# Electrical Engineering (M.S.E.E.)

## About The Program:

The M.S.E.E. program offers students practice-oriented graduate-level education in Electrical and Computer Engineering. Concentrations include Computer Architectures and Microelectronics, Digital Signal Processing and Digital Data Communication, and Intelligent Systems and Control. Current active research projects in the department include embedded systems and system-on-chip design, intelligent interactive tutoring systems, intrusion detection, multisensor fusion, speaker identification, speech processing, and visualization and fault detection in multicasting networks. Other active areas of research include digital signal processing, heat dissipation problems in microchips, human-computer interaction, intelligent multimedia systems, robust and optimal control, and wireless data networks.

**Career Options:** Graduates with the M.S.E.E. are employed in high-tech industries and government laboratories with responsibilities for design, analysis, and applications of electrical engineering principles. Students who complete an M.S.E.E. with a thesis are prepared to enter a doctoral program.

**Prerequisites for Admission:** Background in Electrical Engineering or Computer Engineering

**Areas of Specialization:** For each of the three areas of specialization, research includes:

- Computer Architectures and Microelectronics — current practices of computer design and development; hardware realization and integrated circuit layout; MOS-integrated circuit design for high-speed digital computation and data communication; and software-level testing.
- Digital Signal Processing and Digital Data Communication — array signal processing; detection of faults in communication networks; detection of multidimensional signals in the presence of noise; filtering and modulation; intrusion detection, visualization, and security of multicast networks; multisensor data fusion; performance evaluation of local area and wireless networks, broadband networks, and protocols; speaker identification; and voice signal processing.
- Intelligent Systems and Control — intelligent tutoring systems, interactive multimedia, neuro-fuzzy control, and robust and optimal control.

For the M.S.E.E. program, students also choose between three tracks:

1. The Thesis Track is intended for students pursuing advanced research and includes 24 credits of didactic coursework, 3 credits of Project (ECE 9995), and 3 credits of Thesis (ECE 9996).
2. The Project Track introduces students to applied research and includes 27 credits of didactic coursework and 3 credits of Project (ECE 9995).
3. The Coursework Track provides students with an advanced engineering background for their future in the engineering profession through 30 credits of didactic coursework.

In the first term, the student and the ECE Graduate Program Director establish a graduate Plan of Study that outlines all required courses and the sequence for the student to follow. This form is used to track the student's progress as the various benchmarks in the program are completed. Once established, any revisions to the Plan of Study require approval in advance. However, if considering whether to change one's track, the student should note that:

- "Thesis" credits (ECE 9996) can only be applied toward the Thesis M.S.E.E. Track and cannot be applied to either the Project or Coursework Tracks.
- "Project" credits (ECE 9995) can be applied toward the Thesis and Project M.S.E.E. Tracks but cannot be used for the Coursework Track.

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## Requirements of Programs:

- **Total Credit Hours**: 30
- **Culminating Events**:

  *Thesis Track:*
  The culminating events in the Thesis Track are typically undertaken during the last two successive terms of study. Successful completion requires the following:
  Thesis Proposal — ECE 9995 Project (3 credits)

  Under the guidance of the advisor, the student conducts independent research on an applied engineering topic of current interest and registers for ECE 9995. This work includes the research and preliminary results that form the basis of an extended study that the student plans to carry on in ECE 9996 Thesis in the following term. The student submits a research report as her/his Thesis Proposal to a committee consisting of three or more faculty members, including the faculty advisor, and presents her/his proposal in an open College-wide seminar, which is scheduled and posted at least 10 business days in advance of the presentation date. Immediately following the presentation, the student's advisory committee questions the student about the details and strategy of the proposed research. The committee then accepts, accepts with revisions, or rejects the proposal.

  The student must pass the Thesis Proposal before registering for ECE 9996. If the student fails Thesis Proposal, s/he may either re-register for ECE 9995 (1 credit) in the next regular term and repeat the entire proposal process or consider switching to the Project or Coursework Track. *NOTE: A second failure of Thesis Proposal results in automatic dismissal from the University.* If switching to another track, the Plan of Study form requires updating and appropriate approvals.

