UNIVERSITY of DAYTON

The Department of Electrical & Computer Engineering

Undergraduate Brochure

Programs, Courses, Faculty

100 YEARS 1911-2011
SCHOOL OF ENGINEERING

http://www.udayton.edu/engineering/electrical_and_computer/index.php

Fall 2012

Accredited ABET Engineering Accreditation Commission

Our electrical and computer engineering undergraduate programs are accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone: (410) 347-7700.

UNIVERSITY of DAYTON
Department of Electrical & Computer Engineering

The Department of Electrical and Computer Engineering (ECE) offers world-class programs leading to the degrees of Bachelor of Electrical Engineering and Bachelor of Science in Computer Engineering. Both degrees are accredited by the Accreditation Board for Engineering and Technology (ABET). Electrical and Computer Engineering is one of the broadest areas in engineering. According to the U.S. Dept. of labor, nearly 45% of all engineering done in the U.S. is in the field of Electrical and Computer Engineering! Electrical and Computer Engineer's enjoy the top (or nearly the top) salaries in engineering at all education levels. Electrical and Computer engineering includes topics such as robotics and controls, biomedical/bioengineering, telecommunications and wireless systems, signal and image processing, computer hardware and software, digital system design and integrated circuit design, electro-optics, computer vision, wide area surveillance, and sensor technologies. The Dayton area is a high-tech research and development community, and our faculty work with Wright-Patterson Air Force Base (WPAFB), AFRL, IDCAST and numerous aerospace, automobile and information technology companies. Our department faculty include world-renowned teachers and researchers who have authored several textbooks, published extensively in national and international journals and conferences, and are Fellows in their respective professional organizations. We pride ourselves on our world-class curriculum, which is flexible and updated regularly to meet the changing needs of government, industry, and academia. We offer more technical electives and lab classes (with hands-on activities) than other engineering majors with our state-of-the-art facilities.

Highlights of the ECE Program at UD

ECE provides world-class ABET accredited curricula for Electrical and Computer Engineering degrees that rivals any top program around the country. ECE offers concentrations in electro-optics, robotics, and electrical energy systems. A new **bioengineering concentration is currently in the planning stages.** The curriculum is flexible with many technical electives, allowing you to mold it to your needs and personal interests.

Our graduates are consistently well placed in government and industry. Nationally, and locally, there are more jobs than expected graduates. The average annual salary offer for ELE and CPE graduates at UD is well above the national average.

ECE students are consistently placed in top graduate programs including Stanford, University of Illinois-Urbana, University of Michigan, Purdue University, Ohio State University, Penn State University, University of Maryland-College Park, University of Tennessee, University of Florida, Drexel University, and the University of Dayton as well.

ECE pioneered a Five Year B.S.+M.S. accelerated degree program for qualified undergraduate students. By taking two approved graduate courses in the senior year in place of technical electives, one can complete the M.S. degree in as little time as one additional academic year. This program is available to both ELE and CPE undergraduate majors.

ECE supports a strong co-op program with student placements in many top local and national companies. Extensive research opportunities with University of Dayton Research Institute (UDRI) and WPAFB also give students hands-on research experience as undergraduates. There are many co-op schedules available.

ECE maintains state-of-the-art laboratories that support a hands-on approach to education. We have recently renovated and enhanced all of our classroom teaching labs and have a ***new robotics lab*** established in collaboration with the Motoman Company. We have active research programs in areas that include advanced digital design, embedded systems, computer vision, control systems, signal and image processing, electro-optics, microelectronics, nanotechnology, robotics, and microwaves. To support these activities, we have a number of specialty labs including the signal and image processing lab, controls lab, microelectronics lab, electro-optics labs, vision labs, embedded data processing lab, multisensors integration lab, Motoman robotics lab, intelligent signal processing lab, and neuro-morphic computing lab.

ECE offers a comprehensive set of technical electives and interdisciplinary capstone design experiences with the innovation center working on real-world industry sponsored projects.

Top 10 Reasons to Pick ECE Major at UD

1. **Great careers commanding top salaries**
2. **Broad-based curriculum prepares you for all areas of ECE. Both Electrical Engineering and Computer Engineering curriculum is accredited by ABET.**
3. **More technical electives & lab courses than other engineering majors, plus hot concentration areas (electro-optics, robotics, electrical energy systems, and the planned bioengineering concentration)**
4. **Top notch facilities and faculty (recent UD award winners in both teaching and scholarship)**
5. **Small classes, lots of personalized attention**
6. **Excellent job, co-op and graduate school placement. Well structured co-op program**
7. **Plenty of design experiences including capstone design with innovation center working on real-world projects sponsored by industry.**
8. **5 year BS/MS degree program and an "MBA ready" program**
9. **Funded undergraduate and graduate research opportunities**
10. **Fun, cutting edge field that plays a major role in service to modern society**

Quotes from ECE Alumni

- "By incorporating a hands-on and real-life application lab with many undergraduate ECE lectures, students are fully engaged and apply the theory of lecture in a manner similar to industry practice."

- "No matter how long you have been in the ECE department, the faculty and staff always make themselves available to assist with coursework, supervise organizations, or are around just to talk."

~ Maria Otte, B.S. in CPE 2009 (Now a Software Engineer at Midmark Corporation)

- "The ECE faculty strive to teach the importance of developing talents in a number of areas. In this pursuit, they expect more from their students and work hard themselves to present the material in a manner conducive to learning."

