.

ECE 554  Theory of Error Correcting Codes (3 cr)
Introduction to error control coding; finite field mathematics; polynomial fields; general theory of block codes; syndrome decoding; cyclic codes; encoders and decoders for cyclic codes; generator polynomials; BCH and Reed-Solomon codes; convolutional codes; the Viterbi algorithm; convolutional encoders and decoders; Trellis coded modulation.
Prereq: ECE 455 or Permission

ECE 555  Information Theory (3 cr)
Introduction to Shannon Theory; entropy, relative entropy, and mutual information; asymptotic equipartition; entropy rates of stochastic processes; data compression; channel capacity, differential entropy; the Gaussian channel, Lempel-Ziv coding, rate distortion theory.
Prereq: ECE 455 or ECE 554 or Permission

ECE 556  Adaptive Signal Processing (3 cr)
Theory and applications of adaptive signal processing; adaptive linear combiner; performance surfaces; adaptive optimization of performance by gradient search; learning curve behavior, adaptation rates, and misadjustment; applications to filtering, prediction, estimation, control, and neural networks.
Prereq: ECE 350, Math 330, ECE 452 or 476 or 477, or Permission

ECE 557  Biological Signal Processing (3 cr)
See Neur 521.

ECE 559  Advanced Topics in Communication Systems (1-3 cr, max arr)
A selection of advanced topics from new research areas in communication systems; a representative selection of topics includes: recent developments in coding and information theory, image compression, cellular and mobile communication systems, magnetic recording, satellite communication systems, spread-spectrum modulation, set-membership theory, clock and carrier recovery methods, and communication channel modeling.
Prereq: ECE 452 or Permission

ECE 562  Semiconductor Theory (3 cr)
See ECE J462/J562.

ECE ID&WS570  Random Signals (3 cr)  WSU E E 507
Probability, random variables, and random signals in engineering systems; stochastic calculus, stationarity, ergodicity, correlation, and power spectra; propagation of random signals through linear systems; Kalman filter theory and applications.
Prereq: ECE 350, and Stat 301 or 451, or Permission
ECE 571  System Identification (3 cr)
Identification of dynamic system models from test data; methods to be considered include least-squares, prediction error, maximum likelihood, instrumental variables, correlation, and extended Kalman filter; practical applications and computer-based exercises emphasized within a mathematically rigorous framework.
Prereq: ECE 570 or Permission

ECE ID&WS572  Linear System Theory (3 cr)  WSU EE 501
Same as ME 580. Linear spaces and linear operators; descriptions of dynamic systems; input-output descriptions; state-space concepts; canonical forms; controllability and observability; minimal realizations; application to control and general systems analysis; pole assignment; observers.
Prereq: ECE 470 or Equivalent

ECE 573  Fuzzy Logic Control Systems (3 cr)
See ME 581.

ECE ID&WS574  Optimal Control Theory (3 cr)  WSU EE 502
Intro to optimization, parameter optimization, optimization of dynamic systems, optimization of dynamic systems with path constraints, optimal feedback control and dynamic programming, linear quadratic regulators, second variation methods, singular control problems, differential games.
Prereq: ECE 572 or Permission

ECE 575  Advanced Vibrations (3 cr)
Free and forced vibration of strings, membranes and plates; response to random inputs; advanced topics in spectral analysis to include statistical properties, windowing, and the zoom transforms; analysis of nonlinear systems including linearization, local and global stability, perturbation methods, and numerical simulation; introduction to chaos theory.
Prereq: ECE 470 or Permission

ECE 576  Digital Signal Processing (3 cr)
Characteristics of discrete time signals; design of digital filters with applications; advanced digital signal processing algorithms; discrete time spectral analysis; introduction to 2D processing.
Prereq: ECE 476 or Permission

ECE 577 (s)  Advanced Topics in Control Systems (3 cr)
Selection of advanced topics from new research areas in control systems; a representative selection of topics would include: adaptive, LOG/LTR, robust, nonlinear, fuzzy, and neural network control methods.
Prereq: ECE 572 or Permission

ECE 578  Neural Network Design (3 cr)
Same as CS 578 and ME 578. Same as ME 578 and CS 578. Introduction to neural networks and problems that can be solved by their application; introduction of basic neural network architectures; learning rules are developed for training these architectures to perform useful functions; various training techniques employing the learning rules discussed and applied; neural networks used to solve pattern recognition and control system problems.
Prereq: Permission

ECE ID579  Engineering Acoustics (3 cr)
See ME J413/ID-J513.

