Our electrical and computer engineering undergraduate programs are accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org.
# Department of Electrical and Computer Engineering
## Undergraduate Programs Handbook

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Introduction to the Department of Electrical and Computer Engineering

The Department of Electrical and Computer Engineering (ECE) at the University of Dayton 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 biomedical/bioengineering, computer hardware and software, computer vision, digital system design and integrated circuit design, electro-optics, robotics and controls, sensor technologies, signal and image processing, telecommunications and wireless systems, and wide area surveillance. The Dayton area is a high-tech research and development community, and our faculty work with nearby Wright-Patterson Air Force Base (WPAFB), Air Force Research Laboratories (AFRL), and numerous aerospace, automobile, sensor systems, and information technology companies. The UD campus is home to the $53 million General Electric Electrical Power Integrated Systems Center (EPIS), with close ties to our department. In addition to state of the art teaching labs, we have a number of exciting specialty labs such as the Mumma Radar Lab, Vision Lab, Integrated Microsystems Lab, High Performance Computing Lab, Embedded Systems Lab and the Motoman Robotics lab, and numerous faculty research labs with active undergraduate research projects. Our department faculty include world-renowned teachers and researchers who have authored textbooks, published extensively in prestigious journals and conferences, and are Fellows in their respective professional organizations. We pride ourselves on our world-class curriculum, which is updated regularly to meet the changing needs of government, industry, and academia. We offer more hands-on lab classes than other engineering majors, and these utilize our state-of-the-art laboratory facilities.

**Highlights of Electrical and Computer Engineering 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.

*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 from 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, UC-San Diego, Georgia Tech, Northwestern, John Hopkins 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 as 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 continually renovate and enhance all of our classroom teaching labs and have the Mumma Radar Lab, which combines radar sensors and robotics, as well as the Motoman Robotics Lab. We have numerous additional research labs to support research programs in advanced digital design, embedded systems, computer vision, control systems, signal and image processing, electro-optics, microelectronics, nanotechnology, robotics, and microwaves.

*ECE offers a comprehensive set of technical electives* and an interdisciplinary capstone design experience with the innovation center, working on real-world industry sponsored projects.
Top 10 Reasons to Pick ECE Major at UD

1. Great careers that command 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 allow lots of personalized attention.
6. Excellent job, co-op and graduate school placement, in addition to a 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 (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, M.S. ELE (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 (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, (Now with Amazon)
About the Department

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.

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.

Contact Information

Address

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Contacts

Dr. Guru Subramanyam, Chairperson
E-mail: gsubramanyam1@udayton.edu

Ms. Nancy Striebich, Administrative Assistant
Email: nstriebich1@udayton.edu

Advising

During their first two years, students are advised by a team of advisors in the School of Engineering Office of Student Success. Once the student has achieved junior standing, s/he will have a faculty advisor assigned to them within the ECE department. All course registration, drop/add, minor/concentration selection, 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).

Our Mission

Our mission is to provide an educational experience of the highest quality to produce the discipline’s most valued graduates, with the skills and knowledge to learn, lead, and serve in electrical and computer engineering related professions and in their communities.

Programs of Study (What courses do I take?)

The official programs of study for ELE and CPE are provided in the Academic Catalog. However, one helpful way to understand the programs is with the course flow charts provided at the end of this document (one for ELE and one for CPE). Each column is an academic semester and each block represents a course. Prerequisites are indicated by the solid black lines connecting courses, and these must flow from left to right. Co-requisites are courses that must be taken at the same time. These include all of our lab courses and this is designated on the flow charts with a dashed line connecting the courses. The lab courses must be taken with the corresponding course (unless a course or lab is being taken for a second time). Some departures from the courses listed in the programs of study are allowed. For example,
approved transfer credits or AP credits may be used as substitutions. Any changes to the standard program must be approved by the department Chair by means of a “Request to modify program of study” form (found on Porches - Engineering).

