

EDUC 495H. Directed Study Courses in Education 1-3 cr.
Special topics relating to school programs. Course shall be identified by a qualifying subtitle. For honor students only.

• E E—Electrical and Computer Engineering

- E E 109. The Engineering of How Things Work** 3 cr.
This class provides students in the HP-Engineering cluster with an introduction to various aspects of engineering. Restricted to HP cluster students.
- E E 110. The Science and Engineering of How Things Work** 4 cr. (3+3P)
Introduction to the basic science and engineering concepts of everyday devices. For nonmajors only.
- E E 111. Introduction to Electrical and Computer Engineering** 4 cr. (3+3P)
Covers electric and electronic component descriptions and equations. Kirchoff's voltage and current laws, formulation and solution of DC network equations. Applications of circuit analysis to actual circuits including phasors, ideal op amps, and diodes. Corequisite: MATH 191.
- E E 161. Computer Aided Problem Solving** 4 cr. (3+3P)
Evolution and application of computers, social and economic implications, introduction to programming using engineering workstations. Extensive practice in writing programs to solve engineering problems. Computer interfaces to real-world systems. Satisfies General Education computer science requirement. Corequisite: MATH 191.
- E E 201. Networks I** 3 cr.
Electric component descriptions and equations. Kirchoff's voltage and current laws, formulation and solution of network equations using time domain concepts. Prerequisite: Minimum 2.0 GPA. Corequisite: MATH 192. For nonmajors only.
- E E 211. AC Circuits** 4 cr. (3+3P)
Complete solutions of RLC and switching networks. Sinusoidal steady-state analysis. Three-phase analysis. Mutual coupling. Frequency-selective networks. Prerequisites: C or better in E E 111 and MATH 192.
- E E 221. Electronics I** 4 cr. (3+3P)
Single-time-constant circuits and opamp applications. Introduction to solid-state devices. Diode circuits. Single-transistor BJT and MOS amplifiers. Introduction to digital CMOS circuits. Prerequisite: C or better in E E 211.
- E E 261. Digital Design I** 4 cr. (3+3P)
Design of combinational logic circuits. Introduction to state machine design. Implementation using programmable logic devices and micro-controllers. Prerequisites: C or better in E E 111 and E E 161. Corequisite: MATH 192.
- E E 264. Object-Oriented Problem Solving** 4 cr. (3+3P)
Continuation of E E 161, in which computer problem-solving skills are enhanced using object-oriented techniques. Prerequisite: C or better in E E 161. Main campus only.
- E E 301. Vector Principles for Electrical Engineers** 3 cr.
Calculus of vector functions through electrostatic and magnetostatic applications. Techniques for finding resistance, capacitance, and inductance. Coulomb's law, gradient, Gauss' divergence theorem, curl, Stoke's theorem, and Green's theorem. Prerequisite: C or better in MATH 291. Main campus only.
- EE 302. Random Variable and Signal Analysis (f, s)** 3 cr.
Application of probability, random variables and random processes to problems in electrical engineering. Topics include modeling random experiments, discrete probability, random variables, probability density functions, functions of a random variable, computing mean, variance, moments and characteristic foundation, joint random variables, confidence intervals, and related topics. Applications to be covered include probabilistic modeling of electrical/electronic systems in general and, in particular, the analysis of simple communications systems. Prerequisite: EE 211.
- E E 311. Signals and Systems** 4 cr. (3+3P)
Transform methods for solution of continuous- and discrete-time systems. Fourier and Laplace transforms. Frequency response and Bode plots. Z transform. Continuous- and discrete-time convolution. Prerequisites: C or better in E E 161 and E E 211. Corequisites: MATH 392.
- E E 315. Applied Electromagnetics** 4 cr. (3+3P)
Static electric and magnetic fields. Maxwell's equations, time-varying electromagnetic fields, generalized plane wave propagation in lossless media, introduction to plane-wave polarization, and microwave transmission line theory. Prerequisite: C or better in E E 161, E E 211, and E E 301.