  Thesis Defense — ECE 9996 Thesis (3 credits)

  The student should register for ECE 9996 in the term that s/he plans to defend the thesis. The thesis document should be prepared in a format compliant with University standards. (See Graduate School Policy 02.26.12.02.) Two weeks prior to the thesis defense, the student provides the committee with a copy of the completed thesis and posts an announcement of the defense, which is to take place during a regular academic term (i.e., not scheduled during study days, final exams, or the breaks between terms). If the student is to graduate in the same term as the thesis defense is held, then the defense should take place at least 30 days prior to the end of the term.

  The thesis defense is an open College seminar in which the student presents the concepts and results of her/his research. Immediately following the defense, the thesis committee convenes to closely examine the student's research and decide to accept the thesis as provided, accept

the thesis with revisions, or not accept the thesis. If the thesis is accepted, a letter grade for ECE 9996 is assigned. If the thesis is accepted with revisions, then the student must submit the revised thesis within 30 days and with the approval of the Thesis Committee. If the thesis is not accepted, but the committee decides to not fail the student, an "R" grade is assigned to ECE 9996. In the following term, the student registers for one credit of ENGR 9991 Directed Research until s/he is again prepared to attempt the defense. The defense procedures described above are then carried out again in the term that the student is prepared to defend the thesis.

*Project Track:*

The culminating event for the Project Track is ECE 9995 Project. This entails a one-term research activity done under the supervision of a full-time faculty advisor on an applied engineering topic of interest. Near the end of the term, the student prepares a report of her/his findings and presents the study in an open departmental seminar. Both the seminar and the written report are used to determine the student's grade for ECE 9995. The grade is determined jointly by the advisor and another designated grader selected by the Graduate Program Director.
*Coursework Track:*
No culminating event is warranted for the Coursework Track.

## Core Course (Thesis Track)

**Engineering Analysis and Applications** – Vector space, basis, projection, null space, function space, L2 and space of continuous functions, Hilbert space, orthogonality, generalized Fourier series, linear transformation, adjoint transformation, eigenvalue problem, linear functional, Gateaux and Frechet differential, constrained optimization, infinite dimensional systems, complex analysis.

**Probability and Random Processes** – Sets and events, Random variables, Distribution and density functions, Functions of multiple random variables, Moments and conditional statistics, Information entropy, stochastic processes, wide-sense stationary process, ergodicity, correlation, and power spectrum of stationary processes. Applications to sampling theory and signal modulation and detection.

**Graduate Seminar** – Required seminar for graduate students in Electrical and Computer Engineering for scientific and professional development. Speakers for these seminars include prominent researchers from academic and professional backgrounds. Students will be graded on participation of at least 70% of the bi-weekly seminars during the semester.

### Elective (18 Credits Worth)

### Research Courses

**Project** - Under the guidance of a faculty member, students will select a topic in electro-technology to be researched using at least five references. Student present the research at an open seminar, and submits an extensive research paper, which will be reviewed by two faculty members. Projects related to industrial applications are encouraged. For non-thesis students only.

**Thesis** - Under the guidance of a faculty member, students will select a topic in electro-technology, and conduct research leading to submission and oral presentation of a thesis proposal and the final defense of the thesis. For thesis students only.

## Core Courses (Project Track)

**Engineering Analysis and Applications** – Vector space, basis, projection, null space, function space, L2 and space of continuous functions, Hilbert space, orthogonality, generalized Fourier series, linear transformation, adjoint transformation, eigenvalue problem, linear functional, Gateaux and Frechet differential, constrained optimization, infinite dimensional systems, complex analysis.

