UNIVERSITY OF DETROIT MERCY

We Want Great Things for You

DOCTOR OF ENGINEERING IN ELECTRICAL ENGINEERING

Chair & Professor
Mark Paulik, Ph.D.
Image & Signal Processing, Embedded Sensor Systems
Office: 330 Engineering
Telephone: (313) 993-3365
Email: ece_chair@udmercy.edu

Professor: Nizar Al-Holou, Ph.D.
Wireless Networking, Parallel and Distributed Processing
Office: 324 Engineering
Telephone: (313) 993-1057
Email: nizar.alholou@udmercy.edu

Associate Professor: Armand R. Ash, Ph.D.
Mechatronics, Biomedical measurements
Office: 327 Engineering
Telephone: (313) 993-3364
Email: arash@udmercy.edu

Professor: Mohan Krishnan, Ph.D.
1D & 2D DSP, signal modeling, Computational Intell.
Office: 328 Engineering
Telephone: (313) 993-3367
Email: mohank@udmercy.edu

Professor: Chun-Ju Lin, Ph.D.
Electromagnetics, EMC, Power Systems
Office: 325 Engineering
Telephone: (313) 993-3384
Email: lincj@udmercy.edu

Emeritus Professor: Dipak Sengupta, Ph.D.
Antennas and Radiation, EMC
Office: 330 Engineering
Telephone: (313) 993-3365
Email: sengupdl@udmercy.edu

Associate Professor: Sandra Yost CSJ, Ph.D.,
Robust Control, Stability Theory, Engineering Education
Office: 322 Engineering
Telephone: (313) 993-1748
Email: yostsa@udmercy.edu

Technician: Utayba Mohammad, M.E.
Wireless sensor networking, embedded systems
Office: 363 Engineering
Telephone: (313) 993-3366
Email: mohammut@udmercy.edu

In addition to full-time faculty, we employ several adjunct faculty in various areas of specialization.

Doctoral Study in Electrical Engineering

The Doctor of Engineering in Electrical Engineering program at the University of Detroit Mercy focuses on you, the student. You'll get personal attention, in small classes and research seminars, from faculty who place teaching first. Our relevant and practical research and close connections with industry help create an exciting learning environment that will guarantee your success.. For the working person, all our classes are held in the late afternoon and evening. Many of our full-time graduate students obtain paid internships in local industry for one or two terms during their course of study.

Degrees

The Department of Electrical and Computer Engineering offers a Doctor of Engineering in Electrical Engineering. Course work and research specializations in computer engineering, mechatronics, and signals and systems are available.

Program Strengths

• Graduate Co-op Program
Qualified individuals can choose to work in industry on either alternating semesters or during the summer semesters. A rich variety of advanced engineering opportunities are available in the Southeastern Michigan region.

• Design and Project Oriented
Participate in exciting hands-on projects that integrate theory and application. For example, current students are working on the design and development an internationally competitive autonomous vehicle to participate in the International Ground Vehicle Competition (www.IGVC.org). In the 2006 & 2007 competitions, our teams placed overall 3rd in the Grand Award among 37-40 teams.

• Student Centered
Take advantage of small class sizes and opportunities for one-on-one contact with professors. Most courses include opportunities to work in teams and advance the professional and personal skills so vital to long term career success in industry.

Admission Requirements

The requirements for admission to Doctoral program in the ECE department include the following:

- An undergraduate overall GPA of at least 3.00 or a graduate GPA of 3.0 on a previously completed engineering or science graduate degree. The undergraduate degree must be in electrical engineering or computer engineering. If the degree is in a related field such as computer science, physics, or another engineering field, additional undergraduate electrical engineering courses will be required. Prior Masters degrees must be in an approved closely related area.
- A completed application form and fee;
- Official transcripts from all current and previous colleges;
- Three letters of recommendation, and
- A letter of intent describing your graduate study interests.

Although not required, GRE and TOEFL scores are welcome.

Degree Requirements

The Doctor of Engineering in Electrical Engineering adheres to the College's general requirements for admission to and candidacy in a Doctor of Engineering program with some department specific modification/additions.

Coursework

The doctoral program requires 51 credit hours of coursework beyond the engineering baccalaureate or 21 hours past an approved Masters Degree. Up to 36 graduate credit hours can be transferred but at least 21 additional graduate credits must be accrued at UDM. Coursework is divided into Doctoral Core, Concentration Core, and Discipline Specific. There are three Doctoral Core courses (or equivalent): E 502 Design of Experiments; E 520 Optimization; and E 530 Advanced Engineering Mathematics. For Concentration Core courses, each concentration has a number of associated courses, all of which must be taken to fulfill the requirements for the concentration. Discipline Specific courses are those related to Electrical and Computer Engineering. All Doctoral courses must be at the 500 level (unless specifically approved by the advisor/committee and the department chairperson). Also, all doctoral programs of study must be approved by the faculty advisor/committee and the department chairperson.