ECE 591  Electrical Engineering Research Colloquium (0 cr)
Graded P/F. Weekly colloquia on topics of general interest in electrical engineering and related fields; speakers will be from UI Electrical Engineering Department, other departments on campus, WSU, the local community, and outside agencies and universities.

ECE 599 (s)  Non-thesis Master’s Research (cr arr)
Research not directly related to a thesis or dissertation.
Prereq: Permission

ECE 600  Doctoral Research and Dissertation (cr arr)

BACKGROUND COURSES

These are not introductory-level courses. They are intended for engineers and scientists whose previous degrees are not in electrical engineering from ABET/EAC-accredited programs, who need to remove deficiencies before beginning graduate studies in electrical engineering.

ECE 319  Background Study in Electronics (3 cr)
Not applicable toward any UI undergrad degree; valid only for removal of electronics (ECE 310) deficiency for grad students who do not have BSEE background. See ECE 310 for description. Graded P/F based on comprehensive exam at completion of course.

**Prereq:** Permission

**ECE 329 Background Study in Energy Systems (3 cr)**
Not applicable toward any UI undergrad degree; valid only for removal of electrical machinery (ECE 320) deficiency for grad students who do not have BSEE background. See ECE 320 for description. Graded P/F based on comprehensive exam at completion of course.

**Prereq:** Permission

**ECE 339 Background Study in Electromagnetic Theory (3 cr)**
Not applicable toward any UI undergrad degree; valid only for removal of electromagnetic theory (ECE 330) deficiency for grad students who do not have BSEE background. See ECE 330 for description. Graded P/F based on comprehensive exam at completion of course.

**Prereq:** Permission

**ECE 349 Background Study in Digital Logic (3 cr)**
Not applicable toward any UI undergraduate degree; valid only for removal of digital computer fundamentals (ECE 240) deficiency for graduate students. See ECE 240 for description. Graded P/F.

**ECE 359 Background Study in Signals and Systems Analysis (3 cr)**
Not applicable toward any UI undergrad degree; valid only for removal of signals and systems analysis (ECE 350) deficiency for grad students who do not have BSEE background. See ECE 350 for description. Graded P/F based on comprehensive exam at completion of course.

**Prereq:** Permission

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**Engineering – General**

Aicha Elshabini, Dean (125 Janssen Engr. Bldg.; 208/885-2651); Howard S. Peavy, Associate Dean.

**Engr 102 Introduction to Engineering (2 cr)**
Offered summer only for students in the JEMS Program. Introduction to engineering career opportunities through analysis of engineering design problems; includes computer graphics, programming languages, economics, and statistics. (Summer only).

**Engr ID&WS105 Engineering Graphics (2 cr) WSU M E 103**
Freehand and computer aided drawing in pictorial and orthographic projection; section and auxiliary views; descriptive geometry; graphical presentation of data; scales, dimensioning, and measurements. Two lec and one 2-hr lab a wk.

**Engr 204 (s) Special Topics (cr arr)**

**Engr 205 Near Space Engineering (1 cr)**
Idaho RISE (Research Involving Student Engineers and Educators) is the NASA Idaho Space Grant Consortium student high-altitude scientific balloon program at the University of Idaho. RISE is a multidisciplinary program involving students from all departments in the College of Engineering, as well as Physics, Chemistry, Life Sciences, Education, and many other departments. Students in ENGR 205 will participate in the design, development, testing, flight and flight operations, recovery, and data analysis of balloon-borne science and engineering instrumentation flown to altitudes of 100,000 feet and higher. Recommended Preparation: Interest in space, aerospace science and engineering recommended.

**Engr ID&WS210 Engineering Statics (3 cr) WSU C E 211**
Principles of statics with engineering applications; addition and resolution of forces, vector algebra, moments and couples, resultants and static equilibrium, equivalent force systems, centroids, center of gravity, free body method of analysis, two and three dimensional equilibrium, trusses, frames, and friction.