**Probability and Random Processes** – Sets and events, Random variables, Distribution and density functions, Functions of multiple random variables, Moments and conditional statistics, Information entropy, stochastic processes, wide-sense stationary process, ergodicity, correlation, and power spectrum of stationary processes. Applications to sampling theory and signal modulation and detection.

**Graduate Seminar** – Required seminar for graduate students in Electrical and Computer Engineering for scientific and professional development. Speakers for these seminars include prominent researchers from academic and professional backgrounds. Students will be graded on participation of at least 70% of the bi-weekly seminars during the semester.

### Electives (21 Credits Worth)

### Research course

**Project** – Under the guidance of a faculty member, students will select a topic in electro-technology to be researched using at least five references. Student present the research at an open seminar, and submits an extensive research paper, which will be reviewed by two faculty members. Projects related to industrial applications are encouraged. For non-thesis students only.

## Core Course (Coursework Track)

**Engineering Analysis and Applications** – Vector space, basis, projection, null space, function space, L2 and space of continuous functions, Hilbert space, orthogonality, generalized Fourier series, linear transformation, adjoint transformation, eigenvalue problem, linear functional, Gateaux and Frechet differential, constrained optimization, infinite dimensional systems, complex analysis.

**Probability and Random Processes** – Sets and events, Random variables, Distribution and density functions, Functions of multiple random variables, Moments and conditional statistics, Information entropy, stochastic processes, wide-sense stationary process, ergodicity, correlation, and power spectrum of stationary processes. Applications to sampling theory and signal modulation and detection.

**Graduate Seminar** – Required seminar for graduate students in Electrical and Computer Engineering for scientific and professional development. Speakers for these seminars include prominent researchers from academic and professional backgrounds. Students will be graded on participation of at least 70% of the bi-weekly seminars during the semester.

### Electives (24 Credits Worth)

## Courses:

**Click HERE for more information on the courses below.**

- Engineering Analysis and Applications
- Probability and Random Processes
- Spacecraft Systems Engineering
- Microelectronics
- VLSI System Design and Testing
- Fundamentals of Bio-MEMS and Biomedical Microdevices
- Control System Analysis
- Game Theory and Applications in Engineering
- Intro Digital Comm
- Digital Signal Processing Analysis
- Introduction to Communication Networks
- Engineering Principles of Computer Intrusion and Detection
- Introduction to Cryptography and Information Security
- Hardware and Industrial Control System Security
- Hardware Security Lab
- Secure Computer Memory Architecture and Intrusion Prevention Methodologies
- Reverse Engineering
- Wireless Communications Engineering
- Cloud Computing Security
- Forensics for Cyber Physical Systems Security
- Engineering Project Quality and Risk Management, and ISO Standards
- Certificate Preparation - (ISC)2/CISSP-Information Systems Security
- Certificate Preparation - Cisco Networking Academy
- Capstone Project
- Graduate Seminar
- Advanced Processor Systems
- Introduction to Computer Architecture
- Power Systems Engineering
- Introduction to Intelligent Systems Engineering
- Power Electronic Devices and Systems
- Electric Machines and Drives
- Information Theory
- Research Experience in Electrical Engineering
- Special Topics in Electrical and Computer Engineering
- Mixed Signal VLSI Design
- Nano Applications, MEMS & NEMS
- Optimal and Robust Control
- Adaptive Control
- Signal Processing and Communication Theory
- Applications in Digital Signal Processing
- Design and Performance of Communication Networks
- Speech Signal Processing
- Fundamentals of Speech Recognition
- Information Theory
- Introduction to Machine Learning and Pattern Recognition
- Advanced Topics in Statistical Modeling for Engineering Applications
- Fundamentals of EEG Processing
- Advanced Computer Architecture
- Power Systems Operation and Control
- Applications of Advanced Power Electronics Technologies
- Independent Study I
- Independent Study II
- VLSI Physical Design
- Nonlinear Control System
- Detection, Estimation, and Modulation Theory
- Adaptive Signal Processing
- Digital Image Processing
- Parallel Processing Architectures
- Directed Research