- E E 324. Introduction to Analog and Digital VLSI** 4 cr. (3+3P)
Introduction to analog and digital VLSI circuits and MOS technology. Design of differential amplifiers, opamps, CMOS logic, and flip-flops. Introduction to VLSI CAD tools. Prerequisites: C or better in E E 221 and E E 261.
- E E 330. Environmental Management Seminar I** 1 cr.
Survey of practical and new developments in hazardous and radioactive waste management provided through a series of guest lectures and reports of ongoing research. Same as: C E 330, CH E 330, E S 330, E T 330, I E 330, M E 330, and WERC 330.
- E E 332. Introduction to Electric Power Engineering** 4 cr. (3+3P)
Introduction to the principles, concepts, and analysis of the major components of an electric power system. Material includes basic electro-mechanics, transformers, AC and DC machines, transmission lines, and system analysis. Prerequisites: C or better in E E 161 and E E 211.
- E E 341. Control Systems I** 4 cr. (3+3P)
Mathematical representations of systems, time and frequency response characteristics, stability, introduction to control system design. Prerequisite: C or better in E E 311.
- E E 361. Digital Design II** 3 cr.
Sequential digital logic design technique. Classical and modern design of synchronous and asynchronous machines. Design using SSI and MSI technology. Prerequisite: C or better in E E 261.
- E E 363. Computer Systems Architecture I (f, s)** 4 cr. (3+3P)
Concepts of modern computer architecture. Processor micro-architectures, hardwired vs. micro-programmed control, pipelining and pipeline hazards, memory hierarchies, bus-based system architecture and memory mapping, hardware-software interface, and operating system concepts. Prerequisite: C or better in C S 273 or E E 261. Same as C S 363.
- E E 370. Geometrical Optics** 4 cr. (3+3P)
Reflection, refraction, lenses, prisms, ray tracing, stops and pupils, image formation, first order lens design, aberrations, and optical instrumentation. Prerequisite: MATH 191.
- E E 395. Introduction to Digital Signal Processing (f)** 3 cr.
Undergraduate treatment of sampling/reconstruction, quantization, discrete-time systems, digital filtering, Z-transforms, transfer functions, digital filter realizations, discrete Fourier transform (DFT) and fast Fourier transform (FFT), finite impulse response (FIR) and infinite impulse response (IIR) filter design, and digital signal processing (DSP) applications. Prerequisite: C or better in E E 311.
- E E 400. Undergraduate Research** 1-3 cr.
Directed undergraduate research. May be repeated for a maximum of 9 credits. Prerequisite: consent of the department head.
- E E 430. Environmental Management Seminar II** 1 cr.
Survey of practical and new developments in hazardous and radioactive waste management provided through a series of guest lectures and reports of ongoing research. Same as: C E 430, CH E 430, E S 430, E T 430, I E 430, M E 430, and WERC 430.
- E E 431. Power Systems II** 3 cr.
Analysis of a power system in the steady-state. Includes the development of models and analysis procedures for major power system components and for power networks. Prerequisites: C or better in E E 332.
- E E 432. Power Electronics (f)** 3 cr. (2+3P)
Basic principles of power electronics and its applications to power supplies, electric machine control, and power systems. Prerequisites: C or better in E-E 321 and E E 332. Corequisites: E E 311 and E E 341.
- E E 442. Real-Time Digital Signal Processing** 3 cr.
Project-oriented course covering the fundamentals of real-time digital signal processing (DSP) by programming a state-of-the-art digital processor to solve a variety of problems in digital audio and communications engineering. Prerequisite: C or better in E E 395.
- E E 452. Introduction to Radar** 3 cr.
Basic concepts of radar. Radar equation; detection theory. AM, FM, and CW radars. Analysis of tracking, search, MTI, and imaging radar. Prerequisite: C or better in E E 315.
- E E 453. Microwave Engineering** 3 cr.
Techniques for microwave measurements and communication system design, including transmissions lines, waveguides, and components. Microwave network analysis and active device design. Prerequisites: C or better in E E 315.
- E E 454. Antennas and Radiation** 3 cr.