~ Joseph Meola, B.S. CPE 2006, M.S. ELE 2006 (Now a Research Scientist with the Air Force Research Labs working on advanced imaging systems)

- "Over the past few years the electrical and computer engineering department at UD has become my home. Small class sizes and friendly professors have created an environment where the students get to know their professors on a personal as well as a professional level."
- "This academic atmosphere allows for collective learning with other students and friendships that will last for the rest of my life. I have nothing but praise for the department that has molded me into the engineer I am today."

~ David Krivonak, B.S. ELE & CPE 2007 (Now with Sprint Nextel: Network Engineer I)

- "From Day #1 the passionate nature of UD's faculty is obvious. They are excited about everything: engineering, science, teaching, and helping the greater good of humanity through their work. The culture here encourages involvement in extra-curricular activities which teach important skills that can be applied to research, problem-solving, and social networking among many others. The program is by no means easy, it is very hard work; the students that finish the CPE program have had their mettle tested and proven themselves to be intellectually versatile. After going through the Computer Engineering program at the University of Dayton, I feel very prepared to enter the "real world" and continue a very long tradition of excellence." ***~ Christopher Pitstick, BS. CPE, 2009 (Now with Microsoft)***

About the Department

Visit us on the Web at:
http://www.udayton.edu/engineering/electrical_and_computer/index.php and see *The University of Dayton Bulletin* at:
http://bulletin.udayton.edu/bulletin.ud?v=32&g=0&pp=-1000004852#p
The Department of Electrical and Computer Engineering (ECE) offers two ABET accredited undergraduate degree programs: the Bachelor of Electrical Engineering program and the Bachelor of Science in Computer Engineering program.

Our Mission

The mission of the Department of Electrical and Computer Engineering is to develop in students the skills and knowledge to learn, lead and serve in their profession and their community.

Both electrical engineering (ELE) and computer engineering (CPE) are broad-based engineering disciplines that provide for a wide range of career choices within the engineering field. They also provide an excellent basis for careers in such diverse areas as business, law, and medicine.

Bachelor of Electrical Engineering

The undergraduate ELE curriculum is designed to provide an understanding of basic electrical engineering principles with emphasis on the development of problem solving skills. An extensive laboratory experience is integrated with the classroom work to assure that the student develops a working knowledge of the fundamentals. In addition to including electrical engineering *breadth*, the curriculum allows students to explore *depth* in selected topic areas/concentrations. Upper level courses integrate the knowledge base with current technology and tools resulting in a graduate capable of making a contribution to the engineering profession by either entering the work force or pursuing a graduate education. To see the electrical engineering flowchart and class list go to:
http://www.udayton.edu/engineering/electrical_and_computer/resources/flowcharts/ELE%202012-13%20flowchart.pdf

ELE Objectives

Our alumni will:

1. find rewarding careers as engineering professionals, as electrical engineers, they will design and develop new products, technologies and processes that incorporate one or more of the following elements: analog and digital circuits, signals and systems, propagation and processing of signals, and control systems,
2. continue their professional education either formally, in graduate school, professional schools, or through industrial training programs; or informally through activities such as continuing education, attendance in short courses, professional workshops and conferences,
3. exercise and further develop their skills in professional communications through activities such as project briefings, conference presentations, technical reports and manuals and journal publications,
4. participate in activities for the betterment of society and carry on the traditions of the University of Dayton by maintaining high ethical standards in their professional activities, and by serving their country and community through service, leadership and mentorship.

Bachelor of Science in Computer Engineering

The undergraduate CPE curriculum is designed to provide an understanding of basic computer engineering principles with emphasis on the development of problem solving skills. The basic software aspects of computer engineering are introduced in the very first year while hardware and hardware-software integration topics are emphasized starting in the sophomore year. An extensive hands-on laboratory experience is integrated with the classroom work to assure that the student develops a working knowledge of the fundamentals. To see the computer engineering flowchart and class list go to:
http://www.udayton.edu/engineering/electrical_and_computer/resources/flowcharts/CPE%202012-13%20flowchart.pdf

CPE Objectives

Our alumni will engage in:
1. The design and development of new products, technologies and processes that incorporate one or more of the following elements: analog and digital circuits, signals and systems, computer design, software development, and hardware/software integration;
2. Professional development through activities such as continuing education, attendance in short courses and/or conferences, professional workshops, and graduate school;
3. Professional communications through activities such as project briefings, conference presentations, technical reports and manuals, and journal publications;
4. Service, leadership and mentorship roles in their profession and community.

General Education Requirements

The ELE and CPE programs include general education requirements (GER), as well as engineering related topics. The ELE program requires 134 total semester hours of credit. The CPE program requires 137 total semester hours of credit. The GER amounts to eleven (11) courses that include a humanities base consisting of four (4) specific courses. In addition, three (3) of the GER courses meet ECE program requirements and, accordingly, are specified in the program. The seven (7) courses referenced above are:

Humanities Base:	HST 101/102/198
	PHL 103
	REL 103
	ENG 100/200
Program Specific:	PHY 206
	CHM 123
	PHL 316/319

The four (4) remaining GER courses are elective. They are selected from the following four domains of knowledge:

- Historical studies (one course)
- Philosophy and Religious Studies (one course)
- Social sciences, (one course) and
- Arts studies (one course)

This selection of four (4) courses plus PHL 316/319 must include a minimum of three (3) courses satisfying any one of the following thematic clusters:

- The Arts and Human Experience
- Catholic Intellectual Tradition
- Cross Cultural
- Perspectives on Global Environmental Issues
- Social Justice
- Values, Technology, and Society
- Woman and Culture
- Business Professional in a Global Society

The University Honors program offers thematic clusters for students participating in that program. The details of the various thematic clusters appear online at http://gened.udayton.edu

Ideally, students should select a thematic cluster before completing their first year. Each student formally enrolls in a thematic cluster by filing out a Thematic Cluster Registration Form. This form is available in the ECE Department Office (KL-341) or on the SoE Community website at: http://www.udayton.edu/engineering/electrical_and_computer/index.php

If a student should decide to change a cluster after completing this form, he or she must submit a revised form and have it approved by his or her advisor.