Note that the curricula may change from one academic year to another. Know that the academic year in which you enter the program defines the course requirements for your degree. Thus, make sure you consult the flow chart labeled with the same academic year in which you enter (an archive of flow charts by date is available on the ECE website). You can monitor your progress towards your degree with the DegreeWorks tool that can be accessed from the Porches website http://porches.udayton.edu under the Flyer Student Services tab. Registration for courses is done online and can be accessed through Porches. A numerical registration code is needed each semester from your faculty advisor to sign up for classes. Email your advisor and make an appointment to address any question and to receive your code.

**Electrical Engineering Program Objectives**

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 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 level education.

Our specific educational objectives are that 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.
Computer Engineering Program Objectives

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.

Our specific educational objectives are that 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.

Common Academic Program Requirements

The ELE and CPE programs include university level Common Academic Program (CAP) requirements, as well as engineering related topics. CAP requirements are satisfied by the courses shown on the flow chart with a red outline. These CAP-fulfilling courses include the Humanities Commons:

- HST 103
- PHL 103
- REL 103
- ENG 100 and ENG 200
- CMM 100.
- SSC 200

Some courses that are part of the required technical program of study also jointly serve to satisfy CAP requirements. These include the following:

- MTH 168
- PHY 206
- CHM 123
- PHL 316 or 319
- PHY 210L
- ECE 432L.

The remaining CAP requirements are fulfilled with what we refer to as the CAP electives (as there are multiple ways for students to fulfill these). There are a total of three CAP elective courses needed as shown on the flow charts. These 3 courses must include the following:

- Arts Elective
- Advanced Historical Study
- Advanced Philosophy or Religious Study
It is important that students take care to select these 3 courses so as to successfully complete the 2 CAP attributes of Faith Traditions and Diversity and Social Justice. Note that all other CAP requirement are satisfied by the required curriculum and do not need to be considered when picking CAP electives. The CAP requirements satisfied by various courses are listed on the CAP page: www.udayton.edu/provost/cap/advise.php. The easiest way to ensure that you fulfill the CAP requirements is by using the “What if” feature in DegreeWorks (accessed from Porches).

The Integrated Engineering Core Curriculum (IEC)

During the first two years, 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, and Engineering Thermodynamics. 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. The IEC courses are shown on the flow charts with diagonally lined blocks.

Technical Electives

Electives for ELE and CPE Program

Students are required to choose Technical Electives from the following list:

- Any 300 or 400 level course in: ECE, EGR, CPS, MTH, MEE, CEE, CME.
- EGM 303, EGM 304, EGM 445, PHY 303, PHY 321, PHY 390, PHY 404, PHY 411, PHY 440
- Any graduate ECE or EOP course between 501 and 509
- ECE 532, ECE 533, CPS 510, CPS 536, CPS 570

Exceptions: Required courses in ECE or CPS, MTH367, MTH 368, MTH 395, EGR308, EGR 323

For ELE majors: choose four courses from the list above, of which two must be ECE coded. (12 semester hours of technical electives, with 6 in ECE)

For CPE majors: choose three courses, one must be CPS (9 semester hours)

Note: Pre-requisites may be required for some technical elective courses. Additional technical electives may be approved by the ECE department Chair.

Concentrations

A concentration is a specialization within your major. This is not to be confused with a minor. Minors are offered by other departments outside of your major department. You should contact the department in which the minor is offered for more information.

Concentration in Electro-Optics

The departments of Electrical and 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 co-op 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 and Computer Engineering offers a concentration in Robotics available to ECE students. ELE students can complete the concentration using available technical electives, while CPE students need one additional course outside the required technical electives. 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 Introduction to Robotics
- ECE 447 Digital Controls

Any one 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

Undergraduate Required

EGR Courses

EGR 100. Enrichment Workshop. 0 Hours
A workshop structured to provide collaborative learning of engineering calculus facilitated with upper-class engineering students. Required course both semesters for first-year students.

