ELECTRICAL AND COMPUTER ENGINEERING

The Department of Electrical and Computer Engineering (https://www.uakron.edu/engineering/ECE/) offers two undergraduate programs, leading to the Bachelor of Science in Electrical Engineering and the Bachelor of Science in Computer Engineering. The department also offers graduate programs leading to a Master of Science in Electrical Engineering, and an interdisciplinary Doctor of Philosophy in Engineering.

4400: Electrical Engineering

Every aspect of modern life is influenced by electrical engineers. They design and develop systems ranging from massive power grids and global communications networks to tiny integrated circuits inside computers and personal electronics. Branches of electrical engineering include communications, controls, electromagnetics, electronics, and power systems. Important applications include power generation and distribution, sustainable energy systems, manufacturing automation, aerospace systems, robotics, sensors and instrumentation, imaging systems, and many others.

The Electrical Engineering program is accredited by the Engineering Accreditation Commission of ABET, www.abet.org (http://www.abet.org). Our comprehensive curriculum prepares students to identify, formulate, and implement solutions to real-world problems. Students learn how to use modern engineering tools in well-equipped laboratories, with activities that reinforce the concepts learned in the classroom. The curriculum emphasizes design and teamwork, and culminates in a capstone senior design project that integrates the material learned in earlier courses. The Electrical Engineering program offers two options, with and without a co-operative education component; our well-established co-op program enables students to strengthen the connections between theory and practice in a professional setting, and provides valuable industrial experience.

The program educational objectives (PEOs) for the Electrical Engineering program are that, within a few years after graduation, our Electrical Engineering graduates:

- achieve competitively compensated electrical engineering positions or related professional positions, or entry into programs of advanced study
- prove to be highly competent and productive in electrical engineering or related practice
- continue to develop professionally through both practical experience and a lifelong commitment to learning
- exhibit high standards of ethical conduct, societal responsibility, and professionalism in engineering

The Electrical Engineering program has specified these student outcomes to be achieved by the time of graduation:

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

(2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

(3) an ability to communicate effectively with a range of audiences

(4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

(5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

4450: Computer Engineering

In addition to traditional large computer applications, devices containing some form of embedded computing system are becoming pervasive in our society. Computer engineers design and develop hardware and software for all of these systems, ranging from software applications to communication networks to components in computing systems to small embedded sensors. Branches of computer engineering include operating systems, embedded systems design, digital circuits, algorithms, software design, and computer architecture among others. Important applications include wired and wireless networks, simulation, automation, digital control, sensing, robotics, “apps,” data management, and many others.

The Computer Engineering program is accredited by the Engineering Accreditation Commission of ABET, www.abet.org (http://www.abet.org). Our comprehensive curriculum prepares students to identify, formulate, and implement solutions to real-world problems. Students learn how to use modern engineering tools in well-equipped laboratories, with activities that reinforce the concepts learned in the classroom. The curriculum emphasizes design and teamwork, and culminates in a capstone senior design project that integrates the material learned in earlier courses. The Computer Engineering program offers two options, with and without a co-operative education component; our well-established co-op program enables students to strengthen the connections between theory and practice in a professional setting, and provides valuable industrial experience.

The program educational objectives (PEOs) for the Computer Engineering program are that, within a few years after graduation, our Computer Engineering graduates:

- achieve competitively compensated computer engineering positions or related professional positions, or entry into programs of advanced study
- prove to be highly competent and productive in computer engineering or related practice
- continue to develop professionally through both practical experience and a lifelong commitment to learning
- exhibit high standards of ethical conduct, societal responsibility, and professionalism in engineering

The Computer Engineering program has specified these student outcomes to be achieved by the time of graduation:

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

(2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

(3) an ability to communicate effectively with a range of audiences

(4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

(5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Information specific to the available program options in electrical engineering and computer engineering is available:

- Computer Engineering, BS (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/electrical-computer/computer-engineering-bs/)
- Computer Engineering, Co-op Option, BS (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/electrical-computer/computer-engineering-co-op-bs/)
- Electrical Engineering, BS (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/electrical-computer/electrical-engineering-bs/)
- Electrical Engineering, Co-op Option, BS (https://bulletin.uakron.edu/undergraduate/colleges-programs/engineering-polymer-science/electrical-computer/electrical-engineering-co-op-bs/)

Electrical Engineering (4400)

4400:101 Tools for Electrical Engineering (3 Credits)
Corequisite: 3450:221 or 3450:149. Orientation to degree programs and design practice in electrical and computer engineering. Introduction to computer applications and resources for engineering studies.