Students are encouraged to complete minimum thematic cluster requirements prior to the senior year so as to avoid potential scheduling conflicts with ECE core courses which are offered only once per calendar year.

The Integrated Engineering Core Curriculum (IEC)

During their first two years, our students are introduced to engineering via the IEC, which is comprised of ECE seminars, workshops and courses in the fundamentals of engineering: Engineering Innovation, Engineering Mechanics, Engineering Thermodynamics and Electrical and Electronic Circuits. The primary goals of the IEC are to instill in all students a common problem solving, an understanding of the linkages between engineering disciplines and an understanding of the context in which engineering is practiced.

Engineering-related Electives for the ELE Program

Electrical Engineering students are required to choose four Technical Electives from the following list.

Technical Electives 2012-2013:

Engineering-related Electives for the ELE Program

- Any 3 credit hour 300 or 400 level course in: CEE, CME, CPS, ECE, MEE, MTH
    - *Exceptions:*
        - *Required courses in ELE program*
        - *MTH 367 Statistical Methods I*
        - *MTH 368 Statistical Methods II*
        - *MTH 395 Development of Mathematical Ideas*
        - *MEE 314 Computational Methods*
        - *MEE 432L Multidisciplinary Engineering Design Lab II*
        - *MEE 439 Dynamic Systems and Controls*
        - *CME 452 Process Control*
- Any graduate ECE course between 501 and 509
- Any graduate EOP course between 501 and 509
- Additional approved technical electives not covered above:
    - EGM 303 Mechanics II
    - EGM 304 Advanced Strength of Materials
    - EGM 445 Finite Element Applications
    - EGR 311 Principles of Nanotechnology
    - EGR 330 Engineering Design and Appropriate Technology
    - EGR 498 Honors Thesis
    - PHY 303 Intermediate Mechanics I
    - PHY 321 Atomic and Nuclear Physics
    - PHY 390 Intro. to Quantum Mechanics
    - PHY 404 Physical Optics
    - PHY 411 Topics in Modern Physics
    - PHY 440 Quantum Mechanics II

Examples of Approved Technical Electives:

CEE 390 Environmental Pollution Control
CEE 421 Construction Engineering
CEE 422 Design and Construction Project Management
CEE 425 Civil Engineering Systems

CME 432 Chemical Product Design
CME 486 Introduction to Petroleum Engineering
CME 490 Introduction to Bioengineering
CME 492 Chemical sensors and biosensors

CPS 310 Systems Analysis
CPS 312 Systems Design
CPS 341 Discrete Structures
CPS 343 Comparative Languages
CPS 346 Operating Systems I
CPS 350 Data Structures and Algorithms
CPS 353 Numerical Methods I
CPS 354 Numerical Methods II
CPS 455 Numerical Analysis I
CPS 460 Computer Graphics
CPS 470 Data Communications
CPS 480 Artificial Intelligence
CPS 482 Automata Theory

ECE 316 Introduction to Electrical Energy Systems
ECE 414 Electromechanical Devices
ECE 440 Physical Electronics
ECE 441 Integrated Circuit Electronics
ECE 442 Engr. Electromagnetics
ECE 443 Intro. To Electro-Optics
ECE 444 Advanced Digital Design
ECE 445 Signal Processing
ECE 446 Microelectronic Systems Design
ECE 447 Digital Control Systems
ECE 448 Fiber Optic Communications
ECE 449 Computer Systems Engineering
ECE 471: Contemporary Power Systems and the Smart Grid
ECE 472: Smart Grid Technologies

ECE 498 Multidisciplinary Research and Innovation Laboratory
ECE 499 Special Problems in ECE
ECE 501 Contemporary Digital Systems
ECE 503 Random Processes
ECE 506 Microelectronic Systems Design
ECE 507 Electromagnetic Fields I
ECE 509 Analysis of Linear Systems
ECE 572 Linear Systems and Fourier Optics
ECE 573 Electro-Optical Devices & Systems
ECE 574 Guided Wave Optics

EGM 303 Mechanics II
EGM 304 Advanced Strength of Materials
EGM 445 Finite Element Applications

EGR 311 Principles of Nanotechnology
EGR 330 Engineering Design and Appropriate Technology
EGR 498 Honors Thesis

EOP 501 Geometric Optics
EOP 502 Optical Radiation and Matter
EOP 505 Introduction to Lasers
EOP 506 Electro-optical Devices and Systems

MEE 308 Fluid Mechanics
MEE 312 Engineering Materials I
MEE 321 Theory of Machines
MEE 341 Engineering Experimentation
MEE 410 Heat Transfer
MEE 417 Internal Combustion Engines
MEE 430 Biomechanical Engineering
MEE 434 Mechatronics
MEE 438 Robotics and Flexible Manufacturing
MEE 471 Design of Thermal Systems
MEE 472 Design for Environment
MEE 473 Renewable Energy Systems
MEE 478 Energy Efficient Manufacturing

MTH 308 Foundations and Discrete Mathematics
MTH 310 Linear Algebra and Matrices
MTH 330 Intermediate Analysis
MTH 342 Set Theory
MTH 403 Boundary Value Problems
MTH 404 Complex Variables
MTH 435 Advanced Multivariate Calculus
MTH 440 Introduction to Mathematical Modeling
MTH 466 Graph Theory and Combinatorics
MTH 471 Topology

PHY 303 Intermediate Mechanics I
PHY 321 Atomic and Nuclear Physics
PHY 390 Intro. to Quantum Mechanics
PHY 404 Physical Optics
PHY 411 Topics in Modern Physics
PHY 440 Quantum Mechanics II

Engineering-related Electives for the CPE Program

Computer Engineering students are required to choose three Technical Electives from the following lists.