Basic antenna analysis and design. Fundamental antenna concepts and radiation integrals. Study of wire antennas, aperture antennas, arrays, reflectors, and broadband antennas. Prerequisite: C or better in E E 315.

- EE 455. Signal Intelligence I 3 cr.
Analysis of realistic navigation, communication, radar, telemetry, networks and other signals which may contain intelligence information. Prerequisites: C or better in EE 161 and EE 395.
- EE 456. Signal Intelligence II 3 cr.
Application of signal intelligence techniques to three-dimensional images. Prerequisites: C or better in EE 161 and EE 455.
- EE 458. Wireless Systems I 3 cr. (2+3P)
Wireless components including passive and active microwave devices, as well as end-to-end RF system performance. Design, simulation, fabrication, and test of prototype components. Prerequisite: C or better in EE 451 and consent of instructor.
- EE 459. Wireless Systems II 3 cr. (2+3P)
Techniques for wireless communication system design with an emphasis on practical antenna design. Design, simulation, fabrication, and test of wireless system. Prerequisites: C or better in EE 451 and consent of instructor.
- EE 460. Space System Mission Design and Analysis 3 cr.
Satellite system design, including development, fabrication, launch, and operations. A systems engineering approach to concepts, methodologies, models, and tools for space systems. Prerequisite: junior standing.
- EE 461. Systems Engineering and Program Management 3 cr.
Modern technical management of complex systems using satellites as models. Team projects demonstrate systems engineering disciplines required to configure satellite components. Prerequisite: junior standing.
- EE 463. Computer Systems Architecture II 3 cr.
Same as C S 473. Prerequisite: C or better in EE 363.
- EE 464. Software Engineering I 3 cr.
Design of software systems for modern microcomputers. Emphasis on design of real-time operating systems, multi-tasking systems, device drivers, and interrupt handlers. Projects require design of software interfaces between hardware components, language compilers, and operating systems. Prerequisite: C or better in EE 363.
- EE 466. Modern Digital System Design 3 cr.
Design techniques for solving problems using state-of-the-art MSI, LSI, and microprocessor components. Algorithmic State Machine design is stressed for small systems. Hierarchical design methods used for microprocessor systems and interfaces. Emphasis on problem definition, design, and verification. Prerequisite: EE 361. Corequisite: EE 363.
- EE 467. High Performance Computers 6 cr. (3+9P)
Design of high-performance computer systems, including rigorous timing analysis, and consideration of transmission-line effects and metastability. Design projects emphasize state-of-the-art technology and architectures with realistic design objectives and constraints, and pull together concepts from many areas of electrical and computer engineering. Prerequisite: C or better in EE 466.
- EE 468. Real-Time Computers 3 cr.
Covers computer system designing for real-time applications such as aerospace systems, industrial process control, and laboratory instrumentation; transducers and their limitations; modular hardware and software design; real-time programming and operating systems. Includes student design project. Prerequisite: C or better in EE 466
- EE 469. Digital Communications Networks 3 cr.
Simulation-based design of data/computer communication networks. Design of wide area, local area, and computer networks and protocols. Network performance. Projects require use of network simulation tools in comprehensive network design. Prerequisite: EE 361 or EE 363.
- EE 470. Physical Optics 3 cr.
Same as PHYS 470.
- EE 475. Control Systems II 3 cr.
Design and synthesis of control systems using state variable and frequency domain techniques. Compensation, optimization, multi-variable system design techniques. Prerequisite: C or better in EE 341.
- EE 476. Computer Control Systems 3 cr.
Representation, analysis and design of discrete-time systems using time-domain and z-domain techniques. Microprocessor control systems. Prerequisite: C or better in EE 341.
- EE 477. Fiber Optic Communication Systems 4 cr. (3+3P)
Fundamental characteristics of individual elements (transmitters, detectors, and fibers) of fiber optic communication systems. Design and characterization of high-speed, multichannel fiber optic communication links. Introduction to fiber optic distribution networks as components. Prerequisite: C or better in EE 315 or PHYS 461. Same as PHYS 477.
