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:

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments as well as to analyze and interpret data
- an ability to design a system, component, or process to meet desired needs
- an ability to function on multi-disciplinary teams

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:

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments as well as to analyze and interpret data
• an ability to design a system, component, or process to meet desired needs
• an ability to function on multi-disciplinary teams
• an ability to identify, formulate and solve engineering problems
• an understanding of professional and ethical responsibilities
• an ability to communicate effectively
• the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social context
• a recognition of the need for, and an ability to engage in life-long learning
• a knowledge of contemporary issues
• an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
• an understanding of safety issues in computer engineering

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

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 the College of Engineering, 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 the College of Engineering 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 the College of Engineering 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)

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)

4400:340 Signals & Systems (4 Credits)
Prerequisites: [3460:209 or 4450:208 or 4800:220], 3450:335, 4400:332 and admission to the College of Engineering. 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)

4400:353 Electromagnetics I (4 Credits)

4400:354 Electromagnetics II (3 Credits)

4400:360 Physical Electronics (3 Credits)
Prerequisites: 4400:332, 4450:220 and admission to the College of Engineering. 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 the College of Engineering. Power amplification, feedback, oscillators, linear integrated circuits, modulation and demodulation circuits.

4400:371 Control Systems I (4 Credits)
Prerequisites: 4400:340 and admission to the College of Engineering. 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)

4400:401 Senior Design Project I - Electrical Engineering (2 Credits)
Prerequisites: 4400:309, senior standing, admission to the College of Engineering 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 project. Requires project presentation, approval of a written proposal, and ordering of required parts.

Gen Ed: Tier 3 - Critical Thinking

4400:402 Senior Design Project II - Electrical Engineering (3 Credits)
Prerequisite: 4400:401 and admission to the College of Engineering. 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)

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)

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)

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, ultracapacitors. 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)

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 the College of Engineering 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 the College of Engineering 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 the College of Engineering and permission. Research project, supervised by faculty member of the department; requires oral research presentation and written report.

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, admission to the College of Engineering and permission. Project selection and proposal. Project specifications and alternative design. Professional ethics. Intellectual property. Societal impact issues in engineering design. Senior Design Project II presentations.

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)

4450:367 VLSI Design (3 Credits)

4450:401 Senior Design Project I - Computer Engineering (2 Credits)
Prerequisites: 4450:309, senior standing, admission to the College of Engineering, and completion of 4450:325, 4450:367, 4450:420, 4450:427 and 4450:440 with a combined average grade of 2.0 or higher. Design and preparation phase of an engineering project. Requires project presentation, approval of a written proposal, and ordering of required parts.

Gen Ed: Tier 3 - Critical Thinking

4450:402 Senior Design Project II - Computer Engineering (3 Credits)
Prerequisites: 4450:401 and admission to the College of Engineering. 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)

4450:415 System Simulation (3 Credits)

4450:420 Computer Systems Design (3 Credits)

4450:422 Embedded Systems Interfacing (3 Credits)
Prerequisites: [3460:209 or 4450:208] and admission to the College of Engineering. 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 the College of Engineering. 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.