Technical Electives: (choose three, one must be CPS)

Any 300 or 400 level course in:
ECE, CPS, MTH, MEE, CEE, CME.
EGR 330 Engineering Design and Appropriate Technology
EGR 498 Honors Thesis
Any graduate ECE course between 501 and 509

Exceptions:
- *Required courses in ECE or CPS*
- *MTH 367, 368, 395*

Note:
Pre-requisites may be required for some technical elective courses.
Conditional approval by department chair required for 300-400 level courses in PHY and CHM.

Examples of Approved Technical Electives:

ECE 332 Electromagnetics
ECE 333 Applied Electromagnetics
ECE 401 Communication Systems
ECE 415 Control Systems
ECE 443 Intro. To Electro-Optics
ECE 445 Signal Processing
ECE 446 Microelectronic Systems Design
ECE 447 Digital Control Systems
ECE 503 Random Processes
ECE 506 Microelectronic Systems Design
ECE 507 Electromagnetic Fields I
ECE 509 Analysis of Linear Systems

CPS 310 System Analysis
CPS 312 System Design
CPS 341 Discrete Structures
CPS 343 Comparative Languages
CPS 353 Numerical Methods I
CPS 415 Software Testing

CPS 430 Database Management Systems
CPS 432 Database Management Systems II
CPS 445 Systems Programming II
CPS 460 Computer Graphics
CPS 470 Data Communications
CPS 472 Computer Networking
CPS 480 Artificial Intelligence
CPS 481 Advanced Artificial Intelligence
CPS 482 Automata Theory

MEE312 Engineering Materials 1
MEE 321 Theory of Machines
MEE 430 Biomechanical Engineering
MEE 434 Mechatronics
MEE 438 Robotics and Flexible Manufacturing
MEE 471 Design of Thermal Systems
MEE 472 Design for Environment
MEE 473 Renewable Energy Systems

CME 432 Chemical Product Design
CME 486 Intro To Petroleum Engineering
CME 492 Chemical sensors and biosensors

CEE 390 Environmental Pollution Control
CEE 421 Construction Engineering
CEE 422 Design and Construction Project Management
CEE 425 Civil Engineering Systems

Concentration in Electro-Optics

The departments of Electrical & Computer Engineering and Physics, with the support of the Electro-Optics Graduate Program at University of Dayton, offers an undergraduate concentration in Electro-Optics. This multidisciplinary concentration is open to Electrical Engineering, Computer Engineering and Physics undergraduates with appropriate prerequisite background. This concentration will enable students to pursue new coop opportunities and possible careers in photonics, and better prepare students to pursue graduate degrees in the area of optics.

Courses required:

ECE 443	Introduction to Electro-Optics
PHY 404	Physical Optics

Any two from:

EOP 501	Geometric Optics
EOP 502	Optical Radiation and Matter
EOP 505	Introduction to Lasers
EOP 506 (ECE 573)	Electro-Optical Devices & Systems
EOP 513 (ECE 572)	Linear Systems and Fourier Optics
EOP 514 (ECE 514)	Guided Wave Optics

Concentration in Robotics

The department of Electrical & Computer Engineering now offers a concentration in Robotics available to ECE students. ELE students can complete concentration using available technical electives, while CPE students need two additional courses. The concentration has five courses: three required and two from a set of electives.

Courses Required:

ECE 415	Control Systems (Note: this is already required for ELE students)
ECE 416/499	Introduction to Robotics
ECE 447	Digital Controls

Any two from:

ECE 414	Electro-Mechanical Devices
ECE 444	Advanced Digital Design
ECE 445	Signal Processing
MEE 321	Theory of Machines
MEE 434	Mechatronics
MEE 438	Robotics & Flexible Manufacturing
CPS 480	Artificial Intelligence

Concentration in Electrical Energy Systems

The Electrical Energy Systems Concentration (EES) will prepare our Electrical and Computer Engineering students all aspects of Electrical Energy Systems including generation, transmission, distribution, utilization, storage, as well as enabling technologies for the smart grid.

Courses Required;

ECE 316/499	Intro. To Electrical Energy Systems
ECE 414	Electro-Mechanical Devices
ECE 471	Contemporary Power Systems

Any one from:

ECE 472	Smart Grid Technologies
MEE 473	Renewable Energy Systems

Courses of Instruction

ECE 101. INTRODUCTION TO ELECTRICAL AND COMPUTER ENGINEERING: Introduction to Electrical and Computer engineering faculty, facilities, and curriculum; survey of career opportunities in ECE engineering; orientation to the university. This course is part of the Integrated Engineering Core for all engineering students. Meets during the Fall and Winter semesters. *0 sem. hr.*

ECE 198. MULTIDISCIPLINARY RESEARCH AND INNOVATION LABORATORY: Students participate in (1) selection and design, (2) investigation and data collection, (3) analysis and (4) presentation of a research project. Research can include, but is not limited to, developing an experiment, collecting and analyzing data, surveying and evaluating literature, developing new tools and techniques including software, and surveying, brainstorming, and evaluating engineering solutions and engineering designs. Proposals from teams of students will be considered. *1-6 sem. hrs.*