Dissertation

Dissertation credits consist of research credits under the guidance of a Doctoral Dissertation committee headed by a faculty member who acts as the supervisor. Although Doctoral research is independent, novel, and advances the state of the art, the committee members can provide guidance, advice and technical expertise. A minimum 30 dissertation credits are required for the Doctor of Engineering degree.

Examination

Examinations comprise three stages: Qualifying, Dissertation Topic, and Final. The Qualifying Examination is administered and interpreted by the college-level Doctoral Graduate Committee. The exam consists of three parts: Mathematics, Computer, and Discipline Specific (for Electrical and Computer Engineering, separate major and minor exams are given with the topic areas chosen by the individual examinee in consultation with his/her committee). The qualifying exam must be taken as soon as the student has completed the doctoral core courses. Students passing the qualifying exam are allowed to advance in the Doctoral program. Students can repeat the qualifying exam once. Students failing the qualifying exam for the second time are dismissed from the doctoral program. The Dissertation Topic Examination consists of the formal presentation of the dissertation topic to the supervisory committee. The committee provides feedback to the student regarding scope, depth and relevancy of the topic. With approval of the committee, the student can proceed with the research and subsequent accrual of dissertation credits. Final Examination consists of the formal and public presentation of the dissertation results. The written dissertation must also be approved and accepted by the supervisory committee. The Final Examination, in concert with submission of the approved version of the written dissertation, constitutes the last step in completion of the Doctor of Engineering degree.

Concentration in Computer Engineering

The computer engineering specialization is a program focused on the design and development of embedded computer/control and wireless smart sensor systems. This focus uniquely addresses the needs of the BioElectric, Wireless Communications, Multimedia, Aerospace and Automotive communities. The program seeks to provide students with the ability to design real-time distributed microcontroller-based systems. Career opportunities in this area are excellent.

Concentration in Signals and Systems

The signals and systems specialization provides a background in digital signal and image processing, and control systems. The advent of high-speed specialized digital signal processor and FPGA integrated circuits has spurred rapid development in this area (witness cellular phones, software radios, CD and DVD players, and HDTV systems). The subsequent demand for specialists in this field has created excellent career opportunities. Students completing this program will have both the theoretical background and practical experience to design and develop quality products in this market.

Concentration in Mechatronics

Mechatronics Engineering is a modern discipline that transcends the boundaries between Embedded Systems, Mechanical, Electrical, and Computer Engineering. Mechatronics Engineering is commonly defined as "The discipline that focuses on the design and control of electro-mechanical devices" or "the integration of electronics, control engineering and mechanical engineering." The Faculty of the ECE department, in close cooperation with the Mechanical Engineering department has designed an innovative world class Mechatronics program that offers a balance of Electrical,

Software, and Mechanical content with a focus on Embedded Systems Design. Career opportunities can be found in the Aerospace, BioMedical, and Automotive fields among many others.

Required courses for each concentration are as follows:

Concentration in Computer Engineering
EE486/487 Microcontrollers and lab (special permission req.)
EE 577/579 Embedded Systems and lab
EE 580 Computer Architecture
(Other courses may be substituted with permission of the advisor depending on prior preparation)

Concentration in Signals and Systems
EE 588 Digital Signal Processing I
EE 558 Advanced Electronics
EE 576 Digital Control
(Other courses may be substituted with permission of the advisor depending on prior
preparation)

Concentration in Mechatronics
EE 577/579 Embedded systems and Lab and/or EE478 /
EE 479 Microcontrollers and Lab (with permission)
E 552 Sensors and Actuators
E 579 Mechatronics Modeling

Remaining Courses selected (with advisors approval) from EE, ME/E, and CSC Courses

A partial list of commonly accepted Courses:
EE486/487: Microcontrollers and lab (with permission, for students without prior microcontroller instruction)
EE 552 Real Time Control Systems
EE 564/565 Hardware Description Languages – VHDL
EE 568/569 Computer Networks and Lab
EE 586 Advanced Microprocessors
EE 577/579 Embedded Systems and lab
EE 580 Computer Architecture
EE 588 Digital Signal Processing I
EE 590 Digital Signal Processing II
EE592 Digital Image Processing
EE 562 Random Variables and Random Processes
EE 574 Pattern Recognition
EE554 Fuzzy Systems Theory & Applications
E 579 Mechatronics Modeling
E 552 Sensors and Actuators
EE 557 Vehicular Electrical Power Systems
E 596 Advanced Topics in Engineering
EE 594 Advanced Topics in Electrical Engineering
EE 558 Advanced Electronics
EE 466 Electromagnetics II
EE 470 Controls II
EE 474 Communications II
EE 490 Radiation and Antennas
EE 560 CAD in Integrated Circuits
EE 584 Electromagnetic Compatibility
EE 594 Advanced Topics in Electrical Engineering
CSC 542 Automata Theory
CSC 547 Systems Programming
CSC 548 Artificial Intelligence