- EE 478. Optical Sources, Detectors and Radiometry 4 cr. (3+3P)
Fundamentals of optical sources, detectors, and radiometric measurements in the visible and infrared. Radiometry of imaging and nonimaging optical systems, including optical fibers. Detector preamplifiers, noise, NEP, D, optical filters, and sensor system design. Laboratory included. Corequisite: an undergraduate optics course. Same as PHYS 478.
- EE 479. Lasers and Applications 4 cr. (3+3P)
Lasers, their construction, operating principles, characteristics, and applications with hands-on experience. Beam propagation in optical fibers. Laboratory included. Prerequisite: C or better in EE 315 or in PHYS 461. Same as PHYS 479.
- EE 471. Modern Experimental Optics 2 cr.
Same as PHYS 471.
- EE 482. Electronics II (f) 3 cr. (2+3P)
Feedback analysis, application of operational amplifiers, introduction to data converters, analog filters, oscillator circuits.. Prerequisite: C or better in EE 161 and EE 221.
- EE 483. RF Microelectronics 3 cr.
Analysis, design and implementation of RF integrated circuits in CMOS/BJT technologies. Low noise amplifiers and mixers, power amplifiers, wideband amplifiers, oscillators, phase-locked frequency synthesizers. Prerequisites: C or better in EE 324 and EE 315. Same as EE 519.
- EE 484. A/D and D/A Converter Design 3 cr.
Practical design of integrated data converters in CMOS/BJT technologies. Opamps, comparators, sample and holds, MOS switches, element mismatches. Nyquist rate converter architectures: flash, successive approximation, charge redistribution, algorithmic, two-step, folding, interpolating, pipelined, delta-sigma converters. Prerequisite: C or better in EE 311 and EE 485. Same as EE 520.
- EE 485. Analog VLSI Design 3 cr. (2+3P)
Analysis, design, simulation, layout and verification of CMOS analog building blocks, including references opamps, switches and comparators. Teams implement a complex analog IC. Prerequisite: C or better in EE 311 and EE 324. Same as EE 523.
- EE 486. Digital VLSI Design 3 cr. (2+3P)
Static and dynamic logic techniques, memory circuit, datapath operators. Teams implement a complex CMOS digital block using industrial VLSI CAD tools. Prerequisites: C or better in EE 324 and EE 361.
- EE 493. Power Systems III 3 cr.
Analysis of a power system under abnormal operating conditions. Topics include symmetrical three-phase faults, theory of symmetrical components, unsymmetrical faults, system protection, and power system stability. Prerequisite: C or better in EE 332.
- EE 494. Distribution Systems 3 cr.
Concepts and techniques associated with the design and operation of electrical distribution systems. Prerequisite: C or better in EE 332.
- EE 496. Introduction to Communication Systems I 3 cr.
Introduction to the analysis of signals in the frequency and time domains. A study of baseband digital transmission systems and digital/analog RF transmission systems. Introduction to telecom systems as well as satellite systems. Prerequisites: C or better in EE 311 and MATH 392.
- EE 497. Introduction to Communication Systems II 3 cr.
Continuation of EE 496. Introduction to probability theory and the analysis of the performance of digital bandpass signaling methods. Prerequisite: C or better in EE 496 and STAT 371.
- EE 498. Capstone Design I 1-6 cr.
Application of engineering principles to a significant design project. Includes teamwork, written and oral communications, and realistic technical, economic, and public safety requirements. Prerequisite: senior standing and consent of instructor.
- EE 499. Capstone Design II 1-6 cr.
Realization of design project from EE 498 within time and budget constraints. Prerequisite: C or better in EE 498 and consent of instructor.
- EMD—Educational Management and Development
- EMD 101. Freshman Orientation 1 cr.
Introduction to the university and to the College of Education. Discussion of and planning for individualized education program and field experience. Graded S/U.
- EMD 195. Teacher Pathway Orientation 1-3 cr.
Introduction to the education profession for public school students who are participating in the Teacher Pathway Program. Special permit required. Restricted to education majors. Graded S/U.