DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

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The Department of Electrical and Computer Engineering offers degree programs in the closely related fields of electrical engineering and computer engineering. The electrical engineering program spans the subdisciplines of analog electronics, electric power, electromagnetics, computers, and communication and control systems. The computer engineering program focuses on the architecture, programming, and application of digital computers. Bachelor of Science, Master of Science, and Master of Engineering degrees are offered in both electrical engineering and computer engineering. The Doctor of Philosophy degree is offered in electrical engineering and encompasses research in both electrical and computer engineering.

Mission and Vision

The mission of the department is to educate students for the professional practice of electrical and computer engineering by offering undergraduate and graduate programs that encourage lifelong learning, foster teamwork and leadership, and promote creative discovery. The department is committed to maintaining the highest possible standards in teaching, scholarship, advising, and service. The vision of the department is to continue to expand its role in the state and region as a provider of outstanding undergraduate and graduate education programs in electrical and computer engineering.

Continuous Improvement

The department uses a continuous improvement process to attain the program educational objectives set forth below. Each of the broad objectives is associated with a number of specific student outcomes that are measured by a variety of assessment tools. Programs are assessed annually to identify problems and initiate changes to ensure that program objectives are being met. Additional information about the assessment and continuous improvement process is available under the department web page.

The department is proud of its over 100-year history and its more than 2,500 alumni. Our graduates have become productive engineers and industrial and community leaders all over the nation and the world, and are actively recruited by major employers of electrical and computer engineers. Both the Electrical and Computer Engineering programs are accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, ph. 410-347-7700. Graduates of our program consistently score higher than the national average on the Fundamentals of Engineering examination administered by the National Council of Examiners for Engineering and Surveying.

The department offices and laboratories are located in the Buchanan Engineering Laboratory and the Gauss-Johnson Laboratory on the Moscow campus. Courses are also offered through branch campuses located in Boise, Idaho Falls, and Coeur d'Alene, and through the Engineering Outreach program.

Electrical Engineering Undergraduate Program. Electrical engineering involves the application of electrical phenomena for the benefit of society. Electrical engineers design and use circuits and systems for computers, instruments, communications devices, and power conversion equipment.

Program Educational Objectives

The program educational objectives of the electrical engineering program are to produce graduates who:

1. **Learn and Integrate.** Graduates of the program will demonstrate proficiency in identifying, formulating, and solving engineering problems by applying their knowledge and understanding of mathematics, science, and engineering.
2. **Think and Create.** Graduates of the program will demonstrate proficiency in designing analog and digital circuits and systems, power systems, control systems, or computing systems. They will demonstrate the capabilities of analyzing, designing, implementing, and verifying circuits, devices, and systems to meet specified requirements while considering real-world constraints.
3. **Communicate.** Graduates of the program will demonstrate an ability to communicate effectively through oral and written media to interdisciplinary groups, including team members, constituents, and the public.
4. **Clarify Purpose and Perspective.** They will engage in lifelong learning activities to further develop their technical and professional capabilities and skills.
5. **Practice Citizenship.** Graduates of the program demonstrate knowledge of professional and ethical responsibility. They will consider the societal impact of their work, and/or add value to the profession and to society through active engagement in professional societies, community services, and outreach to future generations of engineers.

Students in the electrical engineering program are assigned a faculty advisor upon entry into the program. The advisor helps the student prepare appropriate class schedules each semester and provides guidance on other academic and professional issues. Students can take an electrical engineering course in their freshman year that introduces them to the field and helps prepare them for further study. Required courses in the freshman year help develop a solid foundation in physics, chemistry, mathematics, and writing. Foundation courses in science, mathematics, and engineering are continued in the sophomore year, including the first two courses in electrical circuits. The junior year exposes the student to a wide variety of electrical engineering courses to develop breadth in electrical engineering knowledge and skills. In the senior year, students specialize in specific areas of electrical engineering through the choice of technical electives. Students also take a two-semester sequence of design courses where students learn to design, test, and build an electrical engineering circuit or system. Additional courses in the humanities, social sciences, and English help prepare the graduate to become a well-rounded and productive member of society.

