Electrical and Computer Engineering (PhD)

There are eight named academic concentrations spanning electrical and computer engineering around which admissions, course offerings, and advising are organized, as listed below. However, the interests and work of students and faculty alike may overlap more than one concentration.

Architecture, Computer Systems, and Embedded Systems. Computer architecture is at the interface of computer hardware and software. Its practitioners are responsible for specifying, designing, and implementing at the architecture level the hardware structures that carry out the work specified by computer software. Computer architects share the responsibility for providing mechanisms that algorithms, compilers, and operating systems can use to enhance the performance and/or energy requirements of running applications, ranging from small embedded IoT devices, autonomous systems, emerging quantum computing systems, to large cloud-based machine learning clusters. Computer architecture spans many dimensions, such as the scope of a processor (embedded processors, desktop systems, servers, and supercomputers); the target application (general-purpose versus domain-specific); the characteristics of the design objectives (speed, power consumption, cost, reliability, availability, and reconfigurability); and the measurement and analysis of resulting designs.

bioECE. Understanding, engineering, and interfacing with biological systems are among humanity's most important challenges, impacting numerous fields from basic science to health. Motivated by this larger vision, the bioECE track is focused on the intersection of electrical and computer engineering with biology and medicine. It includes biomedical instrumentation and sensing, neural engineering and interfaces, computational biology and bioinformatics, biophotonics and medical imaging, synthetic biology, biomimetic electronics, human-AI teaming, and other areas. Associated faculty have expertise in diverse topics: brain-machine interfaces and neuroprosthetics, neural engineering and neuromodulation, medical and computational imaging, contact tracing and disease-aware navigation, optical biosensing, wearable and flexible bioelectronics, health monitoring and activity recognition, digital biomarkers for disease detection, biomedical instrumentation and embedded systems, bioinformatics and computational genomics, molecular programming and synthetic biology, nanoscale manipulation and drug delivery, and soft robotics for biomedical applications.

Decision, Information, and Communications Engineering. This concentration involves research and design in the following fields: (1) Communications and Networking: all aspects of transmission of data, including: wireless communications, communication theory, information theory, networking, queueing theory, sensor networks; (2) Artificial Intelligence and Machine Learning: all aspects of extraction of knowledge from data, including: algorithms, data mining, optimization, statistics, pattern recognition, predictive analytics, data science and engineering, generative AI, reinforcement learning; and (3) Controls, Signals, and Systems: estimation and detection; signal, image and video processing; computer vision.

Electromagnetics and Acoustics. This concentration includes the study of electromagnetic and acoustic phenomena ranging from ultralow frequencies to the visible spectrum. The activities in electromagnetics involve research in computational methods, microwave and millimeter-wave components and integrated circuits, guided wave devices and systems, wave-matter interactions, antenna design, radar scattering, bioelectromagnetics, wave manipulation using artificial materials, wireless propagation channels, electromagnetic forces, and Maxwell's stress tensor. The activities in acoustics involve research in transducers, microelectromechanical systems, radio-frequency and millimeter-wave piezoelectric resonators and filters, atmospheric and underwater acoustics, and noise and vibration control.

Electronics, Photonics, and Quantum Systems. This concentration focuses on the development and improvement of electronic, photonic, optoelectronic, spintronic, and micro-electromechanical (MEMS) materials, devices, and systems for a variety of applications including digital, neuromorphic and quantum computing, high-speed communications, displays, sensors, and power applications. Electronic devices include nano-scaled CMOS transistors and, post-CMOS devices, memory, and compute-in-memory devices including memristors and magnetic and ferroelectric tunnel junctions. Photonic devices include photodetectors, solar cells, optical interconnects, LEDs, and lasers, including those incorporating semiconductor heterostructures, and topological photonic, metamaterials, metasurfaces, and other novel nanophotonic structures. Sensors include those for acoustic, chemical, and biological applications. Material systems include unstrained and strained column-IV and III-V- materials in bulk and quantum-well heterostructures, intrinsically low-dimensional systems including carbon nanotubes (1D) and mono-layer or few-layer graphene or transition metal dichalcogenides structures (2D), and organic and polymer thin films. Thin layers and heterostructures can be created through molecular beam epitaxy or various forms of chemical vapor deposition. Naturally 2D material layers also can be pulled from the layer stacks and manipulated by methods including novel methods developed in-house.

Integrated Circuits and Systems. This concentration involves all aspects of analysis, design, synthesis, and implementation of digital, analog, mixed-signal, and radio frequency (RF) integrated circuits and systems for applications in computing, sensing, and communications. Research in the area spans levels of abstraction from devices to systems-on-chip (SoC), and involves transceiver architectures, data converters, memory technologies, signal processing systems, integrated bio-chips, neuromorphic computing, high-performance and low-power design, fault tolerance, design for manufacturability (DFM), design for test (DFT), verification, computer-aided design (CAD) and electronic design automation (EDA).

Power Electronics and Power Systems. This concentration involves research in the generation, transmission, distribution, conversion, storage, and management of electric energy. Research activities include but are not limited to advanced power semiconductor devices; high-frequency-power-electronic conversion systems; GPU/accelerator power delivery and management; high-frequency magnetics; medium voltage power electronics for applications in renewable energy, energy storage and smart grid systems; dc power grids; power system analyses; modeling and simulation of power systems across all times scales; grid data analytics; applications of AI to power systems; security and resilience of power grid infrastructures; protection systems; power system harmonics and power quality.

