ELECTRICAL & COMPUTER ENGR (ECE)

ECE 101 Foundations of Electrical and Computer Engineering (2 credits)
Introductory course for incoming students with little or no fundamental electrical/computer engineering knowledge. Includes coverage of basic analog and digital circuits. Lab assignments also included.
Coreqs: MATH 143 or MATH 170

ECE 204 (s) Special Topics (1-16 credits)
Credit arranged

ECE 210 Electrical Circuits I (3 credits)
Intro to d. c. and transient electrical circuits; mesh and nodal analysis; dependent sources; circuit theorems; transient analysis with differential equations. Three lectures and one recitation per week.
Prereqs: MATH 175 with a grade of 'C' or better
Coreqs: ECE 211, MATH 310 and PHYS 212 and PHYS 212L

ECE 211 Electrical Circuits Lab I (1 credit)
Lab to accompany ECE 210. Lab experiments and computer simulations. One 3-hour lab per week.
Coreqs: ECE 210 and PHYS 212 and PHYS 212L

ECE 212 Electrical Circuits II (3 credits)
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 lectures and one recitation per week.
Prereqs: ECE 210, MATH 310, and PHYS 212 and PHYS 212L; a grade of 'C' or better is required for all prerequisite courses
Coreqs: ECE 213

ECE 213 Electrical Circuits II Lab (1 credit)
Lab to accompany ECE 212. Continuation of ECE 211. Lab experiments and computer simulations. One 3-hour lab per week.
Prereqs: ECE 211 and PHYS 212 and PHYS 212L
Coreqs: ECE 212

ECE 240 Digital Logic (3 credits)
Number systems, truth tables, logic gates, flip-flops, combinational and synchronous sequential circuits; intro to digital systems and basic microprocessor architecture.
Prereqs: PHYS 212 and PHYS 212L
Coreqs: ECE 241

ECE 241 Logic Circuit Lab (1 credit)
Lab to accompany ECE 240.
Prereqs: PHYS 212 and PHYS 212L
Coreqs: ECE 240

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

ECE 299 (s) Directed Study (1-16 credits)
Credit arranged

ECE 310 Microelectronics I (3 credits)
Operational amplifier fundamentals and applications, introduction to electronic devices such as diodes, bipolar junction transistor (BJT) and metal oxide semiconductor field effect transistors (MOSFET), 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 using passive and active elements such as current mirrors, frequency response 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.
Prereqs: ECE 212 and ECE 213
Coreqs: ECE 311

ECE 311 Microelectronics I Lab (1 credit)
Lab to accompany ECE 310.
Coreqs: ECE 310

ECE 319 Background Study in Electronics (3 credits)
Not applicable toward any UI undergraduate degree; valid only for removal of electronics (ECE 310) deficiency for graduate students who do not have BSEE background. See ECE 310 for description. Graded Pass/Fail based on comprehensive exam at completion of course. Graded Pass/Fail. Typically Offered: Varies.
Prereqs: Permission

ECE 320 Energy Systems I (3 credits)
Single-phase AC measurements, transformer parameters, transformer performance, rotating DC machines, DC-DC PE converters. Three lectures per week.
Prereqs: ECE 212 and PHYS 212 and PHYS 212L
Coreqs: ECE 321

ECE 321 Energy Systems I Laboratory (1 credit)
Lab to accompany ECE 320. Lab experiments and computer simulations. One 3-hour lab per week.
Prereqs: ECE 213, PHYS 212, PHYS 212L, MATH 310
Coreqs: ECE 320

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

ECE 330 Electromagnetic Theory (3 credits)
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.
Prereqs: MATH 275, MATH 310, and PHYS 212 and PHYS 212L
Coreqs: ECE 331

ECE 331 Electromagnetics Laboratory (1 credit)
Lab to accompany ECE 330. Lab experiments and computer simulations. One 3-hour lab per week.
Prereqs: MATH 275, MATH 310; PHYS 212 and PHYS 212L
Coreqs: ECE 330