Computer Engineering Undergraduate Program. Computer engineering involves the application of the principles of electrical engineering and computer science for the benefit of society. Computer engineers design and use digital computers for instrumentation, control, communication, and power conversion systems.

Program Educational Objectives

The program educational objectives of the computer engineering program are to produce graduates who:

1. **Learn and Integrate.** Graduates of the program will demonstrate proficiency in identifying, formulating, and solving engineering problems by applying their knowledge and understanding of mathematics, science, and engineering.
2. **Think and Create.** Graduates of the program will demonstrate proficiency in analysis and design of hardware and software-based systems using modern methods and tools to meet specified requirements while considering real-world constraints.
3. **Communicate.** Graduates of the program will demonstrate an ability to communicate effectively through oral and written media to interdisciplinary groups, including team members, constituents, and the public.
4. **Clarify Purpose and Perspective.** They will engage in lifelong learning activities to further develop their technical and professional capabilities and skills.
5. **Practice Citizenship.** Graduates of the program demonstrate knowledge of professional and ethical responsibility. They will consider the societal impact of their work, and/or add value to the profession and to society through active engagement in professional societies, community services, and outreach to future generations of engineers.

Students in the computer engineering program are assigned a faculty advisor upon entry into the program. The advisor helps the student prepare appropriate class schedules each semester and provides guidance on other academic and professional issues. In the freshman year, students take introductory courses in physics, mathematics, and computer science to help develop a solid foundation based on these fundamental areas. The sophomore year continues with more physics and mathematics, but also introduces the students to more advanced courses in computer science, computer engineering, and electrical circuits. The junior year provides breadth in several areas of electrical and computer engineering and computer science including electronics, signals and systems, microcontrollers, programming languages, and operating systems. The senior year allows the student to develop some depth of knowledge in selected areas through a variety of technical elective courses. In addition, the student takes a two-semester sequence of design courses where students learn to design, test, and build a computer engineering system. Additional courses in the humanities, social sciences, English, and public speaking help prepare the graduate to become a well-rounded and productive member of society.

Note: In addition to college requirements for admission to classes (see "Admission to Classes" under the College of Engineering section), students majoring in electrical engineering or computer engineering must earn a grade of C or better in certain lower division courses and a passing grade in ECE 292 as prerequisite to any upper-division course in electrical engineering or computer engineering. Advisor's approval is required for admission to all ECE courses.

Courses

See the course description section for courses in Electrical and Computer Engineering (ECE).

Electrical and Computer Engineering Undergraduate Curricular Requirements

Computer Engineering (B.S.Comp.E.)

Required course work includes the university requirements (see regulation J-3) and:

Comm 101	Fundamentals of Public Speaking (2 cr)
CS 120	Computer Science I (4 cr)
CS 121	Computer Science II (4 cr)
CS 150	Computer Organization and Architecture (3 cr)
CS 210	Computing Languages (3 cr)
CS 240	Computer Operating Systems (3 cr)
CS 270	System Software (3 cr)
ECE 101	Foundations of Electrical and Computer Engineering (2 cr)
ECE 210	Electrical Circuits I (3 cr)
ECE 211	Electrical Circuits I Lab (1 cr)
ECE 212	Electrical Circuits II (3 cr)
ECE 213	Electrical Circuits II Lab (1 cr)
ECE 240	Digital Logic (3 cr)
ECE 241	Logic Circuit Lab (1 cr)
ECE 292	Sophomore Seminar (0 cr)
ECE 310	Microelectronics I (3 cr)
ECE 311	Microelectronics I Lab (1 cr)
ECE 340	Microcontrollers (3 cr)
ECE 341	Microcontrollers Lab (1 cr)
ECE 350	Signals and Systems Analysis (3 cr)
ECE 351	Signals and System Lab (1 cr)
ECE 440	Digital Systems Engineering (3 cr)
ECE 482	CompE Senior Design I (3 cr)
ECE 483	CompE Senior Design II (3 cr)
ECE 491	Senior Seminar (0 cr)
Engl 317	Technical Writing (3 cr)
Math 170	Analytic Geometry and Calculus I (4 cr)
Math 175	Analytic Geometry and Calculus II (4 cr)
Math 176	Discrete Mathematics (3 cr)
Math 310	Ordinary Differential Equations (3 cr)
Math 330	Linear Algebra (3 cr)
Phys 211, Phys 211L	Engineering Physics I and Lab (4 cr)
Phys 212, Phys 212L	Engineering Physics II and Lab (4 cr)
Stat 301	Probability and Statistics (3 cr)