ECE 200. PROFESSIONAL DEVELOPMENT SEMINAR: Presentations on contemporary and professional engineering subjects by students, faculty, and engineers in active practice. The seminar addresses topics in key areas that complement traditional courses and prepare distinctive graduates, ready for life and work. Registration required for all sophomore students. *0 sem. hrs.*

EGR 103. ENGINEERING INNOVATION: First year multi-disciplinary innovation projects primarily geared towards skill development in the areas of requirements analysis, creativity, conceptual design, design and problem-solving processes, prototyping, teamwork, and project communications. Application to the development of a new product or technology meeting societal needs. This course is part of the Integrated Engineering Core for all engineering students. *2 sem. hrs.*

EGR 201. ENGINEERING MECHANICS: This course provides an introduction to mechanics as applied to engineering problems. Principles of force and moment balance, work, and energy conservation are applied to systems in static equilibrium. The similarity of balance laws applied to mechanical behavior to those used in thermodynamics and electric circuits is introduced. Students are introduced to the concepts of free-body diagrams and equivalent systems of forces, properties of areas and sections, analysis of simple structures, internal forces, stress, and material failure. Introduces a common problem-solving approach and processes to address and solve open ended problems and creative application of theory. Both analytical and computer solutions of engineering mechanics problems are emphasized. This course is part of the Integrated Engineering Core for all engineering students. Prerequisite(s): MTH 168, PHY 206. *3 sem. hrs.*

EGR 202 ENGINEERING THERMODYNAMICS: This course provides an introduction to engineering thermodynamics, emphasizing the vital importance of energy generation and efficiency from a multi-disciplinary perspective. State descriptions of pure substances and mixtures. Control volume analysis and conservation principles applied to systems with respect to mass, energy, and entropy with applications to power, refrigeration, chemically reacting and other energy conversion systems. Introduces a common problem-solving approach and processes to address real, open ended problems and creative application of theory. Both analytical and computer solutions of engineering thermodynamics problems are emphasized. This course is part of the Integrated Engineering Core for all engineering students. Prerequisite(s): MTH 1 *3 sem. hrs.*

EGR 203. ELECTRICAL AND ELECTRONIC CIRCUITS: This course provides an introduction to the discipline of Electrical and Computer Engineering. Covers principles of linear circuit analysis and problem solving techniques associated with circuits containing both passive and active components. Students are introduced to DC circuit analysis, AC circuit analysis, and transient circuit analysis. Applications of basic electronic devices including diodes, transistors, and operational amplifiers are studied. Both analytical and computer solutions of electrical and electronic circuit problems are emphasized. This course is part of the Integrated Engineering Core for all engineering students. Prerequisite: MTH 168. *3 sem.hrs*

ECE 201L. CIRCUIT ANALYSIS LABORATORY: Laboratory course stressing experimental techniques, laboratory reporting, safety, and instrumentation. Experimental investigation of basic steady-state and transient circuits. Corequisite: EGR 203. *1 sem. hr.*

ECE 203. INTRODUCTION TO MATLAB PROGRAMMING: MATLAB system and development environment, vectors and matrices operations using MATLAB, linear algebra and calculus using MATLAB, MATLAB graphics, flow control, symbolic math toolbox. Prerequisites: CPS 132 or CPS 150, or equivalent. *1 sem. hr.*

ECE 204. ELECTRONIC DEVICES: Study of the terminal characteristic of electronic devices and basic single stage amplifier configurations using bipolar junction transistors and field-effect transistors. Analysis of the devices includes a qualitative physical description, volt-ampere curves, and the development of small- and large- signal equivalent circuit models. Prerequisite: EGR 203. Corequisite: ECE 204L. *3 sem. hr.*

ECE 204L. ELECTRONIC DEVICES LABORATORY: Laboratory investigation of electronic devices: diodes, bipolar junction transistors, field-effect transistors and operational amplifiers. Corequisite: ECE 204. *1 sem. hr.*

ECE 215. INTRODUCTION TO DIGITAL SYSTEMS: Introduction to binary systems, logic circuits, Boolean algebra, simplification methods, combinational circuits and networks, programmable logic devices, flip flops, registers, counters, memory elements, and analysis and design of sequential circuits. Prerequisite: ECE 201. Corequisite: 215L. *1 sem. hr.*

ECE 215L. DIGITAL SYSTEMS LABORATORY: Laboratory investigation of digital logic circuits and systems covered in ECE 215. Logic gate characteristics; combinational logic design and analysis; latches and flip-flops; synchronous and asynchronous sequential logic; simple digital systems. Experiments include design and

analysis of digital systems using breadboarding, FPGA boards, modeling and simulation tools, hardware description languages, and logic synthesis tools. Corequisite: ECE 215, Prerequisite: EGR 203 and ECE 201L. *1 sem. hr.*

ECE 298. MULTIDISCIPLINARY RESEARCH AND INNOVATION LABORATORY: Students participate in (1) selection and design, (2) investigation and data collection, (3) analysis and (4) presentation of a research project. Research can include, but is not limited to, developing an experiment, collecting and analyzing data, surveying and evaluating literature, developing new tools and techniques including software, and surveying, brainstorming, and evaluating engineering solutions and engineering designs. Proposals from teams of students will be considered. *1-6 sem. hrs.*

ECE 303. SIGNALS AND SYSTEMS: Mathematical framework associated with the analysis of linear systems including signal representation by orthogonal functions, convolution, Fourier and Laplace analysis, and frequency response of circuits and systems. Prerequisites: ECE 204, MTH 218. Corequisite: ECE 303L. 3 *sem. hrs.*

