

descriptions in this catalog for specific information). All areas offer challenging programs that provide students with the opportunity to become experts in their chosen fields. A major emphasis in the college is to train graduate students in the fundamentals of engineering and scientific research and to prepare them, especially on the doctoral level, to be critical thinkers who can advance human knowledge through research.

The college is composed of the following four academic departments.

- Computer Science and Engineering
- Electrical Engineering
- Engineering Technology
- Materials Science and Engineering

Research

Research interests in the Department of Computer Science and Engineering include theoretical computer science, databases, visualization, game programming, wired and wireless networks, computer security, artificial intelligence, natural language processing, computer systems architecture, agent based systems, collaborative learning, parallel and distributed processing, and numerical analysis.

The research areas in the Department of Electrical Engineering include signal processing, wireless communication, channel modeling and measurement, radar systems, VLSI design and testing, analog and mixed-signal IC design, nanoscale semiconductor device modeling and design, wireless sensor network design, radio-frequency identification (RFID) systems, sensor and sensor interface design, coding theory, bioinformatics, artificial intelligence, pattern recognition and multi-sensor fusion.

Research capabilities in the Department of Engineering Technology include small target visibility, voice cancellation, VLSI design of antenna array, logic circuit design, applications of technology to education, biomedical optics, pulse oximetry, telemedicine, liquid nitrogen automobiles, mechanical behavior of materials for structures and micromechanical systems, control systems, field emissions and corrosion engineering.

Research programs in the Department of Materials Science and Engineering emphasize hands-on research with modern equipment and facilities. Areas of research include polymers, nanocomposites, electronic materials and molecular electronics.

Advising

For general information, contact the Toulouse School of Graduate Studies. For specific requirements for graduate degrees, contact the appropriate department chair or graduate adviser.

Department of Computer Science and Engineering

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The Department of Computer Science and Engineering offers graduate programs leading to the following degrees:

- Master of Science with a major in computer engineering.
- Master of Science, and
- Doctor of Philosophy, both with a major in computer science.

For information regarding these degree programs, including admission requirements and degree requirements, contact the department.

The objective of the master's degree is to produce professional computer scientists capable of contributing technically to the basic core areas of computer engineering and computer science as well as to application areas. The purpose of the doctoral degree is to produce professionals capable of conducting and directing research within the discipline of computer science.

The department is committed to overall excellence in graduate education. Consequently, the programs of study for these degrees include a mixture of course, laboratory and research work designed to place graduates at the forefront of technical excellence.

The department also supports an interdisciplinary doctorate with a major in information science. See the School of Library and Information Sciences section of this catalog for more information.

Research

The Department of Computer Science and Engineering has a broad-based research program. Current faculty research interests include artificial intelligence, data and knowledge bases, computer

systems architecture, computer graphics and visualization, logic programming, mathematical software, wired and wireless networking, computer security, neural computing, operating systems, parallel and distributed computing, pattern recognition and robotics, programming languages, natural language processing, theory of algorithms and VLSI.

The **Center for Research in Wireless Computing (CRWC)** was established by a group of faculty in the Department of Computer Sciences in 1990. CRWC is dedicated to the promotion and fostering of basic and applied research in all aspects of the theory and practice of parallel and distributed computing. In addition, the Network Research Laboratory (NRL) provides facilities for research in networking, parallel and distributed algorithms, and large network simulations.

The **Computer Systems Research Laboratory** investigates multithreaded architectures, compiler optimizations, memory systems, intelligent memory devices and real-time and embedded processing. The resources available to this research include Compaq (DEC) Alpha Servers, Sun Workstations, a four-node SUN SMP server, a tera-byte storage system and several PC based Linux and Window systems.

The **CoPS (Computer Privacy and Security) Laboratory** conducts research on improving privacy and security of computer systems. The **Interactive Media Laboratory** conducts research related to human-computer interaction, intelligent interfaces and visualization. Resources include high-end 2D workstations as well as virtual reality hardware and software.