ECE 340 Microcontrollers (3 credits)
Introduction to use of embedded microcontrollers and microprocessors; processor architecture; 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.
Prereqs: ECE 212, ECE 213, ECE 240, ECE 241, and CS 112 or CS 120
Coreqs: ECE 341

ECE 341 Microcontrollers Lab (1 credit)
Lab to accompany ECE 340.
Coreqs: ECE 340

ECE 349 Background Study Digital Logic (3 credits)
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 350 Signals and Systems I (3 credits)
Continuous and discrete, linear time invariant systems. Continuous and discrete linear time invariant systems. Differential and difference equations. Convolution integrals and sums. Fourier and Laplace transforms. Discrete time Fourier transforms and Z transforms. Emphasis on practical applications to engineering systems.
Prereqs: ECE 212 and MATH 310
Coreqs: ECE 351

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

ECE 359 Background Study in Signals and Systems Analysis (3 credits)
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 Pass/Fail based on comprehensive exam at completion of course. Graded Pass/Fail. Typically Offered: Varies.
Prereqs: Permission

ECE 398 Electrical Engineering Cooperative Internship (1-3 credits, max arranged)
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.
Prereqs: Permission

ECE 404 (s) Special Topics (1-16 credits)
Credit arranged

ECE 410 Microelectronics II (3 credits)
Introduction to analog integrated circuit (IC) 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/power amplifiers, advanced current sources and mirrors, and fundamentals of analog filters.
Prereqs: ECE 310 and ECE 311; or Permission

ECE 415 Analog Integrated Circuit Design (3 credits)
Joint-listed with ECE 515
Analog integrated circuit (IC) analysis, design, simulation, and layout, advanced biasing techniques, voltage references and regulators, operational amplifiers, frequency compensation techniques, noise analysis in analog circuits, and continuous-time integrated circuit filter design. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.
Prereqs: ECE 410 or Permission

ECE 418 Introduction to Electronic Packaging (3 credits)
Joint-listed with ECE 518
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 ECE 518. Cooperative: open to WSU degree-seeking students.
Prereqs: ECE 310

ECE 419 Image Sensors and Systems (3 credits)
Joint-listed with ECE 516
This course introduces various concepts and fundamentals related to semiconductor image sensors. Topics cover light production and detection, video image formats, image sensor characteristics and performance metrics, basic and advanced operation principals and types of semiconductor image sensors (CCD and CMOS), noise in imagers, image and color processing, and issues related to camera system design, integration and signal processing. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.
Prereqs: ECE 310

ECE 420 Energy Systems II (3 credits)
Three-phases, three-phase transformers, winding theory, rotating waves, steady state operation of three-phase synchronous and steady state operation of single and three-phase induction machines, and AC drives. Labs: three-phase measurements, three-phase transformers, synchronous machines, induction machines. ECE 420 cannot be counted as a graduate depth area course.
Prereqs: ECE 320 and ECE 321

ECE 421 Introduction to Power Systems (3 credits)
One line diagrams, regulating transformers, calculation of transmission line parameters, line models, Ybus, power flow, power flow studies using commercial software, contingency studies, and power system control. (Fall only)
Coreqs: ECE 420

ECE 422 Power Systems Analysis (3 credits)
Balanced and unbalanced faults, Zbus methods, transient generator models, stability analysis, fault analysis using commercial software, and introduction to power system protection. (Spring only)
Prereqs: ECE 421

ECE 427 Power Electronics (3 credits)
Characteristics, limitations, and application of solid state power devices; practical aspects of power electronic converters, including rectifiers and inverters; choppers, AC phase control, and device gating techniques. Cooperative: open to WSU degree-seeking students.
Coreqs: ECE 420

ECE 430 Microwave and Millimeter Wave Circuits (3 credits)
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.
Prereqs: ECE 330 or Permission

ECE 432 Propagation of Wireless Signals (3 credits)
Maxwell's Equations, including Poynting's vector and Poynting's theorem; Wave equation with solutions, Helmholz 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.
Prereqs: ECE 330 or Permission

ECE 434 Antenna Principles and Design (3 credits)
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.
Prereqs: ECE 330 or Permission