**Prereq:** Math 170

**Engr ID&WS220 Engineering Dynamics (3 cr) WSU M E 212**
Particle and rigid body kinematics and kinetics; rectilinear, curvilinear, and relative motion, equations of motion, work and energy, impulse and momentum, systems of particles, rotation, rotating axes, rigid body analysis, angular momentum, vibration, and time response.

**Prereq:** Engr 210

**Engr 240 Introduction to Electrical Circuits (3 cr)**
Not open for credit to electrical engineering majors. Circuit analysis, transient and steady state behavior, resonant systems, system analysis, and power and energy concepts; elementary differential equations will be introduced to solve basic transient problems.

**Prereq:** Math 175, Phys 211

**Engr ID&WS320 Engineering Thermodynamics and Heat Transfer (3 cr) WSU M E 301**
First and second laws of thermodynamics; thermodynamic processes; thermodynamic properties; flow processes; conversion of heat into work; conduction, convection, radiation, and heat exchangers. Recommended Preparation: Engr 210 and Math 310.

**Engr ID&WS335 Engineering Fluid Mechanics (3 cr) WSU M E 303**
Physical properties of fluids; fluid statics; continuity, energy, momentum relationships; laminar and turbulent flow; boundary layer effects; flow in pipes, open channels, and around objects.
**Prereq:** Engr 210, Math 275

**Engr ID&WS350 Engineering Mechanics of Materials (3 cr) WSU C E 215**
Elasticity, strength, and modes of failure of engineering materials; theory of stresses and strains for ties, shafts, beams, and columns.
**Prereq:** Engr 210, Math 175
**Coreq:** Math 310

**Engr 360 Engineering Economy (2 cr)**
Economic analysis and comparison of engineering alternatives.
**Prereq:** Junior standing

### Engineering Management

Larry Stauffer, Director, Engineering Education (322 E. Front St., Boise, ID, 83702; phone 208/364-6180).

**EM J484/J584 Writing Winning Proposals (3 cr)**
Practical course to define the process for developing and submitting proposals. Topics include RFP identification, budgeting, scheduling, proposal writing, proposal reviews, and other topics in the proposal writing process. Guest lecturers will discuss their successful experiences. Students will produce one submission-ready proposal for review of technical writing skills. Additional projects reqd for grad cr.

**EM 486 Software-Assisted Project Management (3 cr)**
Characteristics and features of project management; procedures and techniques used in identifying software features that are necessary for recording project plans and for reporting project progress; process of selecting project management software that is consistent with the organization's procedures and requirements; evaluation of the modeling capabilities of a system in estimating and scheduling specific case studies of engineering projects. Two lec and 3 hrs of lab a wk.
**Prereq:** CE 482 or PMP Certification

**EM 502 (s) Directed Study (cr arr)**

**EM 504 (s) Special Topics (cr arr)**

**EM 510 Engineering Management Fundamentals (3 cr)**
Fundamental principles of engineering management addressing management theory applied to the engineering environment; management processes and techniques; attitudes that facilitate the leadership role of the engineering manager in an engineering organization; team-taught by business and engineering faculty.
**Prereq:** Permission

**EM 511 Legal Process for Engineers (3 cr)**
Designed to acquaint engineering management students with the legal process in general and the role of the judiciary in issues encountered by engineering managers. The course is intended to prepare professionals and managers for legal problems and potential liabilities they may encounter in their work as managers. Course employs the Socratic process to explore business organizations, employment law, contract law and other related topics.

**EM 582 Advanced Topics in Project Management (3 cr)**
Application of project management tools from a management perspective to address the basic nature of all types of projects including public, business, engineering, information systems, etc. Individual and group projects will apply project management tools to case studies and readings on current issues in project management. The course will roughly cover the eight knowledge areas recommended by the Project Management Institute.
**Prereq:** CE 482 or PMP Certification

**EM 584 Writing Winning Proposals (3 cr)**
See EM J484/J584.

**EM 587 Quality Engineering (3 cr)**
See ME 587.

**EM 599 (s) Non-thesis Master's Research (cr arr)**
Research not directly related to a thesis or dissertation.
Prereq: Permission