EGR 102. INTRODUCTION TO THE UNIVERSITY EXPERIENCE – SCHOOL OF ENGINEERING
This is a first semester course required for all majors in the areas of engineering and engineering technology. The 2 primary components of this course are to include: (1) Introduction to the University of Dayton Educational Experience, (2) Students as Reflective Decision-Makers and Active Learners. It will also be the venue to introduce all engineering and engineering technology students to the disciplines/departments across the School of Engineering. This course is part of the Integrated Engineering Core (IEC).

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 168. 3
sem. hrs.

Undergraduate ECE Courses
Please note – courses required by each program will
have ‘ELE’ or ‘CPE’ or both to indicate if they are
required by the program. Courses missing either of these
designations are considered electives. Should a course
feature only one of these designations, then it would be
considered an elective by the other program.

ECE 101. Introduction to Electrical & Computer
Engineering. ELE, CPE
Introduction to electrical and computer engineering
faculty, facilities, and curriculum. Career opportunities
in electrical and computer engineering and areas of
specialization are discussed. Second semester seminar.
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:
ELE, CPE
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. COP
200 may be substituted 0 sem. hrs.

ECE 201. Circuit Analysis: ELE, CPE
Principles of linear circuit analysis and problem solving
techniques associated with circuits containing both
passive and active components. Includes analysis of
linear circuits with direct current (DC) and alternating
current (AC) excitation, as well as a study of transient
behavior. Course includes an additional mandatory
supervised weekly problem session. Prerequisite(s):
MTH 168. Corequisite(s): ECE 201L. 3 sem. hr.

ECE 201L. CIRCUIT ANALYSIS LABORATORY: ELE, CPE
Laboratory course stressing experimental techniques,
laboratory reporting, safety, and instrumentation.
Experimental investigation of basic steady-state and
transient circuits. Corequisite: ECE201 or EGR 203. 1
sem. hr.

ECE 203. INTRODUCTION TO MATLAB PROGRAMMING:
ELE, CPE
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: ELE, CPE
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: ELE, CPE
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: ELE, CPE
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: EGR 203. Corequisite: 215L. 3 sem. hr.

ECE 215L. DIGITAL SYSTEMS LABORATORY: ELE, CPE
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 300. Professional Development Seminar II. ELE, CPE
Junior level 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 junior ECE students. Waived for Co-op students. Prerequisite(s): ECE 200. 0 sem. hrs.

ECE 303. SIGNALS AND SYSTEMS: ELE, CPE
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 219. Corequisite: ECE 303L. 3 sem. hrs.

ECE 303L. SIGNALS AND SYSTEMS LABORATORY: ELE
Laboratory investigation of signals and systems including signal decomposition, system impulse response, convolution, frequency analysis of systems, and filter design and realization. Prerequisite: ECE 204. Corequisite: ECE 303. 1 sem. hr.

ECE 304. ELECTRONIC SYSTEMS: ELE, CPE
Study of cascaded amplifiers, feedback amplifiers, linear integrated circuits, and oscillators including steady state analysis and analysis of frequency response. Prerequisites: ECE 303. Corequisite: ECE 304L. 3 sem. hrs.

ECE 304L. ELECTRONIC SYSTEMS LABORATORY: ELE, CPE
Design, construction and verification of multistage feedback amplifiers, passive and active filters, and oscillators. Prerequisite: ECE 303. Corequisite: ECE 304. 1 sem. hr.

ECE 314. FUNDAMENTALS OF COMPUTER ARCHITECTURE: ELE, CPE
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 CPS 150. Corequisite: ECE 314L. 3 sem. hrs.

ECE 314L. FUNDAMENTALS OF COMPUTER ARCHITECTURE LAB: ELE, CPE
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: ELE
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/ECE 201. 3 sem. hrs.

ECE 333. APPLIED ELECTROMAGNETICS: ELE
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: ELE, CPE
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: ELE, CPE
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: ELE
Study of amplitude, angle, pulse, and digital communication systems including generation, detection, and analysis of modulated signals and power, bandwidth, and noise considerations. Prerequisites: ECE 340, 304. Corequisite: ECE 401L. 3 sem. hrs.