Electrical and Computer Engineering Graduate Courses Open to Graduate Students Only

EE 510
Network Security **3 cr.**
This course explores the world of network security. It presents all of the practical principles, methods and technology necessary to construct an effective network defense in depth. Upon leaving this course students will be able to execute every common form of professional intrusion detection and response including pen testing, network attack/defense and host and network based IDS and policy enforcement. Students will do hands-on work in the lab with all common elements of network hardware and software.

EE 520
Autonomous Mobility Robotics **3 cr.**
Prerequisites: Engineering Programming, calculus and differential equations, probability, and linear algebra/matrix algebra.
Autonomous Mobility Robotics is concerned with the theory and applications associated with the development of mobile robots that possess sensors and local intelligence sufficient to operate independently in constrained environments. Topics are selected from the four sub-areas of perception, localization, cognition, and motion control.

EE 552
Real Time Control Systems **3 cr.**
Fundamentals of real-time control systems simulation: plant modeling, controller design real-time simulation analysis using MATLAB/SIMULINK, and Hardware-in-the-loop (HIL) systems and applications.

EE 554
Fuzzy System Theory & Applications **3 cr.**
A study of the fundamental concepts of fuzzy set theory and its engineering applications. Topics include fuzzy sets and relations, operations on fuzzy sets, fuzzy rules and inference systems, defuzzification methods, selected applications in the area of controls, image processing, etc.

EE 558
Advanced Electronics **3 cr.**
(Prerequisite: EE 358)
The special topics on 1) Design and Applications with operational amplifiers: linear and non-linear op-amp circuits, active filters, DA/AD converters, signal generators and switching capacitors, 2) power electronics: ac switching controllers, inverteres, choppers, ac/dc motor speed control circuits.

EE 560
Computer-Aided Design of Integrated Circuits **3 cr.**
(Prerequisite: Senior standing.)
Introduction to the basic electrical properties and the technology of fabrication of MOS devices. Automatic layout generation, routing and design simulation with CAD tools using digital logic circuit examples. Case study.

EE 562
Random Variables and Random Processes **3 cr.**
Probability, random variables, distribution and density functions, functions of random variables, joint distributions and density functions. Random processes, auto-correlation and cross-correlation, linear system response.

EE 564
VHDL (Hardware Description Languages) **3 cr.**
Design methodology using hardware programming languages specifically VHDL. Design simulation and synthesis of digital circuits with a focus on FPGA ASIC implementation.

EE565
VHDL: Hardware Description Languages Laboratory **1 cr.**
(Co-requisite EE564)
Focus on VHDL for synthesis on FPGA and PSOC devices. Altera and/or Xilinx device description. Hardware projects utilizing FPGA development boards and/or stand-alone system implementations.

EE 568
Computer Networks **3 cr.**
Introduction to computer networks including LAN, MAN, WAN, CAN, OSI and TCP/IP layering protocols. TCP/IP internetworking and their applications will be covered. Simulation tools such as Opnet will be used to evaluate different network designs, architectures, and topologies.

EE 574
Pattern Recognition **3 cr.**
(Prerequisites: Linear algebra, Probability and Statistics)
Representation of patterns as multi-dimensional feature vectors. Bayesian decision theory. Parameter estimation and supervised learning. Feature selection. Non-parametric techniques. Linear discriminant functions. Unsupervised learning and clustering.

EE 576
Direct Digital Control **3 cr**.
Basic theory of sampling and quantizing, z-transform analysis. System error analysis, modeling and optimal design of discrete data systems by performing indices. Stability of discrete data systems and design compensation.

EE577
Embedded Systems **3 cr.**
(Co-requisite EE579)
Design of embedded systems (hardware & software); advanced topics include behavioral/subsumption programming, multitasking, real-time systems, and programming the 68HS12 in Forth, C, and assembly languages. An open-ended embedded system design project which requires consideration of alternatives, economic and aesthetic constraints, and detailed system description is compulsory.

EE579 **1 cr.**
(Co-requisite EE577)
Embedded Systems Laboratory
Students will perform advanced interfacing and development in the lab. They are taught a system design methodology based on top-down principles. A semester design/ construction project provides the students with an excellent opportunity to develop strengths in embedded system design, construction, testing, and development.

EE 580
Computer Architecture **3 cr.**
(Prerequisite: Senior standing.)
The design of computational systems and circuits. Investigation of alternative structures for computers.