In addition to facilities provided for instructional purposes, the department maintains a large number of PC-based systems, which are available to faculty and graduate students.

Additional support is provided through the potential for interdisciplinary work with other departments and laboratories and a local area network linking the department to the facilities of the campus computer center.

Grants from the U.S. Air Force, the U.S. Navy, the National Science Foundation, the state of Texas, IBM, TWA, EDS and Texas Instruments have contributed to faculty research in algorithm development, artificial intelligence, pattern recognition, parallel and distributed computing, computer architecture, computer security and scientific computation. Each of these projects has involved the work of a number of graduate students.

The main library contains more than 36,000 computer-oriented volumes and subscribes to 133 periodicals specializing in the computer field. The library subscribes to both ACM and IEEE digital libraries and several very powerful search engines to help faculty and graduate students with their research.

The department enjoys a friendly working relationship with local and national companies. The department's Advisory Council is composed of representatives from government agencies and high-tech firms. During the past few years they have helped obtain research funding, fellowships and internships for students in the department.

Degree Programs

The department offers graduate programs leading to the following degrees:

- Master of Science with a major in computer engineering.
- Master of Science, and
- Doctor of Philosophy, both with a major in computer science.

For information regarding these degree programs, including admission requirements and degree requirements, contact the department.

In all cases admission to graduate degree programs in computer science is competitive since available facilities and faculty do not permit admission of all qualified applicants. Applications, complete with transcripts, and GRE and TOEFL scores, must reach the computer science and engineering department by the following dates to be considered for the term/semester indicated.

October 1 — spring term/semester

March 1 — first summer session

March 1 — fall term/semester

Note that fall applications must be received by March 1 in order to be considered for an assistantship. Students must submit a completed application for assistantship by the above deadline to be considered for financial assistance.

Computer Engineering Program Master of Science

The department offers the Master of Science with a major in computer engineering.

Program Objectives

1. Graduates will exhibit skills needed to pursue doctoral-level work as well as research careers in industry and academia.
2. Graduates will possess a strong background in the breadth of computer engineering, as evidenced by a good balance between software and hardware skills, including software development, design of digital systems, microprocessors, embedded systems, real-time systems and digital communication networks.
3. Graduates will demonstrate a strong, in-depth knowledge in one of the department's specialty areas: VLSI, real-time systems, computer systems and communication networks.

4. Graduates will exhibit excellent communication skills, both oral and written, that will assist them in achieving their career goals.
5. Graduates will be highly recruited in a competitive market and make valuable contributions to a wide variety of industries, particularly in computer and information technology.
6. Graduates will pursue life-long learning and continued professional development.
7. Graduates will demonstrate high levels of professional responsibility and ethical behavior.
8. Graduates will undertake leadership roles in their profession, in their communities and in the global society.

Admission Requirements

Admission requirements for the MS with a major in computer engineering will be the same as the requirements for the MS with a major in computer science (see below).

Admission to Candidacy

After removal of all deficiencies and upon completion of all the leveling courses (as described below), the student is required to submit a formal degree plan to his or her adviser and the Dean of the School of Graduate Studies. Failure to fulfill this requirement may prevent the student from enrolling the following term/semester. Admission to candidacy is granted by the Dean of the School of Graduate Studies after the degree plan has been approved.

Leveling Courses

- Mathematics through multivariable calculus
- Physics including mechanics, electricity and magnetism
- CSCE 2050, Computer Science III
- CSCE 3600, Principles of Systems Programming
- CSCE 3610, Machine Structures
- CSCE 3730, Reconfigurable Logic
- ELET 3720, Electronics I

All entering students must demonstrate knowledge of the material covered in these courses. An entering student may demonstrate knowledge of the material by:

- Completing the courses at UNT
- Completing similar courses at another institution
- Evidence based on employment experience

A student may be required to successfully pass a placement exam to demonstrate their knowledge of the material.