ECE 401L. COMMUNICATION SYSTEMS LABORATORY: ELE
Design, fabrication, and laboratory investigation of modulators, detectors, filters, and associated communication components and systems. Prerequisite: ECE 304, ECE 340. Corequisite: ECE 401. 1 sem. hr.

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. Prerequisites: ECE 316 or equivalent. 3 sem. hrs.

ECE 415. CONTROL SYSTEMS: ELE
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. INTRODUCTION 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. 3 sem hrs.

ECE 431L. MULTIDISCIPLINARY DESIGN I: ELE, CPE
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: Prerequisites: ECE304 and ECE314.

ECE 432L. MULTIDISCIPLINARY DESIGN II: ELE, CPE
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 334 or ECE 340 or CPS 356), ECE 431L, (ECE 444 or CPS 444); ELE majors (ECE 333 or ECE 334 or ECE 340), ECE 431L, (ECE 401 or ECE 415). 3 sem. hrs.
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. DIGITAL INTEGRATED CIRCUIT DESIGN:
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 332. 3 sem. hrs.

ECE 444. ADVANCED DIGITAL DESIGN: CPE
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. CMOS ANALOG CIRCUIT 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 ECE 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: CPE
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 450L. PROJECTS LABORATORY:
Project-oriented laboratory applying engineering skills in the design, development, and demonstration of electrical and electronic systems. Prerequisite(s): Permission of project advisor. Prerequisites: Permission of project adviser. 1-3 sem. hrs.

ECE 471. CONTEMPORARY POWER SYSTEMS AND THE SMART GRID:
Introduction to electrical power systems; generation, transmission and utilization; power system analysis; power system control; energy management; and an introduction to smart grid technologies. Prerequisites(s): ECE 316 or equivalent. 3 sem. hrs.

ECE 472. SMART GRID TECHNOLOGIES:
An introductory study of enabling technologies and energy issues necessary for full realization of the Smart Grid. Course topics vary. This course can be taken
multiple times. Prerequisite(s): ECE 471 or equivalent. 3 sem. hrs.

ECE 493. HONORS THESIS:
Selection, design, investigation, and completion of an independent, original research study resulting in a document prepared for submission as a potential publication and a completed undergraduate thesis. Restricted to students in University Honors Program. 3 sem. hrs.

ECE 494. HONORS THESIS:
Selection, design, investigation, and completion of an independent, original research study resulting in a document prepared for submission as a potential publication and a completed undergraduate thesis. Restricted to students in University Honors Program. Prerequisite: ECE 493. 3 sem. hrs.

ECE 498. 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 499. SPECIAL PROBLEMS IN ELECTRICAL AND COMPUTER ENGINEERING:
Particular assignments to be arranged and approved by the department chairperson. 1-6 sem. hrs.

CPS Courses
Required for CPE

CPS 150. ALGORITHMS & PROGRAMMING I: ELE, CPE
Algorithms, programs, and computers. Algorithm development, basic programming and programming structure. Debugging and program verification. Data representation. Computer solutions to numeric and non-numeric problems using a compiler language. 4 sem. hrs.

CPS 151. ALGORITHMS & PROGRAMMING II:
Continuation of CPS 150. Emphasis on program design, development and style, string processing, data structures, program modularity, and abstract data type, using a compiler language. Prerequisite(s): CPS 150. 4 sem. hrs.

CPS 341. DISCRETE STRUCTURES:
Logic and proofs, sets and counting, Boolean algebra, graph theory, directed graphs, mathematical machines, formal languages and grammars. Prerequisite(s): CPS 150. 3 sem. hrs.

CPS 346. OPERATING SYSTEMS I:
Semaphores, conditions, monitors, and kernels. Concurrent programming, interrupts, memory, and process management. Design and implementation of multithreaded and distributed system components using concurrent languages. Prerequisite(s): CPS 250, CPS 350. 3 sem. hrs.

CPS 350. DATA STRUCTURES & ALGORITHMS:
Advanced concepts of linear data structures, stacks, queues, and abstract data types. Basic and advanced concepts of trees, graphs, hash tables, heaps, algorithm design and analysis techniques. Prerequisite(s): CPS 151. 3 sem. hrs.