ECE 440 Digital Systems Engineering (3 credits)
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.
Prereqs: ECE 240, ECE 241, or Permission

ECE 441 Advanced Computer Architecture (3 credits)
Cross-listed with CS 451
Joint-listed with CS 551, ECE 541
JPrinciples and alternatives in instruction set design; processor implementation techniques, pipelining, parallel processors, memory hierarchy, and input/output; measurement of performance and cost/performance trade-off. Additional work required for graduate credit. Typically Offered: Fall.
Prereqs: CS 150 and (STAT 301 OR STAT 251) or Permission

ECE 443 Distributed Processing and Control Networks (3 credits)
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 of ways of maximizing the three essential processor resources: memory, CPU time, and input/output. Methods for writing error free programs and designing fault tolerant computing systems.
Prereqs: ECE 340, ECE 341, ECE 350, and ECE 351

ECE 444 Supervisory Control and Critical Infrastructure Systems (3 credits)
Cross-listed with CS 444
Joint-listed with ECE 544 and CS 544
Principles of network-based distributed real-time control and critical infrastructure systems. Integration of dedicated control protocols with wide area networks (e. g. the Internet). Issues of reliability, cost, and security. Application to selected industries, such as electric power distribution and waste and water management. Recommended preparation: ECE 340, CS 240, ME 313, CE 330, or CE 372. (Spring, alt/years.)
Prereqs: Senior or Graduate standing in the College of Engineering

ECE 445 Introduction to VLSI Design (3 credits)
Principles of design of very large scale integrated circuits; CMOS logic design; transistor sizing and layout methodologies; intro to IC CAD tools.
Prereqs: ECE 310, ECE 240 or Permission.

ECE 450 Signals and Systems II (3 credits)
Continuation of ECE 350. Two-sided Laplace transform. Relationships among Fourier series, Fourier transform, and Laplace transform. Feedback, modulation, filtering, sampling, state space analysis, and modeling of systems. Emphasis on practical applications of theory to solve engineering problems.
Prereqs: ECE 350 and MATH 330

ECE 452 Communication Systems (3 credits)
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. Cooperative: open to WSU degree-seeking students. (Alt/years)
Prereqs: ECE 450 and (STAT 301 or MATH 451)

ECE 455 Information and Coding Theory (3 credits)
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.
Prereqs: MATH 330 and STAT 301

ECE 460 Semiconductor Devices (3 credits)
Introduction to semiconductor physics and basic semiconductor devices; intro to electro-optical devices.
Prereqs: ECE 350

ECE 462 Quantum Mechanics for Electrical Engineers (3 credits)
Joint-listed with ECE 562
Fundamental theory and behavior of modern semiconductor devices. Additional projects/assignments required for graduate credit. Typically Offered: Spring.
Prereqs: ECE 460 or Permission

ECE 465 Introduction to Microelectronics Fabrication (3 credits)
Joint-listed with ECE 565
This course serves as an introduction to the fabrication of microelectronic devices. Topics include the basics of IC structures, clean room protocol, photolithography, film growth and deposition, as well as IC interconnect technologies. Additional projects/assignments required for graduate credit.
Prereqs: ECE 310

ECE 469 Resilient Control of Critical Infrastructure (3 credits)
Joint-listed with ECE 569
This course establishes a perspective on the unique challenges of automation in our society and provides insight on how an industrial control system works and how it can fail due to threats from cyber security, human error, and complex interdependencies. It also introduces concepts from the resilient controls community that attempt to make industrial control systems more resilient to these threats. Furthermore, it provides background to the vocabulary and fundamental concepts related to the variety of disciplines required for the effective management, control, and protection of critical infrastructure. Additional work required for graduate credit. Cooperative: open to WSU degree-seeking students.