Science elective selected from Chem 111, Geol 111/Geol 111L, MMBB 154/MMBB 155, or Phys 213/Phys 213L (4 cr)
Technical electives selected from upper-division computer engineering, electrical engineering, and computer science courses (15 cr)

One of the following (3 cr):

AmSt 301	Studies in American Culture (3 cr)
Phil 103	Ethics (3 cr)

One of the following (3-4 cr):

Econ 201	Principles of Macroeconomics (3 cr)
Econ 202	Principles of Microeconomics (3 cr)
Econ 272	Foundations of Economics (4 cr)

Courses to total 128 credits for this degree, not counting Engl 101, Math 143, and other courses that might be required to remove deficiencies.

Students majoring in computer engineering must earn a grade of C or better in each of the following courses for graduation, and before registration is permitted in upper-division engineering courses: ECE 210, ECE 212, ECE 240, ECE 241, Math 170, Math 175, Math 310, Phys 211, and Phys 212. Before registration is permitted in 200-level CS courses students majoring in computer engineering must earn a grade of C or better in CS 120, CS 121 and CS 150 and Math 176. Students majoring in computer engineering must earn a grade of C or better in CS 210, CS 240, CS 270, and Math 170, Math 175, Math 176 for graduation and before registration is permitted in upper-division CS courses.

Any student majoring in computer engineering may accumulate no more than five (5) letter grades of D's and F's in mathematics, science, or engineering courses that are used to satisfy graduation requirements. Included in this number are multiple repeats of a single class or single repeats in multiple classes and courses transferred from other institutions. Specifically excluded are D or F grades from laboratory sections associated with courses.

Electrical Engineering (B.S.E.E.)

Required course work includes the university requirements (see regulation J-3) and:

Chem 111	Principles of Chemistry I (4 cr)
CS 120	Computer Science I (4 cr)
ECE 101	Foundations of Electrical and Computer Engineering (2 cr)
ECE 210	Electrical Circuits I (3 cr)
ECE 211	Electrical Circuits I Lab (1 cr)
ECE 212	Electrical Circuits II (3 cr)
ECE 213	Electrical Circuits II Lab (1 cr)
ECE 240	Digital Logic (3 cr)
ECE 241	Logic Circuit Lab (1 cr)
ECE 292	Sophomore Seminar (0 cr)
ECE 310	Microelectronics I (3 cr)
ECE 311	Microelectronics I Lab (1 cr)
ECE 320	Energy Systems I (3 cr)
ECE 321	Energy Systems I Lab (1 cr)
ECE 330	Electromagnetic Theory (3 cr)
ECE 331	Electromagnetics Lab(1 cr)
ECE 340	Microcontrollers (3 cr)
ECE 341	Microcontrollers Lab (1 cr)
ECE 350	Signals and Systems I (3 cr)
ECE 351	Signals and System Lab (1 cr)
ECE 480	EE Senior Design I (3 cr)
ECE 481	EE Senior Design II (3 cr)
ECE 491	Senior Seminar (0 cr)
Engr 210	Engineering Statics (3 cr)
Engr 220	Engineering Dynamics (3 cr)
Engr 360	Engineering Economy (2 cr)
Engl 317	Technical Writing (3 cr)
Math 170	Analytic Geometry and Calculus I (4 cr)
Math 175	Analytic Geometry and Calculus II (4 cr)
Math 275	Analytic Geometry and Calculus III (3 cr)
Math 310	Ordinary Differential Equations (3 cr)
Math 330	Linear Algebra (3 cr)
Phys 211, Phys 211L	Engineering Physics I and Lab (4 cr)
Phys 212, Phys 212L	Engineering Physics II and Lab (4 cr)
Stat 301	Probability and Statistics (3 cr)

One of the following (3 cr):

AmSt 301	Studies in American Culture (3 cr)
Phil 103	Ethics (3 cr)