CPS 444. SYSTEMS PROGRAMMING I:
Analysis of compilers and their construction; programming techniques discussed in the current literature; advanced computer applications in mathematical and nonnumeric areas. Prerequisite(s): CPS 346, CPS 350. 3 sem. hrs.
Additional Opportunities

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.

For information on co-op opportunities, contact the Cooperative Education Program office (KL 266): http://www.udayton.edu/engineering/careers_and_coops/.

Contact:
Office of Cooperative Education
Kettering Labs Room 266
Phone: 937-229-2335
Fax: 937-229-2030.

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 the Cooperative Education program.

5 Year B.S. + M.S. Accelerated Program
(Bachelor’s + Masters)

This program, enables undergraduate ECE students with an engineering GPA of 3.0 or higher, to earn an M.S. degree within a year after their B.S. 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 Graduate Concentration Areas table on page 16. 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. Note: A significant tuition discount is available for the Bachelors + Masters (BPM) students after the completion of undergraduate requirements.

Graduate School

Whether you take advantage of the 5 Year Bachelor’s + Masters program or not, do consider graduate school. An M.S. degree is an excellent terminal degree in engineering as it raises salaries and provides significant professional advancement. It is also a step towards a Ph.D. degree for those with research and academic ambitions. Students with a high GPA are often able to obtain a full teaching or research assistantship to pay for graduate education with a stipend, tuition, and benefits. Our department offers excellent graduate programs in Electrical Engineering, Computer Engineering, and Electro-Optics (with our close partner the Department of Electro-Optics & Photonics). If you think you might be interested don’t hesitate to speak with your professors and/or the department chairperson. Our ECE undergraduates have consistently made excellent and successful graduate students (at UD and elsewhere). More information on graduate programs and resources for graduate students is available on the graduate section of the ECE website.
# Graduate Concentration Areas

<table>
<thead>
<tr>
<th>Sensors and Devices</th>
<th>Signals and Systems</th>
<th>Computing Systems</th>
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<td><strong>Choose Three From:</strong></td>
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## Useful Web Sites

### School of Engineering

### Electrical and Computer Engineering Homepage:

### Academic Catalog ECE Programs Description
- [http://catalog.udayton.edu/undergraduate/schoolofengineering/programsofstudy/electricalandcomputeringeering/](http://catalog.udayton.edu/undergraduate/schoolofengineering/programsofstudy/electricalandcomputeringeering/)

### Academic Calendar
- [https://www.udayton.edu/flyersfirst/registrar/academic_calendar.php](https://www.udayton.edu/flyersfirst/registrar/academic_calendar.php)

### Registration
- [https://www.udayton.edu/flyersfirst/registratio n/index.php](https://www.udayton.edu/flyersfirst/registratio n/index.php)

### Center for International Studies

### Learning Teaching Center
- [http://www.udayton.edu/ltc/learningresources/](http://www.udayton.edu/ltc/learningresources/)

### Counseling Center
- [http://www.udayton.edu/studev/counselingcenter/](http://www.udayton.edu/studev/counselingcenter/)

### Student Development (handbook, wellness, housing, etc.)
- [http://www.udayton.edu/studev/](http://www.udayton.edu/studev/)

### Common Academic Program
- [http://www.udayton.edu/provost/cap/](http://www.udayton.edu/provost/cap/)

### Porches Login
- [https://porches.udayton.edu/cp/home/displaylogin](https://porches.udayton.edu/cp/home/displaylogin)

### Isidore Login:
- [https://isidore.udayton.edu/portal](https://isidore.udayton.edu/portal)

### UD Library
- [http://www.udayton.edu/libraries/](http://www.udayton.edu/libraries/)

### Career Services
- [http://careers.udayton.edu](http://careers.udayton.edu)

### Co-op Office
- [http://www.udayton.edu/engineering/careers_and_coops/](http://www.udayton.edu/engineering/careers_and_coops/)