4400:230 Circuits I Laboratory (1 Credit)
Corequisite: 4400:231. Computation, computer aided circuit analysis, circuit theorem confirmation, report writing to include data analysis and reduction, introduction to electrical measurements.

4400:231 Circuits I (3 Credits)
Corequisite: 4400:230, 3450:223, 3650:292. DC and AC linear circuit analysis. Operational amplifier circuits. Loop and nodal analyses. Network theorems. Phasor techniques, steady-state AC power, three-phase systems.

4400:301 Undergraduate Research I: Electrical Engineering (1 Credit)
Prerequisites: 4400:230, 4400:231, 4400:330, 4400:332, 4450:220, [4400:101 or 4450:101] with a combined average grade of 3.0 or higher, admission to an engineering major within the College of Engineering and Polymer Science, and permission. Research project, supervised by faculty member of the department; requires oral research presentation and written report.

4400:302 Undergraduate Research II: Electrical Engineering (1 Credit)
Prerequisites: [4400:301 or 4450:301], admission to an engineering major within the College of Engineering and Polymer Science, and permission. Research project, supervised by faculty member of the department; requires oral research presentation and written report.

4400:303 Undergraduate Research III: Electrical Engineering (1 Credit)
Prerequisites: [4400:302 or 4450:302], admission to an engineering major within the College of Engineering and Polymer Science, and permission. Research project, supervised by faculty member of the department; requires oral research presentation and written report to the department, and presentation of work in a research venue outside the department.

4400:304 Undergraduate Research IV: Electrical Engineering (1 Credit)
(May be repeated. May not be applied to degree requirements.) Prerequisite: 4400:303 or 4450:303, and permission. Research project, supervised by faculty member of the department; requires oral research presentation and written report.

4400:307 Basic Electrical Engineering (4 Credits)
Prerequisite: 3650:292; corequisite: 3450:335. Covers fundamental aspects of electrical circuits, electronics and electrical machinery. Not open to an electrical or computer engineering major.

4400:309 Design Project Seminar - Electrical Engineering (1 Credit)
Prerequisites: Junior standing and admission to an engineering major within the College of Engineering and Polymer Science. Pre/Corequisites: 4400:341, 4400:354, 4400:361, 4400:371, and 4400:381. Engineering capstone project selection and proposal, including preliminary technical specifications. Professional ethics. Intellectual property. Societal impact issues in engineering design.

4400:330 Circuits II Laboratory (1 Credit)
Corequisite: 4400:332. Computation, computer aided circuit analysis, circuit theorem confirmation, report writing to include data analysis and reduction, intermediate electrical measurements.

4400:332 Circuits II (3 Credits)
Prerequisite: 4400:231 with a grade of C- or better. Corequisites: 3450:335 and 4400:330. Coupled magnetic circuits. Transient and frequency domain analyses of linear circuits. Bode plots, Laplace transforms, transfer functions, resonance, passive and active filters.

4400:340 Signals & Systems (4 Credits)
Prerequisites: [3460:209 or 4450:208 or 4800:220], 3450:335 with a grade of C- or better, 4400:332 with a grade of C- or better, and admission to an engineering major within the College of Engineering and Polymer Science. Linear systems theory and transform analysis techniques for continuous and discrete systems. Convolutions, Laplace transforms, continuous and discrete Fourier transforms. Difference equations and Z transforms.

4400:341 Introduction to Communication Systems (3 Credits)
Prerequisites: 4400:340 and admission to an engineering major within the College of Engineering and Polymer Science. Introduces analog and digital communication systems and signal processing. Time-sampling and filtering. Modulation and demodulation techniques. Noise and bandwidth requirements. System design and performance analysis.

4400:353 Electromagnetics I (4 Credits)
Prerequisites: 4400:231 and admission to an engineering major within the College of Engineering and Polymer Science. Corequisite: 3450:335. Vector analysis. Electrostatics: electrostatic field, scalar potential, dielectrics, boundary-value problems. Magnetostatics: magnetic circuits. Maxwell's equations: Faraday's law, time-harmonic fields. Introduction to plane waves.