One of the following (3-4 cr):

Econ 201	Principles of Macroeconomics (3 cr)
Econ 202	Principles of Microeconomics (3 cr)
Econ 272	Foundations of Economics (4 cr)

Upper-division engineering science elective chosen from Engr 320, Engr 335, Engr 350, Engr 428, Math 428, or Phys 428 (3 cr)
Technical electives taken from upper-division Engineering, Math, Physics, Statistics, and Computer Science courses. Students may request, after approval by their academic advisor and the Petition Committee, to use other upper division technical courses in the College of Science or in Engineering Management (EM) in partial fulfillment of this requirement. Of these eighteen credits a minimum of twelve credits must be selected from electrical engineering courses including at least nine credits from the follow courses: ECE 410 or ECE 418, ECE 420, ECE 430, ECE 440 or ECE 443, ECE 450 and ECE 460 or ECE 465. (18 cr)

Courses to total 128 credits for this degree, not counting Engl 101, Math 143, and other courses that might be required to remove deficiencies.

Students majoring in electrical engineering must earn a grade of P in ECE 292 and a grade of C or better in each of the following courses for graduation and before registration is permitted in upper-division electrical and computer engineering courses: Chem 111, CS 120, ECE 210, ECE 211, ECE 212, ECE 213, ECE 240 and ECE 241; Engr 210, and Engr 220; Math 170, Math 175, Math 275, and Math 310; and Phys 211, Phys 212. Students majoring in electrical engineering or computer engineering must meet the college requirements for admission to classes (see "Admission to Classes" under College of Engineering, part four).

Any student majoring in electrical engineering may accumulate no more than five (5) letter grades of D's and F's in mathematics, science, or engineering courses that are used to satisfy graduation requirements. Included in this number are multiple repeats of a single class or single repeats in multiple classes and courses transferred from other institutions. Specifically excluded are D or F grades from laboratory sections associated with courses.

Within the constraints on choice of technical electives noted above, students may choose sets of electives to develop proficiencies in certain areas of emphasis. Three such areas are currently available, one in communications, one in integrated circuit design, and one in power. The course requirements for each of these areas are described below.

The **Communications** emphasis prepares students for a variety of careers in the communications industry. Students should take a total of 18 credits from the following: (a) core courses: 9 credits from ECE 410, ECE 430, ECE 450, and (b) technical electives: 9 credits from ECE 413, ECE 432, ECE 445, ECE 452, ECE 455.

The **Microelectronics** emphasis prepares students for variety careers in the semiconductor industry. It includes courses in analog/RF and mixed-signal integrated circuit (IC) design, semiconductors, and IC packaging. Students should take a total of 18 credits from the following: (a) 6 required credits: ECE 410, ECE 460, and (b) 3 core credits: ECE 413, ECE 415, ECE 418, and (c) 3 credits of ECE 440, ECE 430, ECE 450 and ECE 465, and (d) 6 additional credits of technical electives from ECE 413, ECE 415, ECE 417, ECE 418, ECE 419, ECE 445, ECE 462, ECE 465.

The **Power** emphasis prepares students for a variety of careers with electric utilities, consulting firms, and with manufacturing and design firms. Students should take a total of 18 credits from the following: (a) 12 credits: ECE 420, ECE 422, ECE 427 and ECE 450, and (b) 3 core credits from: ECE 410, ECE 430, ECE 440, and (c) 3 additional credits of technical electives.

Electrical and Computer Engineering Graduate Academic Certificates Requirements

Analog Integrated Circuit Design Graduate Academic Certificate

Note: A grade of 'B' or higher is required in all coursework for this academic certificate.

ECE 512	Analog Filter Design (3 cr)
ECE 515	Analog Integrated Circuit Design (3 cr)
ECE 517	Mixed Signal IC Design (3 cr)

Electives (3 cr):

ECE 416	Applications of Linear Integrated Circuits (3 cr)
ECE 430	Microwave and Millimeter Wave Circuits (3 cr)
ECE 445	Introduction to VLSI Design (3 cr)
ECE 460	Semiconductor Devices (3 cr)
ECE 513	Radio-Frequency IC Design (3 cr)

Courses to total 12 credits for this certificate

Communication and Control for Power Transmission and Distribution Graduate Academic Certificate

Note: A grade of 'B' or higher is required in all coursework for this academic certificate.