### ECE faculty and staff
- [https://www.udayton.edu/engineering/depart ments/electrical_and_computer/faculty-staff/index.php](https://www.udayton.edu/engineering/depart ments/electrical_and_computer/faculty-staff/index.php)

### Department Related YouTube Videos
- Mumma Radar Lab
  - [https://www.youtube.com/watch?v=Vu5Eo7OSl&noredirect=1](https://www.youtube.com/watch?v=Vu5Eo7OSl&noredirect=1)
- Motoman Robotics Lab Videos
  - [http://homepages.udayton.edu/~ordonere/MRL/Movies.html](http://homepages.udayton.edu/~ordonere/MRL/Movies.html)
- Robotic Ball Catcher Project
  - [https://www.youtube.com/watch?v=hBkPD41WBwU](https://www.youtube.com/watch?v=hBkPD41WBwU)
## ECE Faculty and Staff

<table>
<thead>
<tr>
<th>Name</th>
<th>Position/Role</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Guru Subramanyam</strong></td>
<td>Chair, ECE Department Microelectronics, Electronic Materials, and Microwave Electronics</td>
</tr>
<tr>
<td><strong>Partha Banerjee</strong></td>
<td>Nonlinear Optics, Acousto-optics, Image Processing Department of Electro – Optics and Photonics</td>
</tr>
<tr>
<td><strong>Nancy Striebich</strong></td>
<td>ECE Administrative Assistant</td>
</tr>
<tr>
<td><strong>Ralph Barrera</strong></td>
<td>Adjunct Faculty Digital Systems</td>
</tr>
<tr>
<td><strong>Ramani Asari</strong></td>
<td>Instructor</td>
</tr>
<tr>
<td><strong>Monish Chatterjee</strong></td>
<td>Optical Processing, Holography, Complex Media</td>
</tr>
<tr>
<td><strong>Vijayan Asari</strong></td>
<td>Ohio Research Scholar Chair in Wide Area Surveillance, Computer Vision, Pattern Recognition, Machine Learning, Digital Architectures</td>
</tr>
<tr>
<td><strong>Vamsy Chodavarapu</strong></td>
<td>Associate Professor Integrated Microsystems, MEMS, Sensors, CMOS IC Design</td>
</tr>
<tr>
<td><strong>Theus Aspiras</strong></td>
<td>Research Staff Vision Lab</td>
</tr>
<tr>
<td><strong>Malcolm Daniels</strong></td>
<td>Automatic Control, Electrical Machines Systems Theory Director, The ETHOS Center</td>
</tr>
<tr>
<td><strong>Tanvir Atahary</strong></td>
<td>Research Staff High Performance Computing, Cognitive Computing</td>
</tr>
<tr>
<td><strong>Yakov Diskin</strong></td>
<td>Adjunct Faculty Digital Image Processing Computer Vision</td>
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<tr>
<td><strong>Eric Balster</strong></td>
<td>Image processing, Video processing, Software Engineering, Digital Electronics</td>
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<tr>
<td><strong>Bradley Duncan</strong></td>
<td>Optical Remote Sensing, Image Processing</td>
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</tbody>
</table>
## ECE Faculty and Staff (Continued)