EE 584
Electromagnetic Compatibility **3 cr.**
(Prerequisite: EE 486.)
EMC requirements for electronic system. Signal spectra. Radiated emissions and susceptibility. Conducted emissions and susceptibility. Cross talk. Shielding. Electrostatic discharge. Noise in electronic devices. System design for EMC.

EE 588
Digital Signal Processing I **3 cr.**
(Prerequisite: EE 374.)
Introduction to discrete-time signals and systems. Fourier transforms of discrete-time signals, z-transforms. Digital filters. Implemen-tation using digital signal processors.

EE 590
Digital Signal Processing II **3 cr.**
(Prerequisite: EE 588.)
Multidimensional signal processing. Signal estimation, noise reduction, image restoration and enhancement and pattern recognition. DSP chip architecture, algorithms and programming. IIR and FIR filter design. Deconvolution.

EE 592
Image Processing **3 cr.**
Basic concepts and techniques of digital image processing. Sampling and quantization. Image transforms; image enhancement, restoration and coding. Design, implementation and testing of algorithms and concepts through class projects.

EE 594
Advanced Topics in Electrical Engineering 3 cr.
The special topics such as Parallel and Distributed Processing, Ad Hoc Networking will be offered under this course number.

EE 586 Advanced Microprocessors 3 cr.
(Prerequisite: EE 486)
Treatment of the architecture and organization of 16-bit and 32-bit microprocessors and microcomputers. Design of microcomputers which include dynamic memory, cache memories, interfacing, coprocessors, direct memory, access (DMA), serial and parallel processors.

EE 569
Computer Networking Lab 1 cr.
The Networking laboratory (NL) will provide students with hands-on design, setup, configure, and manage network devices and their applications. In addition, the NL will provide researchers and educators with a controlled environment to validate and evaluate their research, education, and training programs. This lab will educate undergraduate and graduate students about the fundamental design, analysis, operation, control and management of networked systems. Sudents will be able to build and simulate CAN networks using Canoe. The NL will enable students to better understand and get hands-on experiences.

EE 557
Vehicular Electrical Power Systems 3 cr.
(Prerequisite: EE 358)
The course will cover items like: (a) fundamentals of power electronics, (b) electrical machines (briefly), (c) automotive power systems, (d) electric, hybrid vehicles, and fuel cell based vehicles, (e) modeling techniques for automotive electric and hybrid vehicles, (f) automotive motor drives for vehicular applications, (g) multiconverter vehicular dynamics and control.

EE594
Electronics Manufacturing 3 cr.
This course provides the student with a broad foundation in electronics manufacturing. Mainstream technologies included silicon semiconductor and FR4 circuit board manufacturing, electronics packaging, automated assembly and solder processes are examined in detail. Circuit board design methodology with a focus on design for cost optimization is stressed throughout. Electronics packaging, interconnection and thermal management are investigated. Design verification, and manufacturing hand-off conclude the course.

E552: Sensors & Actuators 3 cr.
Study of fundamental transduction mechanisms of common sensors and actuators.Principles of data acquisition. Use of software tools for data interaction with sensors and actuators. Introduction to micro electro-mechanical systems (MEMs). A key component of this course will be laboratory exercises involving sensors and actuators.

If you have any question regarding the application process to any of the Electrical Engineering Graduate programs at UDM, please contact:

Chair, Electrical and Computer Engineering
Mark Paulik, Ph.D.
330 Engineering, (313) 993-3365
ece_chair@udmercy.edu
or

Steven Coddington,
graduate admissions counselor, (313) 993-1592
coddinsm@udmercy.edu

Career Opportunities

With a doctoral degree in electrical and computer engineering, you can choose from a variety of career opportunities in such fields as aerospace, biomedical, telecommunications, automotive, computer design and applications, national security, and business to name a few. Many of our graduates enter the profession, or pursue further degrees in law, dentistry, medicine, or business, for careers as patent lawyers, biomedical engineers, university professors, and corporate entrepreneurs.

Alumni Network

Our alumni provide a powerful network of individuals who support and help our program graduates upon degree completion. Our alumni enjoy tremendous success in Fortune 500 companies, government agencies, and entrepreneurial endeavors. Alumni serve in leadership positions in such companies as
•Sirius Satellite Radio
•Raytheon
•Boeing Satellite Systems
•Nvidia Corporation
•Kodak
•Erim International
•Rockwell Automation
•Lockheed Martin Corporation
•Medtronics
•TARDEC / Army Tank Automotive Command
•Detroit Edison
•Magnavox
•Ford Motor Company
•General Dynamics Land Systems
•General Motors Corporation
•Chrysler
among many others.

For More Information please visit our program's web site at http://eng-sci.udmercy.edu/eengr/graduate_program.html