CS 420 **or** CS 520	Data Communication Systems (3 cr)
ECE 421	Introduction to Power Systems (3 cr)

Electives (6 cr):

CS 448 **or** CS 548	Survivable Systems and Networks (3 cr)
CS 449 **or** CS 549	Fault Tolerant Systems (3 cr)
ECE 422	Power System Analysis (3 cr)
ECE 521	Power System Stability (3 cr)
ECE 525	Power System Protection and Relaying (3 cr)

Courses to total 12 credits for this certificate

Electric Machines and Drives Graduate Academic Certificate

Note: A grade of 'B' or higher is required in all coursework for this academic certificate.

ECE 427	Power Electronics (3 cr)
ECE 520	Advanced Electrical Machinery (3 cr)
ECE 527	Dynamics and Control of AC Drives (3 cr)

Electives (3 cr):

ECE 470	Control Systems (3 cr)
ECE 504	Special Topics (3 cr)
ECE 522	Induction Machines (3 cr)

Courses to total 12 credits for this certificate

Power System Protection and Relaying Graduate Academic Certificate

Note: A grade of 'B' or higher is required in all course work for this academic certificate.

ECE 422	Power Systems Analysis (3 cr)
ECE 525	Power System Protection and Relaying (3 cr)

Electives (6 cr):

ECE 452	Communication Systems (3 cr)
ECE 476	Digital Filtering (3 cr)
ECE 504	Special Topics (3 cr)
ECE 523	Symmetrical Components (3 cr)
ECE 524	Transients in Power Systems (3 cr)
ECE 526	Protection of Power Systems II (3 cr)

Courses to total 12 credits for this certificate

Semiconductor Theory and Devices Graduate Academic Certificate

Note: A grade of 'B' or higher is required in all coursework for this academic certificate.

ECE 460	Semiconductor Devices (3 cr)
ECE 562	Semiconductor Theory (3 cr)

Electives (6 cr):

ECE 515	Analog Integrated Circuit Design (3 cr)
ECE 517	Mixed Signal IC Design (3 cr)
ECE 545	Advanced VLSI Design (3 cr)

Any 500-Level ECE course (except special topics, thesis credit, etc.) as approved by the certificate coordinator (3 cr)

Courses to total 12 credits for this certificate

Electrical and Computer Engineering Graduate Degree Programs

Candidates must fulfill the requirements of the College of Graduate Studies and of the Department of Electrical and Computer Engineering. See the College of Graduate Studies section for the general requirements applicable to each degree.

Computer Engineering

The Computer Engineering Program offers both Master of Science and Master of Engineering degrees. Both degrees may be earned through the Engineering Outreach off campus program. These advanced degrees offer engineering students an opportunity to strengthen their knowledge of computer engineering by taking graduate courses that focus on advanced subject matter and by participating in research.

Qualifications for Admittance. Candidates must have a bachelor's degree in computer engineering, with an undergraduate GPA of 3.00 or higher. International students who are required to take the TOEFL examination by the College of Graduate Studies must have a TOEFL score of at least 79 for the Internet-based Test (iBT) version, 213 for the computer version, or 550 for the paper version. All candidates must submit scores from the general portion of the Graduate Record Examination.

Candidates who do not have a bachelor's degree in computer engineering may be admitted to the graduate program if, in addition to the requirements for candidates who have a B.S.Comp.E., they meet the following minimum requirements.

1. A bachelor's degree in electrical engineering, computer science, or another engineering discipline or in a supporting area of study such as mathematics or physics.
2. Demonstrated proficiency in the fundamentals of computer engineering emphasized in the undergraduate curriculum. Proficiency is demonstrated by successful completion of the following fundamental courses: Fundamentals of Electronics (ECE 310), Digital Logic (ECE 240), Computer Organization and Architecture (CS 150), Computer Science II (CS 121), Discrete Mathematics (Math 176), Differential Equations (Math 310), Linear Algebra (Math 330). Some deficiencies may be removed by taking background courses through Engineering Outreach. Students with undergraduate course deficiencies in the fundamentals of computer engineering must remove these deficiencies prior to admission for graduate work. Such deficiency courses cannot be used for graduate credit.
3. Two advanced undergraduate courses in electrical engineering, computer engineering, or computer science equivalent to Computer Operating Systems, Digital Systems Engineering (ECE 440). Students with undergraduate course deficiencies in the advanced areas of computer engineering must remove these deficiencies either prior to admission or in the first three semesters of graduate work. Such deficiency courses cannot be used for graduate credit.