ECE 470 Control Systems (3 credits)
Cross-listed with ME 481
Analysis and design of feedback control systems using frequency and time domain methods, and computer-aided design tools. Cooperative: open to WSU degree-seeking students.
Prereqs: MATH 330 Prereq for Electrical Engineering and Computer Engineering majors: ECE 350 Prereq for Mechanical Engineering majors: ME 313

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

ECE 477 Digital Process Control (3 credits)
Cross-listed with CHE 445
Dynamic simulation of industrial processes and design of digital control systems. Coordinated lecture-lab periods. Recommended Preparation: CHE 444 (Recommended Preparation for EE majors: ECE 350).

ECE 480 EE Senior Design I (3 credits)
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.
Prereqs: ECE 240, ECE 241, ECE 310, ECE 311, ECE 320, ECE 321, ECE 330, ECE 331, ECE 340, ECE 341, ECE 350, ECE 351; or Permission
Coreqs: STAT 301

ECE 481 EE Senior Design II (3 credits)
General Education: Senior Experience
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.
Prereqs: ECE 480 and STAT 301 or Permission

ECE 482 Computer Engineering Senior Design I (3 credits)
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.
Prereqs: CS 240, CS 270, ECE 240, ECE 241, ECE 310, ECE 311, ECE 340, ECE 341, ECE 350, and ECE 351, or Permission
Coreqs: ECE 440 and STAT 301

ECE 483 Computer Engineering Senior Design II (3 credits)
General Education: Senior Experience
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.
Prereqs: ECE 440 and ECE 482 and STAT 301; or Permission

ECE 487 Sustainable and Renewable Energy (3 credits)
Joint-listed with ECE 587
This course will introduce technologies and characteristics for renewable and sustainable energy systems. Topics will include generation technologies, energy storage technologies and demand response concepts, including recent and future trends. Technological, economic, and policy issues for applying renewable energy technologies for grid connected and stand-alone uses will be presented. Additional projects/assignments required for graduate credit. Typically Offered: Fall.
Prereqs: Upper division standing in Electrical or Computer Engineering

ECE 490 Near Space Engineering Leadership (1 credit, max 6)
This course is for students in the Near Space Engineering program who are in the position of Flight Director, Assistant Flight Director, Project Systems Engineer, Launch and Recovery Manager, or leading one of the four flight engineering teams. The course emphasizes important leadership skills, including communication, planning and scheduling, and delegation. Students are expected to make oral technical presentations of goals, activities, progress, and accomplishments at technical meetings and conferences, work closely with research engineers and scientists in industry and NASA, and work with other high altitude scientific ballooning and near space engineering programs throughout the State. Recommended preparation: Prior experience and concurrent enrollment in University of Idaho Near Space Engineering Program.
Prereqs: Permission

ECE 491 Senior Seminar (0 credits)
Technical topics, professional ethics, employment practice, and interviewing. One lecture per week. Graded P/F.

ECE 498 (s) Internship (1-16 credits)
Credit arranged

ECE 499 (s) Directed Study (1-16 credits)
Credit arranged

ECE 500 Master's Research and Thesis (1-16 credits)
Credit arranged

ECE 501 (s) Seminar (1-16 credits)
Credit arranged

ECE 502 (s) Directed Study (1-16 credits)
Credit arranged

ECE 503 (s) Workshop (1-16 credits)
Credit arranged

ECE 504 (s) Special Topics (1-16 credits)
Credit arranged

ECE 505 (s) Professional Development (1-16 credits)
Credit arranged

ECE 515 Analog Integrated Circuit Design (3 credits)
Joint-listed with ECE 415
Analog integrated circuit (IC) analysis, design, simulation, and layout, advanced biasing techniques, voltage references and regulators, operational amplifiers, frequency compensation techniques, noise analysis in analog circuits, and continuous-time integrated circuit filter design. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.
Prereqs: ECE 410 or Permission

ECE 516 Image Sensors and Systems (3 credits)
Joint-listed with ECE 419
This course introduces various concepts and fundamentals related to semiconductor image sensors. Topics cover light production and detection, video image formats, image sensor characteristics and performance metrics, basic and advanced operation principals and types of semiconductor image sensors (CCD and CMOS), noise in imagers, image and color processing, and issues related to camera system design, integration and signal processing. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.
Prereqs: ECE 310