ECE 303L. SIGNALS AND SYSTEMS LABORATORY: Laboratory investigation of signals and systems including signal decomposition, system impulse response, convolution, frequency analysis of systems, and filter design and realization. Prerequisite: ECE 201L. Corequisite: ECE 303. *1 sem. hr.*

ECE 304. ELECTRONIC SYSTEMS: Study of cascaded amplifiers, feedback amplifiers, linear integrated circuits, and oscillators including steady state analysis and analysis of frequency response. Prerequisites: ECE 204, ECE 204L. Corequisite: ECE 304L. *3 sem. hrs.*

ECE 304L. ELECTRONIC SYSTEMS LABORATORY: Design, construction and verification of multistage feedback amplifiers, passive and active filters, and oscillators. Corequisite: ECE 304. *1 sem. hrs.*

ECE 314. FUNDAMENTALS OF COMPUTER ARCHITECTURE: Study of computer systems organization, representation of data and instructions, instruction set architecture, processor unit and control unit, high- to low-level language mapping, system simulation and implementation, applications and practical problems. Prerequisite: ECE 215 and either CPS 132 or 150. *3 sem. hrs.*

ECE 314L. FUNDAMENTALS OF COMPUTER ARCHITECTURE LAB: Laboratory investigation of digital computer architecture covered in ECE 314. Computer sub-systems such as central processing units, control units, I/O units, and hardware/software interfaces will be experimentally considered. Simulation and implementation will be used to study application and practical problems. Prerequisite ECE 215, Corequisite: ECE 314. *1 sem.hr.*

ECE 316. INTRODUCTION TO ELECTRICAL ENERGY SYSTEMS: A broad introduction to electric energy concepts. Generation, transmission, distribution, and utilization of electric energy. Renewable energy, three phase systems, transformers, power electronics, motors and generators. Contemporary topics. Pre-requisite: EGR 203 or equivalent. 3 sem hrs.

ECE 332. ELECTROMAGNETICS: Study of vector calculus, electro- and magneto- statics, Maxwell's equations, and electromagnetic plane waves and their reflection and transmission from discontinuities. Prerequisites: PHY 232, MTH 219, EGR 203. *3 sem. hrs.*

ECE 333. APPLIED ELECTROMAGNETICS: Electromagnetic theory applied to problems in the areas of waveguides, radiation, electro-optics and electromagnetic interference and electromagnetic compatibility. Prerequisite: ECE 332. *3 sem. hrs.*

ECE 334. DISCRETE SIGNALS AND SYSTEMS: Introduction to discrete signals and systems including sampling and reconstruction of continuous signals, digital filters, frequency analysis, the Z-transform, and the discrete Fourier transform. Prerequisite: ECE 303. *3 sem. hrs.*

ECE 340. ENGINEERING PROBABILITY AND RANDOM PROCESSES: Axiomatic probability, derived probability relationships, conditional probability, statistical independence, total probability and Bayes' Theorem, counting techniques, common random variables and their distribution functions, transformations of random variables, moments, autocorrelation, power spectral density, cross correlation and covariance, random processes through linear and nonlinear systems, linear regression, and engineering decision strategies. Prerequisite(s): ECE 303; MTH 218. *3 sem. hrs*

ECE 398. MULTIDISCIPLINARY RESEARCH AND INNOVATION LABORATORY: Students participate in (1) selection and design, (2) investigation and data collection, (3) analysis and (4) presentation of a research project. Research can include, but is not limited to, developing an experiment, collecting and analyzing data, surveying and evaluating literature, developing new tools and techniques including software, and surveying, brainstorming, and evaluating engineering solutions and engineering designs. Proposals from teams of students will be considered. *1-6 sem. hrs.*

ECE 401. COMMUNICATION SYSTEMS: Study of amplitude, angle, pulse, and digital communication systems including generation, detection, and analysis of modulated signals and power, bandwidth, and noise considerations. Prerequisistes: ECE 340, 304. Corequisite: ECE 401L. *3 sem. hrs.*

ECE 401L. COMMUNICATION SYSTEMS LABORATORY: Design, fabrication, and laboratory investigation of modulators, detectors, filters, and associated communication components and systems. Prerequisite: ECE 303L. Corequisite: ECE 401.
1 *sem. hrs.*

ECE 414. ELECTRO-MECHANICAL DEVICES: Properties and theory of electro-mechanical devices: nonlinear electromagnetic actuators; rotating machine analysis; field and circuit concepts; rotating fields; direct current, synchronous, and induction machines: special-purpose machines: and fractional horsepower machines. Prequisites: ECE 303, 332. *3 sem. hrs.*

ECE 415. CONTROL SYSTEMS: Study of mathematical models for feedback control systems. Performance and stability analysis. Design topics include pole-placement, root locus, and frequency domain design techniques. Prerequisite: ECE 303.
3 sem. hrs.

ECE 416 INTRO TO ROBOTICS: Introduction to the field of industrial robotics. It covers basic homogeneous transformations, direct and inverse kinematics, trajectory generation, and selected topics of robot vision. The course makes extensive use of MATLAB for simulation and visualization. Moreover, students will be able to experiment with the robots in the Motoman Robotics Laboratory, where they will implement projects related to various aspects of the course. Prerequisite: ECE 303, ECE 303L
3 sem hrs.