Degree Requirements

Option A: Thesis Option (24 hours of organized course work plus 6 hours of thesis and CSCE 5020). Leveling courses cannot be counted towards these 24 hours.

Option B: Course Option (36 hours of organized course work which may include 3 hours of project and CSCE 5020). Leveling courses cannot be counted towards these 36 hours.

Course Selection

- Need leveling course(s) if you do not have a BS with a major in computer engineering.
- Select one course from three out of the four specialty areas.
- Select at least three courses from one area; at least one of these should be a 6000-level course.
- No more than 3 hours in non-organized class (such as individual study).
- As an introduction to the department, and to research and computer engineering in general, every master's-level student must take the CSCE 5020, Current Research in Computer Science and Engineering, during the first long term/semester enrolled in graduate classes. One hour of credit is obtained from this course.
- The project requires enrollment in CSCE 5900, which requires a poster presentation of the project work at an open department reception. A final project report that must be submitted to the graduate coordinator at least two weeks before the end of the student's final term/semester.

Course Requirements

Area 1: VLSI

- CSCE 5730, Digital CMOS VLSI Design (core course)
- CSCE 5750, VLSI Testing
- CSCE 5760, Design for Fault Tolerance
- CSCE 6651, Advanced VLSI Systems
- CSCE 6610, Advanced Computer Architecture

Area 2: Communication and Networks

- CSCE 5510, Wireless Communications (core course)
- CSCE 5580, Computer Networks (core course)
- CSCE 5520, Wireless Networks and Protocols
- CSCE 5530, Computer Network Design
- CSCE 5570, Digital Communication
- CSCE 6581, Advanced Computer Networks
- CSCE 6590, Advanced Topics in Wireless Communications

Area 3: Real-Time Systems

- CSCE 5440, Real-Time Software Development
- CSCE 5620, Real-Time Operating Systems
- CSCE 5640, Operating System Design (core course)

- ELET 5310, Industrial Process Control
- ELET 5330, Instrumentation Systems
- CSCE 6620, Advanced Topics in Real-Time Systems

Area 4: Computer Systems

- CSCE 5610, Computer System Architecture (core course)
- CSCE 5640, Operating System Design
- CSCE 5160, Parallel Processing and Algorithms
- CSCE 5650, Compiler Design
- CSCE 5451, Programming Languages
- CSCE 6610, Advanced Computer Architecture
- CSCE 6650, Advanced Compiler Techniques
- CSCE 6450, Advanced Programming Languages
- CSCE 6640, Advanced Operating Systems

General Courses

- CSCE 5932, Internship
- CSCE 5934, Direct Study
- CSCE 5900-5910, Special Problems
- CSCE 5950, Master's Thesis

Computer Science Program

Master of Science

The department offers the Master of Science with a major in computer science.

Admission Requirements

The student must satisfy all the general admission requirements of the Toulouse School of Graduate Studies as well as the admission requirements of the computer science and engineering department as delineated below:

1. an acceptable score on the Graduate Record Examination (GRE); contact the department or the Toulouse School of Graduate Studies for information concerning acceptable admission test scores;
2. for applicants whose native language is not English, a TOEFL score of at least 580 for the written test or 237 for the computer test also is required;
3. a GPA of at least 3.0 on the most recent 60 hours of course work;
4. completion of a sufficient amount of prior work in the field of computer science, including courses equivalent to CSCE 2610, 3110, and 3600; some undergraduate leveling sequences are available; and
5. at least 15 hours of mathematics, including differential and integral calculus, discrete mathematics and two other courses selected from statistics, linear algebra, abstract algebra, logic, numerical analysis and differential equations.

Students not satisfying conditions 1 through 3 will not be admitted to the computer science program nor will they be allowed to enroll in graduate computer science courses. Those students who satisfy condi-

tions 1 through 3 but who lack some of the computer science background may be provisionally admitted to the program and may enroll in graduate-level courses once any required leveling courses are completed with a grade of B or better. Admission is competitive, and satisfaction of the minimum requirements does not guarantee admission.

