Graduate Program in Telecommunications Engineering

Objectives

The Graduate Program in Telecommunications Engineering (TE) provides intensive preparation for professional practice in the design, programming, theory, and applications of telecommunications networks. It is designed to serve the needs of engineers who wish to continue their education. The Telecommunications Engineering Program offers courses of study leading to the MS and a PhD degree in Telecommunications Engineering. Education and training is provided to both academically oriented students and students with professional goals in industrial or governmental occupations requiring advanced knowledge of telecommunications and related technology. A comprehensive program of evening courses is also offered, which enables part-time students to earn the MS and PhD degree or to select individual courses of interest. Courses and research are both offered in a variety of subfields of telecommunications engineering, including, fault-tolerant networks, digital communications, modulation and coding, electromagnetic-wave propagation, fiber and integrated optics, lasers, wireless communications, mobile computing, wireless multimedia, DWDM networks, QoS assurance protocols, network design and optimization, telecommunications software, performance of systems, ad-hoc and PCS wireless networks, network security and high speed transmission protocols.

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 telecommunications, microelectronics, and computer science. The TARGET Laboratory has state-of-the-art telecommunications equipment, which includes a number of transport nodes, data packet routers, voice over IP gears, and a cluster of Linux workstations for protocols development and testing. The Wireless Information Systems (WISLAB) and Antenna Measurement Laboratories at UT Dallas have a wealth of experimental equipment with a unique reconfigurable multiple antenna testbed. Having this testbed allows wireless researchers to integrate and to demonstrate radio functions (i.e. WiFi and WiMAX) in geographically different regions under different frequency usage characteristics. With the aid of the Antenna Measurement Lab located in the Waterview Science and Technology Center (WSTC), the researchers can design, build, and test many type of antennas. 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 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 Photonic Technology and Engineering Center (PhoTEC) has produced more than thirty PhD graduates. The PhoTEC faculty carry out research in enabling technologies for microelectronics and telecommunications.

The Digital Systems Laboratory includes a network of workstations, personal computers, FPGA development systems, and a wide spectrum of state-of-the-art commercial and academic design tools to support graduate research in VLSI design and computer architecture. In the Digital Signal Processing Laboratory several multi-CPU workstations are available in a network configuration for simulation experiments. Hardware development facilities for real time experimental systems are available and include microphone arrays, active noise controllers, speech compressors and echo cancellers.

The Nonlinear Optics Laboratory has a dedicated network of Sun workstations for the development of simulation methods and software for optical transmission and communication systems, optical routers and all-optical networks. 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.

In addition to the aforementioned facilities, a Class 1000 microelectronics clean room facility, including optical lithography, sputter deposition 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 Laboratory has state-of-the-art facilities for mass spectrometry, microwave interferometry, optical spectroscopy, and optical detection. In addition, a Gaseous Electronics Conference Reference Reactor has been installed for plasma processing and particulate generation studies. 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 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. Research in characterization and fabrication of nanoscale materials and devices is performed in the Nanoelectronics Laboratory.

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

### Master of Science in Telecommunications Engineering

**33 semester credit hours minimum**

**Program Faculty**

**Professors:** Naofal Al-Dhahir, Farokh B. Bastani, András Faragó, Andrea Fumagalli, John H. L. Hansen, Jason Jue, Latifur Khan, Kamran Kiasaleh, Hlaing Minn, Won Namgoong, Aria Nosratinia, Mehrdad Nourani, Balakrishnan Prabhakaran, Ravi Prakash, Balaji Raghavachari, Mohammad Saquib, Lakshman Tamil, Murat Torlak, Subbarayan
Admission Requirements

The University's general admission requirements are discussed on the Graduate Admission page (catalog.utdallas.edu/2016/graduate/admission). A student lacking undergraduate prerequisites for graduate courses in electrical engineering must complete these prerequisites or receive approval from the graduate advisor and the course instructor. A diagnostic examination may be required. Specific admission requirements follow.