ECE 518 Introduction to Electronic Packaging (3 credits)
Joint-listed with ECE 418
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 ECE 518. Cooperative: open to WSU degree-seeking students.
Prereqs: ECE 310

ECE 520 Advanced Electrical Machinery (3 credits)
Synchronous machines and transformers, machine transient and subtransient reactances, excitation and voltage regulation, power curves, transformer connections, impedance, harmonics, and impulse characteristics. Cooperative: open to WSU degree-seeking students.
Prereqs: ECE 422

ECE 522 Induction Machines (3 credits)
Winding theory, reference frame theory, induction machine models, complex vector methods, small signal analysis, induction machine capability, simulation, introduction to variable speed drives. Cooperative: open to WSU degree-seeking students.
Prereqs: ECE 350, ECE 422, or Permission

ECE 523 Symmetrical Components (3 credits)
Concepts of symmetrical components, sequence impedances of devices and lines, circuit equivalents for unbalanced faults, management during faults. Cooperative: open to WSU degree-seeking students.
Prereqs: ECE 422

ECE 524 Transients in Power Systems (3 credits)
Analysis and simulation of electromagnetic transients on electric power systems; switching transients; lightning transients; mitigation of transient overvoltages; surge protection; modeling power systems apparatus for transient studies. Cooperative: open to WSU degree-seeking students.
Prereqs: ECE 421

ECE 525 Power System Protection and Relaying (3 credits)
Power systems protection fundamentals; dynamic response of current voltage measurement devices; numerical relay fundamentals; review of symmetrical components; application of overcurrent elements, distance elements and differential elements for the real time protection and monitoring of transmission, distribution and generation apparatus. Cooperative: open to WSU degree-seeking students.
Prereqs: ECE 422 or Permission

ECE 526 Protection of Power Systems II (3 credits)
Protection of electrical equipment as related to electric power systems with emphasis on digital algorithms. Cooperative: open to WSU degree-seeking students.
Prereqs: ECE 525 or Permission

ECE 528 Understanding Power Quality (3 credits)
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 credits)
HVdc transmission, static VAr compensators, FACTS devices, Custom Power devices, electrical energy storage systems, power quality, harmonic compensation, and alternative energy supply interfacing.
Prereqs: ECE 422

ECE 530 Advanced Electromagnetic Theory I (3 credits)
Maxwell's equations, potential theory, wave propagation and scattering, canonical problems, guided wave theory, antenna concepts, boundary value problems. Cooperative: open to WSU degree-seeking students.
Prereqs: ECE 432 or Permission

ECE 531 Advanced Electromagnetic Theory II (3 credits)
Boundary value problems in non-Cartesian systems, diffraction, perturbation techniques, variational techniques, wave transformations.
Prereqs: ECE 530 or Permission

ECE 533 Antenna Theory (3 credits)
Maxwell's equations, reciprocity, equivalence theorems; wire antennas, antenna arrays, aperture antennas; analysis and design techniques; hardware considerations. Cooperative: open to WSU degree-seeking students.
Prereqs: ECE 432 or Permission

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

ECE 541 Advanced Computer Architecture (3 credits)
Cross-listed with CS 551
Joint-listed with CS 451, ECE 441
JPrinciples and alternatives in instruction set design; processor implementation techniques, pipelining, parallel processors, memory hierarchy, and input/output; measurement of performance and cost/performance trade-off. Additional work required for graduate credit.
Typically Offered: Fall.

ECE 544 Supervisory Control and Critical Infrastructure Systems (3 credits)
Cross-listed with CS 544
Joint-listed with CS 444, ECE 444
Principles of network-based distributed real-time control and critical infrastructure systems. Integration of dedicated control protocols with wide area networks (e. g. the Internet). Issues of reliability, cost, and security. Application to selected industries, such as electric power distribution and waste and water management. Recommended preparation: ECE 340, CS 240, ME 313, CE 330, or CE 372. (Spring, alt/ years.)

ECE 562 Quantum Mechanics for Electrical Engineers (3 credits)
Joint-listed with ECE 462
Fundamental theory and behavior of modern semiconductor devices. Additional projects/assignments required for graduate credit. Typically Offered: Spring.