Admission to Candidacy

After removal of all deficiencies and upon completion of an additional 12 hours of graduate credit, the student is required to submit a formal degree plan to his or her adviser and the dean of the School of Graduate Studies. Failure to fulfill this requirement may prevent the student from enrolling the following term/semester.

Admission to candidacy is granted by the dean of the School of Graduate Studies after the degree plan has been approved.

Degree Requirements

The program for the Master of Science degree with a major in computer science is either 31 hours (with thesis) or 37 hours (with 3-hour research project or 6-hour problem in lieu of thesis or just course work). No more than 3 hours of credit in non-organized courses beyond the thesis or project (such as CSCE 5890 or 5900) may be applied toward a master's degree.

Course Selection

Every graduate student must enroll in CSCE 5020, Current Research in Computer Science and Engineering, during the first fall term/semester of graduate work (after any necessary leveling courses have been completed).

At least 24 hours of graduate work in computer science are required, including the core courses, CSCE 5150, 5450, and 5640. Every graduate student may choose to concentrate in one of several specialty areas (contact the department for a listing of the specialty areas.) To qualify for the master's degree, the student must earn a grade of B or better in each of the core courses.

Additional courses to be included in the CSCE graduate degree program may be selected from the full listing of CSCE courses, except CSCE 5012 and CSCE 5013.

Minor

From 6 to 12 hours of graduate work in a minor field of computer science application are required. With prior approval of the graduate coordinator, this work may be done outside the computer science and engineering department.

Academic Standards

If a student's GPA on all graduate and/or deficiency courses falls below 3.0, the student will be placed on probation the following term/semester. Students who cannot raise their GPA above 3.0 during that term/semester will be dropped from the program.

Graduate Minor in Computer Science

A graduate minor in computer science requires 9 to 12 hours of graduate credit. CSCE 5011-5013 are service courses designed for students who are not computer science majors. Since these are introductory courses, only one of these courses is allowed in the 9-hour minor option, and no more than two of these courses may be included in the 12-hour minor option.

Doctor of Philosophy

The program of study for the doctoral degree with a major in computer science includes formal course work, independent study and research. The purpose of the degree is to produce a professional capable of directing and conducting research within the discipline of computer science.

Admission Requirements

Students seeking admission to the doctoral program must meet all general requirements for doctoral candidates at UNT and must have completed all of the requirements (or equivalent work) for the master's degree as defined in the previous section. Additional requirements are delineated below:

1. an acceptable score on the Graduate Record Examination (GRE); contact the department or the Toulouse School of Graduate Studies for information concerning acceptable admission test scores;
2. a 3.5 GPA on the most recent 30 hours of course work;
3. for applicants whose native language is not English, a TOEFL score of at least 580 for the written test or 237 for the computer test is required; and
4. three letters of recommendation.

Admission is competitive, and satisfaction of the minimum requirements does not guarantee admission.

Degree Requirements

In addition to satisfying the general requirements for all UNT doctoral degrees, a student must satisfactorily complete the following:

1. a minimum of 12 hours of 6000-level organized courses in computer science;
2. the residence requirement, consisting of two consecutive terms/semesters of enrollment in at least 9 semester hours;

3. satisfactory completion of a written comprehensive examination prior to submitting a proposal for dissertation research; and
4. submission and successful defense of the doctoral dissertation.

More detailed information on degree requirements is available upon request from the Department of Computer Science and Engineering.

Language or Tool Subject Requirements

Consult the graduate adviser, Department of Computer Science and Engineering, for requirements.

Courses of Instruction

All Courses of Instruction are located in one section at the back of this catalog.

Course and Subject Guide

The "Course and Subject Guide," found in the Courses of Instruction section of this book, serves as a table of contents and provides quick access to subject areas and prefixes.