# Department of Electrical Engineering

http://www.utdallas.edu/dept/ee

## Faculty

**Professors**: Larry P. Ammann, Poras T. Balsara, Andrew Blanchard, Cyrus D. Cantrell III, David E. Daniel, John P. Fonseka, William R. Frensley, Andrea F. Fumagalli, Bruce Gnade, John H. L. Hansen, C. R. Helms, Louis R. Hunt, Nasser Kehtarnavaz, Kamran Kiasaleh, Moon J. Kim, Gil Lee, Philipos C. Loizou, Duncan L. MacFarlane, Raimund J. Ober, Lawrence J. Overzet, William Pervin, Carl Sechen, Don W. Shaw (emeritus), Lakshman S. Tamil, T. R. Viswanathan, Robert M. Wallace, Dian Zhou
**Associate Professors**: Naofal Al-Dhahir, Dinesh Bhatia, Gerald O. Burnham, Dale M. Byrne, Matthew Goeckner, Jiyoung Kim, Jeong-Bong Lee, Jin Liu, Aria Nosratinia, Mehrdad Nourani, M. Saquib, Murat Torlak
**Assistant Professors**: Walter Hu, Hoi Lee, Hlaing Minn, Issa Panahi, Rama Sangireddy

## Objectives

The program leading to the M.S.E.E. degree provides intensive preparation for professional practice in the high technology microelectronic and telecommunications aspects of electrical engineering. It is designed to serve the needs of engineers who wish to continue their education. Courses are offered at a time and location convenient for the student who is employed on a full-time basis.

The objective of the doctoral program in electrical engineering is to prepare individuals to perform original, leading edge research in the broad areas of communications and signal processing; digital systems; microelectronics and nanoelectronics, optics, optoelectronics; lightwave devices and systems; and wireless communications. Because of our strong collaborative programs with Dallas-area microelectronics and telecommunications companies, special emphasis is placed on preparation for research and development positions in these high technology industries.

## Facilities

The Erik Jonsson School of Engineering and Computer Science has developed a state-of-the-art computational facility consisting of a network of Sun servers and Sun Engineering Workstations. All systems are connected via an extensive fiber-optic Ethernet and, through the Texas Higher Education Network, have direct access to most major national and international networks. In addition, many personal computers are available for student use.

The Engineering and Computer Science Building provides extensive facilities for research in microelectronics, telecommunications, and computer science. A Class 1000 microelectronics clean room facility, including ebeam lithography, sputter deposition, PECVD, LPCVD, etch, ash and evaporation, is available for student projects and research. An electron beam lithography pattern generator capable of sub-micron resolution is also available for microelectronics research. The Plasma Applications and Science Laboratories have state-of-the-art facilities for mass spectrometry, microwave interferometry, optical spectroscopy, optical detection, in situ ellipsometry and FTIR spectroscopy. In addition, a modified Gaseous Electronics Conference Reference Reactor has been installed for plasma processing and particulate generation studies. Research in characterization and fabrication of nanoscale materials and devices is performed in the Nanoelectronics Laboratory. The Optical Measurements Laboratory has dual wavelength (visible and near infrared) Gaertner Ellipsometer for optical inspection of material systems, a variety of interferometric configurations, high precision positioning devices, and supporting optical and electrical components. The Optical Communications Laboratory includes attenuators, optical power meters,

lasers, APD/p-i-n photodetectors, optical tables, and couplers and is available to support system level research in optical communications. The Photonic Testbed Laboratory supports research in photonics and optical communications with current-generation optical networking test equipment. The Nonlinear Optics Laboratory has a network of Sun workstations for the numerical simulation of optical transmission systems, optical routers and all-optical networks. The Electronic Materials Processing laboratory has extensive facilities for fabricating and characterizing semiconductor and optical devices. The Laser Electronics Laboratory houses graduate research projects centered on the characterization, development and application of ultrafast dye and diode lasers.

The Center for Integrated Circuits and Systems (CICS) promotes education and research in the following areas: digital, analog and mixed-signal integrated circuit design and test; multimedia, DSP and telecom circuits and systems; rapid-prototyping; computer architecture and CAD algorithms. There are several laboratories affiliated with this center. These laboratories are equipped with a network of workstations, personal computers, FPGA development systems, prototyping equipment, and a wide spectrum of state-of-the-art commercial and academic design tools to support graduate research in circuits and systems.

The Multimedia Communications Laboratory has a dedicated network of PC's, Linux stations, and multi-processor, high performance workstations for analysis, design and simulation of image and video processing systems. The Signal and Image Processing (SIP) Laboratory has a dedicated network of PC's equipped with digital camera and signal processing hardware platforms allowing the implementation of advanced image processing algorithms. The Speech Processing Laboratory has a network of PC's with audio I/O capability for analysis and processing of speech signals. The laboratory is also equipped with several Texas Instruments processors for real-time processing of speech signals. The Broadband Communication Laboratory has design and modeling tools for fiber and wireless transmission systems and networks, and all-optical packet routing and switching. The Advanced Communications Technologies (ACT) Laboratory provides a design and evaluation environment for the study of telecommunication systems and wireless and optical networks. ACT has facilities for designing network hardware, software, components, and applications.