ECE 565 Introduction to Microelectronics Fabrication (3 credits)
Joint-listed with ECE 465
This course serves as an introduction to the fabrication of microelectronic devices. Topics include the basics of IC structures, clean room protocol, photolithography, film growth and deposition, as well as IC interconnect technologies. Additional projects/assignments required for graduate credit.
Prereqs: ECE 310

ECE 569 Resilient Control of Critical Infrastructure (3 credits)
Joint-listed with ECE 469
This course establishes a perspective on the unique challenges of automation in our society and provides insight on how an industrial control system works and how it can fail due to threats from cyber security, human error, and complex interdependencies. It also introduces concepts from the resilient controls community that attempt to make industrial control systems more resilient to these threats. Furthermore, it provides background to the vocabulary and fundamental concepts related to the variety of disciplines required for the effective management, control, and protection of critical infrastructure. Additional work required for graduate credit. Cooperative: open to WSU degree-seeking students.

ECE 570 Random Signals (3 credits)
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. Cooperative: open to WSU degree-seeking students.
Prereqs: ECE 350, and STAT 301 or STAT 451, or Permission

ECE 572 Linear System Theory (3 credits)
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. Cooperative: open to WSU degree-seeking students.
Prereqs: ECE 470 or equivalent

ECE 579 Engineering Acoustics (3 credits)
Cross-listed with ME 513
Joint-listed with ME 413
Fundamentals of acoustics including wave theory; transmission through layers, generation and reception; low frequency models; application to sound measurement, transducers, loudspeaker cabinet design, and nondestructive testing; acoustic design project required. Additional projects/assignments required for graduate credit. ME 513 is cooperative: open to WSU degree-seeking students.
Prereqs: ENGR 240 or ECE 212, and MATH 310, or ME 313

ECE 586 Industrial Control Systems (3 credits)
Cross-listed with NE 586
Combines control systems theory and implementation topics. Theory topics include: process dynamics and modeling; instrumentation, sensors and measurements; feedback and feedforward concepts; and basic control design methods. Implementation topics include: programmable logic controllers, fundamentals of ladder logic, network configuration, and basic security concepts. Typically Offered: Fall.

ECE 587 Sustainable and Renewable Energy (3 credits)
Joint-listed with ECE 487
This course will introduce technologies and characteristics for renewable and sustainable energy systems. Topics will include generation technologies, energy storage technologies and demand response concepts, including recent and future trends. Technological, economic, and policy issues for applying renewable energy technologies for grid connected and stand-alone uses will be presented. Additional projects/ assignments required for graduate credit. Typically Offered: Fall.

ECE 588 Advanced Frequency-Domain Control (3 credits)
Advanced theory and design techniques for high-performance autonomous systems. Frequency-domain methods are presented, along with nonlinear dynamic compensation and absolute stability analysis. Emphasis placed on maximizing performance for reference tracking, disturbance rejection, and insensitivity to parameter variation. Suitable for graduate students and practicing control engineers. Applications include aerospace, power systems, electronics, and robotics problems. Typically Offered: Spring (Odd Years).
Prereqs: ECE 470/ME 481 or equivalent

ECE 589 Power Systems Planning and Operation (3 credits)
Planning and operation of electric power systems. Topics include but not limited to economic dispatch, unit commitment, optimal power flow, and state estimation. Typically Offered: Fall (Odd Years).
Prereqs: ECE 422

ECE 591 Electrical Engineering Research Colloquium (0 credits)
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. Graded P/F.

ECE 598 (s) Cooperative Internship (1-16 credits)
Credit arranged. Supervised internship in industry in professional engineering settings, integrating academic study with work experience; requires a final written report and possible additional requirements to be worked out with the faculty supervisor.

ECE 599 (s) Non-thesis Master's Research (1-16 credits)
Credit arranged. Research not directly related to a thesis or dissertation.
Prereqs: Permission

ECE 600 Doctoral Research and Dissertation (1-45 credits)
Credit arranged