4400:354 Electromagnetics II (3 Credits)
Prerequisites: 4400:353 and admission to an engineering major within the College of Engineering and Polymer Science. Theory and application of transmission lines: transient and steady-state waves. Plane EM waves: propagation, reflection, and refraction. Waveguides open and closed-boundary guiding structures.

4400:360 Physical Electronics (3 Credits)
Prerequisites: 4400:332, 4450:220 and admission to an engineering major within the College of Engineering and Polymer Science. PN junction, diffusion, tunneling, FET and BJT device physics, equivalent circuits for electronic devices, time and frequency analysis, biasing and logic families.

4400:361 Electronic Design (4 Credits)
Prerequisites: 4400:340, 4400:360 and admission to an engineering major within the College of Engineering and Polymer Science. Power amplification, feedback, oscillators, linear integrated circuits, modulation and demodulation circuits.

4400:371 Control Systems I (4 Credits)
Prerequisites: 4400:340 and admission to an engineering major within the College of Engineering and Polymer Science. Introduction to servomechanisms and feedback. Modeling and response of feedback control systems. Stability of linear systems. Experiments include analog simulation and basic servomechanism.

4400:381 Energy Conversion (4 Credits)
Prerequisites: 4400:332 and admission to an engineering major within the College of Engineering and Polymer Science. Corequisite: 4400:353. Nonelectrical to electrical energy conversions and vice versa: thermal, chemical, solar. Fundamentals of electromechanical energy conversion. Principles of operation of transformers, commutator machines, induction and synchronous machines.

4400:401 Senior Design Project I - Electrical Engineering (3 Credits)
Prerequisites: 4400:309, senior standing, admission to an engineering major within the College of Engineering and Polymer Science, and 4400:341, 4400:354, 4400:361, 4400:371, and 4400:381 with a combined average grade of 2.0 or higher. Design and preparation phase of an engineering team project. System specification, design, and simulations; ordering of components; subsystem implementations. Requires project presentations and report.
Gen Ed: Tier 3 - Critical Thinking

4400:402 Senior Design Project II - Electrical Engineering (3 Credits)
Prerequisite: 4400:401 and admission to an engineering major within the College of Engineering and Polymer Science. Implementation and evaluation phases of an engineering design project. Requires a project presentation and report.
Gen Ed: Tier 3 - Complex Systems

4400:434 Active Circuits (3 Credits)
Prerequisite: 4400:340. Applications of operational amplifiers including bilinear transfer functions, scaling, cascade design, biquad circuits, lowpass, high pass, bandpass-filters, Butterworth and Chebyshev response, sensitivity, delay filters, frequency transformations, ladder design, simulated element design, leapfrog simulation and switched-capacitors.

4400:441 Digital Communication (3 Credits)
Prerequisite: 4400:341 or 4450:440. Introduction to digital communications theory and systems. Sampling, formatting and baseband communications. Digital modulation techniques and optimal receivers. Error performance analysis. Error control.

4400:445 Wireless Communications (3 Credits)
Prerequisite: 4400:341 or 4450:440. Theory and analysis of wireless communication systems, wireless propagation, multiple access, modulation, demodulation, multipath channel characterization, diversity, cellular and PCS services and standards.

4400:447 Random Signals (3 Credits)
Prerequisite: 4400:340. Applications of set theory, discrete and continuous sample spaces; probability, random variables, distribution functions, density functions, stochastic processes, random signals, system function, power spectrum and correlation functions.

4400:448 Optical Communication Networks (3 Credits)
Prerequisites: 4400:360. Optical waveguides and integrated components. Optical transmitters and receivers. Optical communications network design.

4400:451 Electromagnetic Compatibility (3 Credits)
Prerequisite: 4400:360. Introduction to electromagnetics, electromagnetic compatibility, crosstalk and effects on computers, communication lines and systems.

4400:453 Antenna Theory (3 Credits)
Prerequisite: 4400:354. Theory of EM radiation. Wire antennas, arrays, receiving antennas, reciprocity. Integral equations for induced currents, self and mutual impedances. Equivalence principle, radiation from aperture antennas.

4400:455 Microwaves (4 Credits)
Prerequisite: 4400:354. Dynamic fields, Maxwell's equation and wave equations. Field analysis of wave guides, microwave components, techniques and systems.

4400:461 Optical Electronics & Photonic Devices (3 Credits)
Prerequisites: 4400:360. Lightwave engineering, photonic principles and optical electronic device technology.