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Department</th>
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<tbody>
<tr>
<td>Russell Hardie</td>
<td>Professor, Signal &amp; Image Processing, Video Processing, Medical Image Processing, Remote Sensing</td>
<td>ECE Faculty and Staff</td>
</tr>
<tr>
<td>Lorenzo LoMonte</td>
<td>Adjunct Faculty, Radar Signal Processing Information Theory</td>
<td>ECE Faculty and Staff</td>
</tr>
<tr>
<td>Joseph Haus</td>
<td>Professor, Electro-Optics Graduate Program</td>
<td>ECE Faculty and Staff</td>
</tr>
<tr>
<td>John Loomis</td>
<td>Professor Emeritus, Digital Systems, Computer Architecture, Digital Image Processing, Computer Vision</td>
<td>ECE Faculty and Staff</td>
</tr>
<tr>
<td>Keigo Hirakawa</td>
<td>Signal and Image Processing, Statistics, Camera Systems</td>
<td>ECE Faculty and Staff</td>
</tr>
<tr>
<td>John Malas</td>
<td>Adjunct Faculty, Radar Signal Processing Information Theory</td>
<td>ECE Faculty and Staff</td>
</tr>
<tr>
<td>Zhenhua Jiang</td>
<td>Joint Appointment with UDRI, Ohio Research Scholar, Electrical Power Systems</td>
<td>ECE Faculty and Staff</td>
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<tr>
<td>Paul McManamon</td>
<td>Technical Director, Ladar and Optical Communications Institute (LOCI)</td>
<td>ECE Faculty and Staff</td>
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<tr>
<td>Temesguen Messay-Kebede</td>
<td>Research Engineer, Motoman Robotics Lab</td>
<td>ECE Faculty and Staff</td>
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<tr>
<td>Julie Motz</td>
<td>Lab Manager</td>
<td>ECE Faculty and Staff</td>
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<tr>
<td>Donald Kessler</td>
<td>Joint Appointment with University of Dayton, Sensor Technology Group</td>
<td>ECE Faculty and Staff</td>
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<tr>
<td>Raul Ordonez</td>
<td>Adaptive, Nonlinear, Robotics Control</td>
<td>ECE Faculty and Staff</td>
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<tr>
<td>Steve Kim</td>
<td>Adjunct Faculty, Sensors, AFRL Human Effectiveness Directorate</td>
<td>ECE Faculty and Staff</td>
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<tr>
<td>Mark Patterson</td>
<td>Adjunct Faculty, Microelectronics, Air Force Life Cycle Management Center</td>
<td>ECE Faculty and Staff</td>
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<tr>
<td>Paul Kladitis</td>
<td>Joint Appointment with UDRI Energy Systems Group</td>
<td>ECE Faculty and Staff</td>
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<tr>
<td>Robert Penno</td>
<td>EM Radiation &amp; Scattering, Diffraction, Radar Cross-Section</td>
<td>ECE Faculty and Staff</td>
</tr>
<tr>
<td>Name</td>
<td>Position and Responsibilities</td>
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<tr>
<td>James Reed</td>
<td>Research Technician</td>
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<tr>
<td>Bang-Hung Tsao</td>
<td>Joint Appointment with UDRI, Energy Systems, Tech Lead for GE EPISCENTER</td>
<td></td>
</tr>
<tr>
<td>Andrew Sarangan</td>
<td>Optoelectronics device technology, Photo-detectors &amp; Image Sensors, Optical &amp; Nano-structured thin films, Nano-fabrication &amp; MEMS Department of Electro-Optics and Photonics</td>
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<tr>
<td>Edward Watson</td>
<td>Adjunct Faculty Nonlinear Optics (LOCI) Department of Electro-Optics and Photonics</td>
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<tr>
<td>Frank Scarpino</td>
<td>Professor Emeritus Optoelectronics device technology, Photo-detectors &amp; Image Sensors, Optical &amp; Nano-structured thin films, Nano-fabrication &amp; MEMS Department of Electro-Optics and Photonics</td>
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<tr>
<td>John Weber</td>
<td>Digital Systems Architecture, Embedded Systems, Information Technology</td>
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<tr>
<td>Eunsung Shin</td>
<td>Research Staff Center of Excellence for Thin Film Research and Surface Engineering (CETRASE)</td>
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<tr>
<td>Michael Wicks</td>
<td>Ohio Research Scholar Chair in Sensor Exploitation &amp; Fusion, Radar Systems, Signal Processing</td>
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<tr>
<td>Christopher Yakopcic</td>
<td>Research Staff Neuromorphic Computing, High Performance Computing</td>
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<tr>
<td>Penny Timmer</td>
<td>Academic Advisor School of Engineering Office of Student Success</td>
<td></td>
</tr>
<tr>
<td>Feng Ye</td>
<td>Cyber security, communication network security, wireless communication &amp; networks</td>
<td></td>
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