A student entering the MSTE 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 (GPA) in upper-division quantitative coursework of 3.0 or better on a 4.0 point scale, and
- GRE revised scores of 154, 156, and 4 for the verbal, quantitative and analytical writing components, respectively, are 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 areas of science or mathematics may be considered for admission to the program; however, some additional coursework may be necessary before starting the master's program.

Degree Requirements

The University's general degree requirements are discussed on the Graduate Policies and Procedures page (catalog.utdallas.edu/2016/graduate/policies/policy). The MSTE degree requires a minimum of 33 semester credit hours. All students must have an academic advisor and an approved degree plan. Courses taken without advisor approval will not count toward the 33 semester credit hour requirement. Successful completion of the approved course of studies leads to the MSTE degree.

The MSTE program has both a thesis and a non-thesis option. All part-time MSTE 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 credit hours of research, a written thesis submitted to the graduate school, and a formal public defense of the thesis. Research and thesis semester credit hours cannot be counted in a MSTE degree plan unless a thesis is written and successfully defended. A supervising committee, which must be chosen in consultation with the student's thesis advisor prior to enrolling for thesis credit,
administers the defense. Full-time students at UT Dallas who receive financial assistance are required to enroll in 9 semester credit hours during the fall, spring and summer semesters. Students enrolled in the thesis option should meet with individual faculty members to discuss research opportunities and to choose a research advisor during the first or second semester that the student is enrolled. After the second semester of study, course selection should be made in consultation with the research advisor. Part-time students are encouraged to enroll in only one course during their first semester and in no more than two courses during any semester they are also working full-time. To receive a Master of Science degree in Telecommunications Engineering, a student must meet the following minimum set of requirements: Completion of a minimum of 33 semester credit hours of graduate level lecture courses including the required core courses. With advisor approval, these may include some 5000 level courses.

Course Requirements

**Required Core Courses: 15 semester credit hours**
Students must take the following five core courses and make a grade of B or better:
- **CS 6385** *(TE 6385)* Algorithmic Aspects of Telecommunication Networks
- **EESC 6349** Random Processes
- **EESC 6352** Digital Communication Systems
- **CS 6352** Performance of Computer Systems and Networks
- **CS 6390** Advanced Computer Networks

**Recommended Elective Courses: 18 semester credit hours**
Students will take additional courses from those described in the following lists. Choose any 18 semester credit hours of 6000 level courses or higher with approval of the advisor.

**Recommended Electrical Engineering Electives**
- **EEDG 6345** Engineering of Packet-Switched Networks
- **EEGR 6316** Fields and Waves
- **EEOP 6310** Optical Communication Systems
- **EEOP 7340** Optical Network Architectures and Protocols
- **EERF 6311** RF and Microwave Circuits
- **EERF 6394** Antenna Engineering and Wave Propagation
- **EERF 6395** RF and Microwave Systems Engineering
- **EESC 6340** Introduction to Telecommunications Networks
- **EESC 6341** Information Theory I
- **EESC 6343** Detection and Estimation Theory
Recommended Computer Science Electives

- CS 6349 Network Security
- CS 6354 Advanced Software Engineering
- CS 6360 Database Design
- CS 6363 Design and Analysis of Computer Algorithms
- CS 6368 Telecommunication Network Management
- CS 6378 Advanced Operating Systems
- CS 6381 Combinatorics and Graph Algorithms
- CS 6386 Telecommunication Software Design
- CS 6392 Mobile Computing Systems
- CS 6396 Real-Time Systems

Doctor of Philosophy in Telecommunications Engineering

*75 semester credit hours minimum beyond the baccalaureate degree*

Each doctoral degree program is tailored to the student. The student must arrange a course program with the guidance and approval of a faculty member chosen as his/her graduate advisor. Adjustments can be made as the student's interests develop and a specific dissertation topic is chosen.