4400:469 Introduction to Sensors and Actuators (3 Credits)
Prerequisite: senior standing or permission. Introduction to the theory and practice of sensors and actuators; sensing and actuation technologies; performance, and interfacing.

4400:472 Control Systems II (4 Credits)
Prerequisite: 4400:371. Sampled-data control system analysis and design. Discrete-time representation of sampled-data systems. Cascade, feedforward and state-variable compensation techniques. Digital computer implementation.

4400:481 Modern Power Systems (3 Credits)
Prerequisite: 4400:381. Introduction to electricity utility load flow, faulty analysis, stability, surge protection and relaying.

4400:483 Power Electronics I (3 Credits)
Prerequisite: 4400:360. Steady-state analysis and design of power electronic converters: AC/DC converters (rectifiers), DC/DC converters, DC/AC PWM and resonant converters, AC/AC converters and cycloconverters.

4400:484 Power Electronics Laboratory & Design Project (2 Credits)
Prerequisite: 4400:483, 4400:583 or equivalent. Experiments on different types of power electronic converters: AC/DC, DC/DC, DC/AC, and AC/AC. Design project to include design, simulation, building, and testing of a power electronic circuit.

4400:485 Electric Motor Drives (3 Credits)
Prerequisite: 4400:381. Application of electric machines, choice of motor for particular drive. Application of power semiconductor circuits in electric machinery.

4400:486 Dynamics of Electric Machines (3 Credits)
See department for course description.

4400:487 Electromagnetic Design of Electric Machines (3 Credits)
See department for course description.

4400:488 Control of Machines (4 Credits)
See department for course description.

4400:489 Electric and Hybrid Vehicles (3 Credits)
Prerequisite: 4400:381. Basic principles of electric and hybrid vehicles. Characteristics of electric machines, internal combustion engines, transmissions, batteries, fuel cells, ultracapcators. Vehicle control strategies, communication networks, and overall system integration.

4400:498 Special Topics: Electrical Engineering (1-3 Credits)
(May be taken more than once) Prerequisite: Permission of department chair. Special topics in electrical engineering.

Computer Engineering (4450)

4450:101 Tools for Computer Engineering (3 Credits)
Corequisite: 3450:221 or 3450:149. Orientation to degree programs and design practice in electrical and computer engineering. Introduction to computer applications and resources for engineering studies.

4450:208 Programming for Engineers (3 Credits)
Prerequisite: 4400:101 or permission. Introduction to programming. Environment and tools. C programming language. Machine level data forms and organization.

4450:220 Digital Logic Design (4 Credits)
Corequisites: 4400:101 or 4450:101 or 4800:101. Boolean algebra and simplification of logic functions. Combinational and synchronous sequential circuits. Laboratory projects include design of digital systems with hardware description language and simulation.

4450:301 Undergraduate Research I: Computer Engineering (1 Credit)
Prerequisites: completion of [4400:101 or 4450:101], 4400:230, 4400:231, 4400:330, 4400:332 and 4450:220 with a combined average grade of 3.0 or higher, admission to an engineering major within the College of Engineering and Polymer Science, and permission. Research project, supervised by faculty member of the department; requires oral research presentation and written report.

4450:302 Undergraduate Research II: Computer Engineering (1 Credit)
Prerequisites: [4400:301 or 4450:301], admission to an engineering major within the College of Engineering and Polymer Science, and permission. Research project, supervised by faculty member of the department; requires oral research presentation and written report.

4450:303 Undergraduate Research III: Computer Engineering (1 Credit)
Prerequisites: [4400:302 or 4450:302], admission to an engineering major within the College of Engineering and Polymer Science, and permission. Research project, supervised by faculty member of the department; requires oral research presentation and written report to the department, and presentation of work in a research venue outside the department.

4450:304 Undergraduate Research IV: Computer Engineering (1 Credit)
(May be repeated. May not be applied to degree requirements.) Prerequisite: 4450:303 or 4400:303, and permission. Research project, supervised by faculty member of the department; requires oral research presentation and written report.

4450:309 Design Project Seminar - Computer Engineering (1 Credit)
Prerequisites: Junior standing and admission to an engineering major within the College of Engineering and Polymer Science. Pre/Corequisites: [3460:426 or 4450:325], 4450:367, [4450:420 or 4450:427], 4450:422, and 4450:440. Engineering capstone project selection and proposal, including preliminary technical specifications. Professional ethics. Intellectual property. Societal impact issues in engineering design.