Master of Science. To be approved, programs must satisfy both the university requirements governing the M.S. degree and must be enrolled in ECE 591, Electrical Engineering Research Colloquium, during each semester of on-campus enrollment.

Master of Engineering. To be approved, programs must satisfy both the university requirements governing the M.S. degree and must be enrolled in ECE 591, Electrical Engineering Research Colloquium, during each semester of on-campus enrollment.

Electrical Engineering

Master of Science. General M.S. requirements apply, except that the department requires at least 24 credits of course work in addition to a thesis. The master's program may provide advanced preparation for professional practice, or it may serve as the first step in graduate study leading to the Ph.D. degree. Specific courses to be taken for the program are not prescribed by the faculty. Students, with the assistance of their major professor, prepare their own program as soon as possible during their first semester, and submit it to the faculty for approval.

1. At least 18 credits in electrical engineering courses numbered 500 or above.
2. Two or more electrical engineering courses numbered above 500 in a given area for depth.
3. At least one course in each of two areas (outside the areas selected under item 2) to provide breadth.
4. Enrollment in ECE 591, Electrical Engineering Research Colloquium, during each semester of on-campus enrollment.

Master of Engineering. General M.Engr. requirements apply, except that the department requires at least 30 credits of course work. Students, with the assistance of their major professor, prepare their own program as soon as possible during their first semester, and submit it to the faculty for approval. To be approved, programs must satisfy both the university requirements governing the M.Engr. degree and the following department requirements:

1. At least 18 credits in electrical engineering courses numbered 500 or above.
2. At least three electrical engineering courses in a given area for depth, two of which must be numbered 500 or above.
3. At least one course in each of two areas (outside the areas selected under item 2) to provide breadth.
4. Enrollment in ECE 591, Electrical Engineering Research Colloquium, during each semester of on-campus enrollment.

Doctor of Philosophy. General Ph.D. requirements apply. The preliminary examination consists of both a written and an oral examination. There is no foreign language requirement. Two semesters of ECE 591, Electrical Engineering Research Colloquium, will be required for on-campus doctoral students.

ELECTRICAL AND COMPUTER ENGINEERING COURSES

Fred D. Barlow, Dept. Chair, Dept. of Electrical and Computer Engineering (214 Buchanan Engr. Lab. 83844-1023; phone 208/885-6554).

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.
Prereq: *Math 175 with a grade of 'C' or better*
Coreq: *ECE 211, Math 310 and Phys 212/212L*

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 212/212L*

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 212/212L; a grade of 'C' or better is required for all prerequisite courses*
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 212/212L*
Coreq: *ECE 212*

ECE 240 Digital Logic (3 cr)
Number systems, truth tables, logic gates, flip-flops, combinational and synchronous sequential circuits; intro to digital systems and basic microprocessor architecture; certification exam not reqd.
Prereq: Phys 212/212L
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 212/212L*
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 Microelectronics I (3 cr)
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.
Prereq: *ECE 212 and ECE 213*
Coreq: *ECE 311*

ECE 311 Microelectronics I Lab (1 cr)
Lab to accompany ECE 310.
Coreq: *ECE 310*

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 212/212L*
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 212/212L, 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, Math 310, and Phys 212/212L*
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, Math 310; Phys 212/212L*
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 212, ECE 213, ECE 240, ECE 241, and CS 112 or CS 120*
Coreq: *ECE 341*

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

ECE 350 Signals and Systems I (3 cr)
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.
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 Microelectronics II (3 cr)
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.