The Center for Systems, Communications, and Signal Processing, with the purpose of promoting research and education in general communications, signal processing, control systems, medical and biological systems, circuits and systems and related software, is located in the Erik Jonsson School.

The faculty of the Erik Jonsson School's Photonic Technology and Engineering Center (PhoTEC) carry out research in enabling technologies for microelectronics and telecommunications. Current research areas include nonlinear optics, Raman amplification in fibers, optical switching, applications of optical lattice filters, microarrays, integrated optics, and optical networking.

In addition to the facilities on campus, cooperative arrangements have been established with many local industries to make their facilities available to U.T. Dallas graduate engineering students.

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# Master of Science in Electrical Engineering

## Admission Requirements

The University's general admission requirements are discussed here.

A student lacking undergraduate prerequisites for graduate courses in electrical engineering must complete these prerequisites or receive approval from the graduate adviser and the course instructor.

A diagnostic exam may be required. Specific admission requirements follow.

The student entering the M.S.E.E. program should meet the following guidelines:

- An undergraduate preparation equivalent to a baccalaureate in electrical engineering from an accredited engineering program,
- A grade point average in upper-division quantitative course work of 3.0 or better on a 4-point scale, and
- GRE examination scores of 500, 700 and 600 for the verbal, quantitative and analytical components respectively, or 1800 for the total score is advisable based on our experience with student success in the program.

Applicants must submit three letters of recommendation from individuals who are able to judge the candidate's probability of success in pursuing a program of study leading to the master's degree. Applicants must also submit an essay outlining the candidate's background, education and professional goals. Students from other engineering disciplines or from other science and math areas may be considered for admission to the program; however, some additional course work may be necessary before starting the master's program.

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### Degree Requirements

The University's general degree requirements are discussed here.

The M.S.E.E. requires a minimum of 33 semester hours.

All students must have an academic advisor and an approved degree plan. These are based upon the student's choice of concentration (Communications and Signal Processing; Digital Systems; Circuits and Systems; Solid State Devices and Micro Systems Fabrication; Optical Devices, Materials and Systems). Courses taken without advisor approval will not count toward the 33 semester-hour requirement. Successful completion of the approved course of studies leads to the M.S.E.E., M.S.E.E. with major in Telecommunications, or M.S.E.E. with major in Microelectronics degree.

The M.S.E.E. program has both a thesis and a non-thesis option. All part-time M.S.E.E. students will be assigned initially to the non-thesis option. Those wishing to elect the thesis option may do so by obtaining the approval of a faculty thesis supervisor.

All full-time, supported students are required to participate in the thesis option. The thesis option requires six semester hours of research, a written thesis submitted to the graduate school, and a formal public defense of the thesis. The supervising committee administers this defense and is chosen in consultation with the student's thesis adviser prior to enrolling for thesis credit. Research and thesis hours cannot be counted in a M.S.E.E. degree plan unless a thesis is written and successfully defended.

## M.S.E.E.

This degree program is designed for students who want a M.S.E.E. without a designated degree specialization. One of the five concentrations listed below, subject to approval by a graduate adviser, should be used to fulfill the requirements of this program. In each of the concentrations, only grades of B or better are acceptable in the four required core courses.

## M.S.E.E. with Major in Telecommunications

Within Telecommunications, there are two concentrations: Communications and Signal Processing, and Digital Systems.

Communications and Signal Processing

This curriculum emphasizes the application and theory of all phases of modern communications and signal processing used in telecommunications.

Each student electing this concentration must take EE 6349, EE 6352, and EE 6360, and one of the following: EE 6331, EE 6340, EE 6350 (12 hours).

Approved electives must be taken to make a total of 33 hours.

Digital Systems

The goal of the curriculum is to educate students about issues arising in the design and analysis of digital systems, an area relevant to a variety of high-technology industries. Because the emphasis is on systems, course work focuses on three areas: hardware design, software design, analysis and modeling.

Each student electing this concentration must take four required courses. Two of the courses are EE 6301 and EE 6304. The remaining two must be selected from EE 6302, EE 6325, and EE 6345 (12 hours).

Approved electives must be taken to make a total of 33 hours.

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## M.S.E.E. with Major in Microelectronics

Within Microelectronics, there are three concentrations: Circuits and Systems; Solid State Devices and Micro Systems Fabrication; and Optical Devices, Materials and Systems.

Circuits and Systems

The courses in this curriculum emphasize the design and test of circuits and systems, and the analysis and modeling of integrated circuits.

Each student electing this concentration must take four required courses: Two of the courses are: EE 6325 and EE 6326. The remaining two must be selected from EE 6301, EE 6303, EE 6306 and EE 6375 (12 hours).

Approved electives must be taken to make a total of 33 hours.

Solid State Devices and Micro Systems Fabrication

This concentration is focused on the fundamental principles, design, fabrication and analysis of solid-state devices and associated micro systems.