4450:320 Computer Systems (3 Credits)
Prerequisite: 3460:209 or 4450:208, 4450:220 or 3450:208. Introduces the design and architecture of modern computer systems. Data and instruction representation. Conventional computer organization. Hardware and software design processes. The hardware/software interface.

4450:325 Operating Systems Concepts (3 Credits)
Prerequisites: 4450:320, 3460:210. Processes and threads. Process communication and resource sharing. Deadlock resolution. Memory management. File systems. Introduction to network operating systems.

4450:367 VLSI Design (3 Credits)
Prerequisites: 4400:360 and admission to an engineering major within the College of Engineering and Polymer Science. Digital logic circuits. Very large scale integration (VLSI) fabrication processes and layout design. Delay and power of digital circuits. Latches and flip-flops in VLSI. Memory design. System-level design issues. Design project.

4450:401 Senior Design Project I - Computer Engineering (3 Credits)
Prerequisites: 4450:309, senior standing, admission to the College of Engineering, and completion of [3460:426 or 4450:325], 4450:367, [4450:420 or 4450:427], 4450:422, and 4450:440 with a combined average grade of 2.0 or higher. Design and preparation phase of an engineering team project. System specification, design, and simulations; ordering of components; subsystem implementations. Requires project presentations and report.
Gen Ed: Tier 3 - Critical Thinking

4450:402 Senior Design Project II - Computer Engineering (3 Credits)
Prerequisites: 4450:401 and admission to an engineering major within the College of Engineering and Polymer Science. Implementation and evaluation phases of an engineering design project. Requires a project presentation and report.
Gen Ed: Tier 3 - Complex Systems

4450:410 Embedded Scientific Computing (3 Credits)
Prerequisites: 4450:208 or 3460:209 and 4400:340. Fixed point, floating point representation and coding. Processor/DSP implementations. Assemblers, C language semantics. Adapting scientific library routines for embedded use. Minimizing complexity. Ill-conditioned problems.

4450:415 System Simulation (3 Credits)
Prerequisite: 4400:371 or 4450:440. Computer simulation of dynamic systems. Discrete system stability, linear multistep and Runge-Kutta methods, nonlinear systems, stiff systems, distributed systems and real-time computing.

4450:420 Computer Systems Design (3 Credits)
Prerequisite: 4450:320. Design of advanced processors at the microarchitecture level. Pipelining. Superscalar, vector and VLIW architectures. Instruction-level parallelism. Compiler support. Multiprocessor architectures.

4450:422 Embedded Systems Interfacing (3 Credits)
Prerequisites: [3460:209 or 4450:208] and admission to an engineering major within the College of Engineering and Polymer Science. Corequisite: 4400:360. Microcontroller structures and embedded peripherals. Interfaces to physical environments. Software access to peripherals including timers, ADCs and DACs. Synchronous and asynchronous communications. Interrupts. Real-time operating systems.

4450:427 Computer Networks (3 Credits)
Prerequisite: 4450:320; 4450:325 or 3460:426. Network architecture and protocol layering. Network design principles, communication protocols, and performance measures. Socket programming, routing, error detection and correction, access control, multimedia networking.

4450:440 Digital Signal Processing (3 Credits)
Prerequisites: 4400:340 and admission to an engineering major within the College of Engineering and Polymer Science. Signal sampling and reconstruction; data-converter models. Unilateral and bilateral z transforms. Discrete Fourier Transform (DFT); Fast Fourier Transform (FFT). Digital filter structures and design methods.

4450:462 Analog Integrated Circuit Design (3 Credits)
Prerequisite: 4400:360. CMOS processes and layout; amplifiers, current mirrors, and comparators; current, voltage, and bandgap references; switched capacitor circuits. Frequency and noise analysis techniques.

4450:465 Programmable Logic (3 Credits)
Prerequisite: 4450:220, 3460:209 or 4450:208. Digital design with programmable devices. PLD and FPGA architectures. Logic design and technology mapping tools.

4450:467 VLSI Circuits & Systems (3 Credits)
Prerequisite: 4450:367. High performance adders and multipliers for very large scale integration (VLSI) systems. Architectural synthesis. Design for high performance, low power, and testability.

4450:498 Special Topics: Computer Engineering (1-3 Credits)
(May be taken more than once) Prerequisite: Permission of department chair. Special topics in computer engineering.