Program Faculty

**Professors:** Naofal Al-Dhahir, Farokh B. Bastani, András Faragó, Andrea Fumagalli, John H. L. Hansen, Jason Jue, Latifur Khan, Kamran Kiasaleh, Hlaing Minn, Won Namgoong, Aria Nosratinia, Mehrdad Nourani, Balakrishnan Prabhakaran, Ravi Prakash, Balaji Raghavachari, Mohammad Saqib, Lakshman Tamil, Murat Torlak, Subbarayan Venkatesan, W. Eric Wong, I-Ling Yen, Si Qing Zheng

**Associate Professors:** Jorge A. Cobb, Neeraj Mittal, Kamil Sarac

**Assistant Professors:** Joseph Callenes-Sloan, Cong Liu

**Senior Lecturers:** Neeraj Gupta, P. K. Rajasekaran, Marco Tacca

**Professor Emeritus:** William J. Pervin
Admission Requirements

The University's general admission requirements are discussed on the [Graduate Admission page](catalog.utdallas.edu/2016/graduate/admission). The PhD degree in Telecommunications Engineering (TE) 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. Applications for the doctoral program are therefore selected by the Telecommunications Engineering Graduate Committee on the basis of research aptitude, as well as academic record. Applications for the doctoral program are considered on the individual basis. The following are guidelines for admission to the PhD program in Telecommunications Engineering.

A master's degree in Telecommunications Engineering, or Electrical Engineering or Computer Science or a closely associated discipline from an institution of higher education in the U.S. 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 (GPA) in graduate coursework of 3.5 or better on a 4.0 point scale.
- GRE revised scores of 154, 156, and 4 for the verbal, quantitative and analytical writing components, respectively, are 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 UT Dallas Letter of Recommendation form from individuals who are familiar with the student 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 in telecommunications engineering and how it relates to their professional goals. For students who are interested in a PhD, 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 PhD students. All students must have an academic advisor and an approved plan of study.

Degree Requirements

The University's general degree requirements are discussed on the [Graduate Policies and Procedures page](catalog.utdallas.edu/2016/graduate/policies/policy). The program will require a minimum of 75 semester credit hours beyond the baccalaureate degree. These credits must include at least 30 semester credit hours of graduate level courses beyond the baccalaureate level in the major concentration. The core requirements for the PhD degree in Telecommunications Engineering are the same as the ones for the MS in Telecommunications Engineering. All PhD students must demonstrate competence in the master's level core courses in their research area. However, a student's supervising committee may impose course requirements that are necessary and appropriate for the student's research program. It is expected that MS degree students planning to enter the proposed doctoral program will take most of the courses as part of their MS degree requirements. All students must have an academic advisor and an approved plan of study.
Also required are:

- A qualifying examination (QE), as approved by the TE graduate committee, demonstrating competence in the PhD candidate's research area. A student entering the PhD program with a MSTE must pass this exam within 3 long semesters, and a student entering without an MSTE must pass this exam within 4 long semesters. A student has at most two attempts at this qualifying exam. The exam will be given during 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 PhD candidate'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 PhD. However, the student's supervising committee may impose these or other requirements that it feels are necessary and appropriate to the student's degree program.

**Dissertation**

A dissertation is required and must be approved by the graduate program. A student must arrange for a dissertation advisor willing to guide this dissertation. The student must have a dissertation supervising committee that consists of no less than four members. The dissertation may be in telecommunication engineering exclusively or it may involve considerable work in an area of application.

**Areas of Research**

The principal concentration areas for the Telecommunications Engineering graduate program are:

- Core and wireless networks
- Communications and signal processing
- Network design and protocols
- Embedded and reconfigurable systems
- Optical and photonic devices, materials and systems
- Fault-tolerant data networks

Doctoral level research opportunities include: VLSI design, reconfigurable systems, system architecture, fault-tolerant computing, digital signal processing, digital communications, modulation and coding, electromagnetic-wave propagation, fiber and integrated optics, lasers and optoelectronic devices, optical transmission systems, optical networks, wireless communications, mobile IP, wireless multimedia, DWDM networks, QoS assurance protocols, network design and optimization, ad-hoc and PCS wireless networks, network security and high speed transmission protocols.

**Interdisciplinary Opportunities**

In keeping with the established tradition of research at UT Dallas, the
Telecommunications Engineering Program encourages students to interact with researchers in other strong programs, including computer science, electrical engineering, computer engineering, and business management.