



We Want Great Things for You

## MASTER OF ENGINEERING IN ELECTRICAL ENGINEERING

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

### Masters of Electrical Engineering

The Master of Engineering in Electrical Engineering program at 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..

### Degrees

The Department of Electrical and Computer Engineering offers graduate degrees with specializations in computer engineering, mechatronics, and signals and systems. Students may elect to complete a Master of Engineering, Master of Engineering Management, or Doctor of Engineering in Electrical Engineering.

### 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, currently students are working on the design and development an internationally competitive autonomous vehicle to participate in the International Ground Vehicle Competition ([www.IGVC.org](http://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 Masters 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.
- 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 scores are welcome.

## Degree Requirements

The Master of Engineering in Electrical Engineering may be completed by either a thesis or a non-thesis plan. The thesis plan includes 24 credit hours of coursework, six credit hours of thesis, and an oral presentation of the thesis to the departmental thesis committee and the public. The non-thesis plan consists of 30 credits hours of coursework. A student's plan of study must consist of at least seven courses with a 500 level designation. Furthermore, the student's program of study must consist of no fewer than six courses from the Electrical and Computer Engineering Department.

### 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 (Master's)

EE486/487 Microcontrollers and lab

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 (Master's):

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 (Master's):

EE486/487 Microcontrollers and lab

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 (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 Courses for Advanced Undergraduates and Graduate Students

**EE 466**  
**Electromagnetics II** 3 cr.  
 (Prerequisite: EE 366.)  
 Maxwell's equations constitutive relations, boundary condition. Poynting theorem. Plane waves, wave polarization, phase and group velocities. Reflection, refraction and attenuation of plane waves in various media. Transmission lines, waveguides and resonators. Antennas and radiation. Wave propagation and radar equation.

**EE 470**  
**Control Systems II** 3 cr.  
 (Prerequisite: E 322.)  
 Advanced study of root locus analysis. Frequency response analysis. Design and compensation techniques. Describing-function analysis of nonlinear control systems. Control system analysis and design using state-space methods.

**EE 474**  
**Communication Theory II** 3 cr.  
 (Prerequisite: EE 374.)  
 Digital communication, probability and random variables, mathematical representation of noise, effect of noise upon system performance, pulse amplitude modulation, multiple pulse detection of signals, detection of signals in colored Gaussian noise, estimation of signal parameters.

**EE 486**  
**Microcontrollers** 3 cr.  
 (Prerequisite: EE 364.)  
 Microprocessor and Microcontroller evolution, MSI components, Microcontroller-based system design. Microprocessor and microcontroller organization and architecture, assembly language. Interrupts, memory and peripheral interfacing, A/D and D/A systems.

**EE 487**  
**Microcontroller Laboratory** 1 cr.  
 (Co-requisite: EE 486.)

Familiarity with microprocessor/microcontroller development and training systems: memory, I/O, CPU. Assembly language. Hardware and software experiments. Microcontroller design projects involving design, prototyping and construction.

### 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, inverters, 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. Implementation 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. Students 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](mailto:ece_chair@udmercy.edu)

or

Steven Coddington,

graduate admissions counselor, (313) 993-1592

[coddinsm@udmercy.edu](mailto:coddinsm@udmercy.edu)

**Career Opportunities**

With a graduate 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 go on to doctoral programs (at schools such as MIT, Duke, UofM, and Notre Dame) or pursue advanced 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](http://eng-sci.udmercy.edu/eengr/graduate_program.html)