Each student electing this concentration must take the following two courses: EE 6316, EE 6319 and at least two of the following four courses: EE 6320, EE 6321,EE 6322 and EE 6382

Additional standard electives include but are not limited to: EE 5383/EE 5283, EE 6324, EE 6325, EE 6372, EE 6383/EE 6283, EE 6384, EE 7320, EE 7325, EE 7371, EE 7383/EE 7283.

Approved electives must be taken to make a total of 33 hours.

Optical Devices, Materials and Systems

This curriculum is focused on the application and theory of modern optical devices, with emphasis on lightwave communications and laser applications.

Each student electing this concentration must take the following four required courses: EE 6314, EE 6316, EE 6317, and at least one of the following two courses: EE 6310 and EE 6329. (12 hours).

Approved electives must be taken to make a total of 33 hours.

# Doctor of Philosophy in Electrical Engineering

## Admission Requirements

The University's general admission requirements are discussed here.

The Ph.D. in Electrical Engineering is awarded primarily to acknowledge the student's success in an original research project, the description of which is a significant contribution to the literature of the discipline. Applicants for the doctoral program are therefore selected by the Electrical Engineering Program Graduate Committee on the basis of research aptitude, as well as academic record. Applications for the doctoral program are considered on an individual basis.

The following are guidelines for admission to the Ph.D. program in Electrical Engineering:

- A master's degree in electrical engineering or a closely associated discipline from an accredited U.S. institution, or from an acceptable foreign university. Consideration will be given to highly qualified students wishing to pursue the doctorate without satisfying all of the requirements for a master's degree.
- A grade point average in graduate course work of 3.5 or better on a 4-point scale.
- GRE examination scores of 500, 700 and 600 for the verbal, quantitative and analytical components, respectively, or 1800 for the total score is advisable based on our experience with student success in the program.

Applicants must submit three letters of recommendation on official school or business letterhead or the UTD Letter of Recommendation Form from individuals who are familiar with the student's record and able to judge the candidate's probability of success in pursuing doctoral study in electrical engineering.

Applicants must also submit a narrative describing their motivation for doctoral study and how it relates to their professional goals.

For students who are interested in a Ph.D. but are unable to attend school full-time, there is a part-time option. The guidelines for admission to the program and the degree requirements are the same as for full-time Ph.D. students. All students must have an academic adviser and an approved plan of study.

## Degree Requirements

The University's general degree requirements are discussed here.

The M.S.E.E. requires a minimum of 33 semester hours.

Each program for doctoral study is individually tailored to the student's background and research objectives by the student's supervisory committee. The program will require a minimum of 90 semester credit hours beyond the baccalaureate degree. These credits must include at least 30 semester hours of graduate level courses beyond the baccalaureate level in the major concentration.

Also required are:

- A qualifying exam over four core courses in an M.S.E.E. concentration that is closest to the Ph.D. research area. A student entering the Ph.D. program with a M.S. must pass this exam within 3 long semesters, and a student entering with a B.S. and no M.S. must pass this exam within 5 long semesters. A student has at most two attempts at this qualifying exam. The exam will be given near the end of the fall and spring semesters.
- A comprehensive exam consisting of: a written dissertation proposal, a public seminar, and a private oral examination conducted by the student's supervising committee.

Completion of a major research project culminating in a dissertation demonstrating an original contribution to scientific knowledge and engineering practice. The dissertation will be defended publicly. The rules for this defense are specified by the Office of the Dean of Graduate Studies. Neither a foreign language nor a minor is required for the Ph.D. However, the student's supervisory committee may impose these or other requirements that it feels are necessary and appropriate to the student's degree program.

# Research

The principal concentration areas for the M.S.E.E. program are: Communications and Signal Processing; Digital Systems; Circuits and Systems; Optical Devices, Materials, and Systems; and Solid-State Devices and Micro Systems Fabrication. Besides courses required for each concentration, a comprehensive set of electives is available in each area.

Doctoral level research opportunities include: VLSI design and test, computer architecture, embedded systems, computer aided design (CAD), ASIC design methodologies, high speed system-on chip design and test, reconfigurable computing, network processor design, interconnection networks, nonlinear signal-processing, smart antennas and array processing, statistical and adaptive signal processing, multimedia signal processing, image processing, real-time imaging, medical image analysis, pattern recognition, speech processing, control theory, digital communications, modulation and coding, electromagnetic-wave propagation, diffractive structures, fiber and integrated optics, nonlinear optics, optical transmission systems, all-optical networks, optical investigation of material properties (reflectometry and ellipsometry), optical metrology, lasers, quantum-well optical devices, theory and experiments in semiconductor-heterostructure devices, plasma deposition and etching, nanoelectronics, wireless communication, network protocols and evaluation, mobile computing and networking, and optical networking.

Interdisciplinary Opportunities: Continuing with the established tradition of research at U. T. Dallas, the Electrical Engineering Program encourages students to interact with researchers in the strong basic sciences and mathematics. Cross disciplinary collaborations have been established with the Chemistry, Mathematics, and Physics programs of the School of Natural Sciences and with faculty in the School of Brain and Behavioral Science.