ECE 431L. MULTIDISCIPLINARY DESIGN I: Multidisciplinary engineering design projects and problems. Introduction to product development using the Product Realization Process. Concentration on proposals, specifications, conceptualization and decision analysis. Project result in final design and prototyping the follow-on course. Prerequisites: ECE 304, 314.
1 sem. hr

ECE 432L. MULTIDISCPLINARY DESIGN II: Combination of lecture and laboratory experiences. The focus of the lecture is on project management aspects of engineering design, including communication, collaboration, project tracking methods, cost estimating, overhead, direct labor costs, time value of money, depreciation, and return on investment. The focuses of the lab is on a multidisciplinary team design project. Detailed evaluation of the Product Realization Process (PRP), including specification, innovation, conceptualization, decision analysis, embodiment design, final design and prototyping. Analysis of the design criteria for safety, ergonomic, environmental, financial, ethical, and socio-political impact. Periodic oral and status reports. Culminates in a comprehensive written report and oral presentation. Prerequisite(s): CPE majors: ECE 340, 431L, 444; ELE majors ECE 340, 431L, 401 or 415. *3 sem. hrs.*

ECE 433. PROJECT MANAGEMENT AND INNOVATION: Introduces students and teams to project management, entrepreneurship, and innovation. Topics include project management, cost estimating, time value of money, patent law, marketing, finance, and business plan development. Prerequisite: Junior status.
1 sem. hr

ECE 440. PHYSICAL ELECTRONICS: Introduction to wave mechanics, electron ballistics, theory of metals and semiconductors, electron emission, space charge flow, and modern electron devices. Prerequisites: MTH 219, PHY 232.
3 sem. hrs.

ECE 441. INTEGRATED CIRCUIT ELECTRONICS: Integrated circuit design, construction and verification including the study of biasing, multistage differential and analog power amplification, and computer assisted design tools for "on-chip" design and layout. Prerequisite: ECE 304.
3 sem. hrs.

ECE 442. ENGINEERING ELECTRO-MAGNETICS: Processing Maxwell's equations and applying the predictions to the analysis and design of engineering systems that make use of electromagnetic energy from ELF through optical frequencies. Topics include propagation, radiation, interactions with matter, guided waves, and antenna fundamentals. Prerequisite: ECE 333. *3 sem. hrs.*

ECE 443. INTRODUCTION TO ELECTRO-OPTICS: Introductory overview of electro-optics starting with Maxwell's equations and leading to lasers, holography, and other timely applications. Prerequisite: ECE 333. *3 sem. hrs.*

ECE 444. ADVANCED DIGITAL DESIGN: Systems approach to digital design including: structured top-down development process using simple and complex logic modules from various logic families; practical aspects of the design, construction, and verification of digital subsystems; application of microcomputer and/or controller as a flexible logic device; real-time embedded systems design; and use of HDL tools and simulation. Prerequisite: ECE 314.
3 sem. hrs.

ECE 445. SIGNAL PROCESSING: Study of signal conditioning, digital signal processing, and data processing. Topics include transducers, high gain amplifier design, digital filtering, and spectrum estimation. Specialized application determined by instructor. Prerequisite: ECE 334.
3 sem. hrs.

ECE 446. MICROELECTRONIC SYSTEMS DESIGN: Basic integrated circuit design concepts, system layout, application of design methodology, the fabrication process, manufacturing limitations of the design process, and CAD/CAE utilization to realize the design process. Prerequisite: ECE 304.
3 sem. hrs.

ECE 447. DIGITAL CONTROL SYSTEMS: Analysis and synthesis of feedback control systems including digital compensators. Topics include performance and stability analysis, regulator and servomechanism design using time and frequency domain methods, and digital implementation case studies. Prerequisites: ECE 415, and 334 or equivalent. *3 sem. hrs.*

ECE 448. FIBER OPTIC COMMUNICATIONS: General light guidance principles; ray optics; dispersion; single mode, multimode, and graded index fibers; basic laser and LED source principles; photodetectors; error probability in digital optical systems; rise time analysis; loss budget analysis; local area networks and long haul communication links. Prerequisite: ECE 333. Corequisite: ECE 401. *3 sem. hrs.*

ECE 449. COMPUTER SYSTEMS ENGINEERING: An introduction to advanced computer architecture and computer systems design. Topics include: exploration of principle architecture features of modern computers, pipelining, memory hierarchy, I/O devices, interconnection networks, introduction to parallel and multiprocessor systems, and the use of hardware description languages (HDLs) in system implementation. Prerequisites: ECE 444 and CPS 346, or permission of instructor. *3 sem. hrs.*

ECE 499. SPECIAL PROBLEMS IN ELECTRICAL AND COMPUTER ENGINEERING: Particular assignments to be arranged and approved by the department chairperson. *1-6 sem. Hrs.*

Advising

During the first semester, students are typically advised by a team of advisors out of the Dean's Office (KL 261; Tel: 229-2736). By the end of the first semester of attendance, students will have a designated advisor from within the ECE department faculty. All course registration, drop/add, minor/concentration selection, thematic cluster registration, and other such activities require approval of the academic advisor. In case an advisor is unavailable and the matter cannot be delayed, the student should make an appointment to consult the ECE chairperson (KL 341: Tel: 229-3611).

Cooperative Education

Cooperative (co-op) education is an optional program in which both ELE and CPE students are eligible to participate as long as the students maintain good academic standing. It enables students to blend classroom theory with practical experience in their chosen field. Placement in a co-op job is not guaranteed since it depends on the student's qualifications and job availability. Students are encouraged to begin their first co-op work semester only after their third semester of academic study.