Prereq: *ECE 310 and ECE 311; or Permission*

ECE 411 Microelectronics II Lab (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 Radio-Frequency IC Design (3 cr)
Radio frequency (RF) communications concepts, integrated circuit (IC) transceiver architectures, low-noise amplifier, mixers, passive devices and matching networks, oscillators, power amplifiers, phase-locked loops, and frequency synthesizers. Additional projects/assignments are required for graduate students.
Prereq: *ECE 410 or Permission*

ECE J415/J515 Analog Integrated Circuit Design (3 cr)
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.
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 Mixed Signal IC Design (3 cr)
Sample and hold (S/H) circuits, comparators, data-converter fundamentals, Nyquist-rate digital-to-analog converters (DAC) and analog-to-digital converters (ADC), over-sampling data converters, and phase-locked loops. Additional projects/assignments are required for graduate credit.
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 J419/J516 Image Sensors and Systems (3 cr)
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 are required for graduate credit.
Prereq: *ECE 310*

ECE 420 Energy Systems II (3 cr)
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.
Prereq: *ECE 320 and ECE 321*

ECE 421 Introduction to Power Systems (3 cr)
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)
Prereq: *ECE 420*

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

ECE 427 Power Electronics (3 cr)
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.
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, 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.
Prereq: *ECE 330 or Permission*

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 J444/J544 Supervisory Control and Critical Infrastructure Systems (3 cr)
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/yrs.)
Prereq: *Senior or Graduate standing in the College of Engineering*

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

ECE 450 Signals and Systems II (3 cr)
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.

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 452 Communication Systems (3 cr)
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/yrs)
Prereq: *ECE 450*

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 for ECE 462: ECE 460
Prereq for ECE 562: Permission

ECE J465/J565 Introduction to Microelectronics Fabrication (3 cr)
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.
Prereq: *ECE 310*

ECE 470 Control Systems (3 cr)
See 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, ECE 241, ECE 310, ECE 311, ECE 320, ECE 321, ECE 330, ECE 331, ECE 340, ECE 341, ECE 350, ECE 351 and Stat 301; or Permission*

ECE 481 EE Senior Design II (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 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)
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 490 Near Space Engineering Leadership (1 cr, 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.
Prereq: *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 Radio-Frequency IC Design (3 cr)
See ECE J413/J513.

ECE 515 Analog Integrated Circuit Design (3 cr)
See ECE J415/J515.

ECE 516 Image Sensors and Systems (3 cr)
See ECE J419/J516.

ECE 517 Mixed Signal IC Design (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 422*

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/yrs)
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 422, 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 422*

ECE 524 Transients in Power Systems (3 cr)
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.
Prereq: *ECE 421*

ECE 525 Power System Protection and Relaying (3 cr)
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.
Prereq: *ECE 422 or Permission*

ECE 526 Protection of Power Systems II (3 cr)
Protection of electrical equipment as related to electric power systems with emphasis on digital algorithms. Cooperative: open to WSU degree-seeking students.
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 422*

ECE 530 Advanced Electromagnetic Theory I (3 cr)
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.
Prereq: *ECE 432 or Permission*

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

ECE 533 Antenna Theory (3 cr)
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.
Prereq: *ECE 432 or Permission*

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

ECE 544 Supervisory Control and Critical Infrastructure Systems (3 cr)
See ECE J444/J544.

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

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, and ECE 450 or ECE 452 or ECE 476 or ECE 477, or Permission*

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

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

ECE 565 Introduction to Microelectronics Fabrication (3 cr)
See ECE J465/J565.

ECE 570 Random Signals (3 cr)
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.
Prereq: *ECE 350, and Stat 301 or Stat 451, or Permission*

ECE 571 Estimation Theory for Signal Processing, Communications, and Control (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. Cooperative: open to WSU degree-seeking students.
Prereq: *ECE 570 or Permission*

ECE 572 Linear System Theory (3 cr)
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. Cooperative: open to WSU degree-seeking students.
Prereq: *ECE 470 or Equivalent*

ECE 578 Neural Network Design (3 cr)
Same as CS 578 and ME 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 579 Engineering Acoustics (3 cr)
See ME J413/J513. Cooperative: open to WSU degree-seeking students.

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 598 (s) Cooperative Internship (cr arr)
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. Graded P/F.
Prereq: *Permission*

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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