The table below shows a variety of recommended co-op schedules. The numbered blocks represent semesters where students are taking the "standard" ECE courses for that semester. The blank blocks represent semesters where students are either working with their co-op employer or are doing make-up/extra study semesters. Note that if make-up courses in ECE become necessary, students should consult the long-term ECE course schedule to see when the required course is offered. The graduation flowchart may also be helpful. Both schedules may be located on our website located at http://www.udayton.edu/engineering/electrical_and_computer/index.php or in the ECE office in Kettering Labs Rm. 341.

For information on co-op opportunities, contact the Cooperative Education Program office (KL 261); http://careers.udayton.edu. Before beginning the co-op program, the interested student is required to have a Work/Study Calendar form signed and approved by the ECE chairperson and the director of Cooperative Education

Co-Op Schedule

	YEAR 1			YEAR 2			YEAR 3			YEAR 4			YEAR 5		
	F	W	S	F	W	S	F	W	S	F	W	S	F	W	S
A	1	2		3		4		5		6			7	8	
B	1	2		3		4		5			6		7	8	
C	1	2		3		4	5			6			7	8	
D	1	2		3		4	5				6		7	8	
E	1	2		3	4			5		6			7	8	
F	1	2		3	4			5			6		7	8	
G	1	2		3	4		5			6			7	8	
H	1	2		3	4		5				6		7	8	

5 Year BS+MS Accelerated Program (Bachelor's + Masters (BPM) Program)

This program, enables undergraduate ECE students with an engineering GPA of 3.25 or higher, to earn an MS degree within a year after their BS degree. Accelerated program students should take two graduate level courses (6 credit hours) from the list of approved technical electives. These two courses satisfy both undergraduate and graduate program requirements. Graduate students will then also take an additional 24 graduate credit hours to complete the M.S. degree requirements. Concentration areas and courses in each area are listed in the following table. While all students are encouraged to do a thesis, students supported by an assistantship or tuition scholarships from the Department (Graduate Teaching Assistantship, or Graduate Research Assistantship) are required to complete a thesis. The M.S. degree will be conferred at the successful completion of the graduate requirements as specified in the program description at http://bulletin.udayton.edu. Note: A significant tuition discount is available for the Bachelors + Masters (BPM) students after the completion of undergraduate requirements.

Graduate Concentration Areas

Sensors and Devices	Signals and Systems	Computing Systems
Choose Three From: Digital Communications I & II, Antennas, Microwave Engineering & Systems, Fourier Optics, Guided Wave Optics, Integrated Optics, Nanoelectronics, etc.	**Choose Three From:** Digital Signal Processing, Image Processing, Statistical Signal Processing, Adaptive Signal Processing, Automatic Control, Nonlinear Systems and Control, Adaptive Control, Robotics, Computer Vision, Machine Learning, etc.	**Choose Three From:** Computer Architecture, Micro-electronic Systems, Embedded Systems, Micro-processor Applications, Advanced Engineering Software, Neuro-morphic Computing, etc.

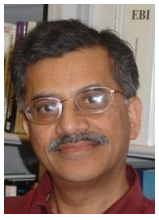
Faculty

Guru Subramanyam
Chair, ECE Department
Microelectronics, Electronic Materials, and Microwave Electronics

Vijayan Asari
Ohio Research Scholar Chair in Wide Area Surveillance, Computer Vision, Pattern Recognition, Machine Learning, Digital Architectures

Eric Balster
Image processing, Video processing, Software Engineering, Digital Electronics

Partha Banerjee
Nonlinear Optics, Acousto-optics, Image Processing



Monish Chatterjee
Optical Processing, Holography, Complex Media

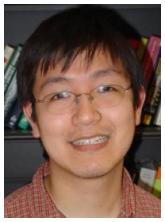
Malcolm Daniels
Automatic Control, Electrical Machines Systems Theory

Bradley Duncan
Optical Remote Sensing, Image Processing

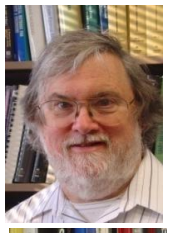
Elena Guliants
Microelectronics, Nano-engineering

Russell Hardie
Signal & Image Processing, Video Processing, Medical Image Processing, Remote Sensing

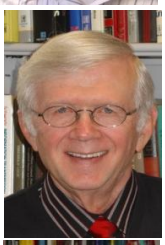
Joseph Haus
Professor, Electro-Optics Graduate Program



Keigo Hirakawa
Signal and Image Processing, Statistics, Camera Systems



John Loomis
Digital Systems, Computer Architecture, Digital Image Processing, Computer Vision



Donald Moon
Digital & Computer Systems, Avionic Systems, Displays

Raul Ordonez
Adaptive, Nonlinear, Robotics Control

Robert Penno,
EM Radiation & Scattering, Diffraction, Radar Cross-Section

Andrew Sarangan
Optoelectronics device technology, Photo-detectors & Image Sensors, Optical & Nano-structured thin films, Nano-fabrication & MEMS

Frank Scarpino
Signal Processing, Avionic Systems, Microelectronics

Tarek Taha
Computer Architecture, Novel Computing for Neuromorphic Systems, High Performance Computing

John Weber
Digital Systems Architecture, Embedded Systems, Information Technology

Michael Wicks
Ohio Research Scholar Chair in Sensor Exploitation & Fusion, Radar Systems, Signal Processing

Mikhail Vorontsov
LADAR Endowed Chair, Electro-Optics Graduate Program; Director, Intelligent Optics Laboratory

Qiwen Zhan
Electro-Optics Graduate Program; Nanoscale Imaging and Sensors

Nancy Striebich
Administrative Assistant
John Fortune LabManager

Contact Information
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web: http://www.udayton.edu/engineering/electrical_and_computer/index.php