Software Engineering and Systems. This concentration involves all aspects of engineering software systems. In addition to the problem of requirements, research and study in the area addresses architecting, designing, building, testing, analyzing, evaluating, deploying, maintaining, and evolving software systems. Problems investigated include theory, techniques, methods, processes, tools, middleware, and environments for all types of software systems in all types of domains and applications. This area of study also is available to working professionals through the Alternatively Scheduled MSE program with a concentration in Software Engineering administered by Texas Engineering Executive Education (TxEEE).

Graduate Handbook

Graduate handbook information is updated and maintained by each program. Graduate handbooks are available within each program's office and online. Please contact the program with concerns or questions.

Objective

The objective of the faculty of the Chandra Family Department of Electrical and Computer Engineering and its Graduate Studies Committee is to provide a graduate program that continues to produce exceptional graduates via an education that is both broad and deep and access to world-class research facilities while advancing the state of the art within diverse subfields spanning electrical and computer engineering.

Admission

Admission to the graduate program in ECE is highly competitive and based on a holistic review of all application materials by admission committees composed of faculty within the applicant's chosen academic tracks. Standards for admission generally exceed the minimum standards established by the University. The Chandra Family Department of ECE neither requires nor considers GRE scores in the selection of students for admission.

Applicants to the graduate program of the Chandra Family Department of Electrical and Computer Engineering normally will have an undergraduate degree in this field. Applicants with a degree in another field also may be considered if their background is appropriate for the chosen area of specialization. However, if admitted, the student may be required to complete additional coursework (outside their Program of Work, discussed below) to address any academic deficiencies.

Graduate students in the Chandra Family Department of Electrical and Computer Engineering are expected to be proficient speakers and writers of English. A newly admitted international student whose test scores indicate they may not meet the University's English proficiency standards must complete a speaking and/or writing screening conducted by the UT English Language Center before they can register for classes. The ESL courses count toward the student's course load for the semester but do not count toward the fulfillment of course requirements for the graduate degree. International non-native speakers of English with an offer of a Teaching Assistantship from ECE must successfully complete a *different* oral English screening to receive ITA English Certification.

Total Hours Required: 30

Requirements

Of the 30 hours of classroom coursework required for the PhD Program of Work, up to 18 semester hours (six semester-long courses) or the quarter-system equivalent of graduate-level classroom coursework taken elsewhere but not used for a prior bachelor or doctoral degree may be used with approval. A minimum grade point average of 3.33 (B+) is required for the classroom coursework taken at The University of Texas at Austin included within the Program of Work. The Program of Work including graduate coursework taken at other institutions also should meet this standard. Moreover, no course with a grade of less than a B- and no course with a grade of less than a B taken at another institution may be counted within the ECE PhD Program of Work. The student's PhD Program of Work must be approved by the student's dissertation supervisor or supervisors, by the remainder of the student's dissertation committee (see below), by the Chair of the ECE GSC, and by the Office of Graduate and Postdoctoral Studies at The University of Texas at Austin. Students in the PhD program attend classes with students in the Traditional and Integrated MSE programs and have access to upper-division undergraduate courses and courses taught outside the Chandra Family Department of ECE.

Beyond the requirements of a master's degree (whether or not the student has or obtains one), the PhD becomes primarily or entirely a research-based degree requiring the student to make a significant original contribution. For students who entered or enter the PhD program fall 2018 or later or who entered earlier but chose to follow the rules that are mandatory for students entering fall 2018 or later, research milestones toward the PhD include: finding and maintaining a dissertation supervisor or supervisors; forming a dissertation committee consisting of the dissertation supervisor or supervisors and of other members inside and outside of the ECE GSC, undergoing a Candidacy Evaluation by the nonsupervisory members of the dissertation committee, and being admitted to PhD candidacy by the Office of Graduate and Postdoctoral Studies at The University of Texas at Austin; passing a Progress Review; and ultimately writing and successfully defending their PhD dissertation before their dissertation committee. For students who entered the PhD program prior to fall 2018 and chose to be grandfathered into the rules in effect at that time, research milestones toward the PhD may still include: retaining a dissertation supervisor or supervisors; forming a qualifying committee consisting of the dissertation supervisor or supervisors and of other members inside and outside of the ECE GSC, successfully performing a qualifying examination before their qualifying committee, forming a dissertation committee (probably but not necessarily the same as their qualifying committee), and being admitted to PhD candidacy by the Office of Graduate and Postdoctoral Studies at The University of Texas at Austin; and ultimately writing and successfully defending their PhD dissertation before their dissertation committee. PhD students also take accompanying individual instruction *Research Problems* and/or additional *Dissertation* courses (beyond the six hours required within the PhD Program of Work) before and after entering candidacy, respectively, as required to meet registration and often employment and visa requirements. These matters are discussed in detail in the *Rules, Procedures and Expectations Regarding Academic Progress within the ECE PhD Program* which can be found on the ECE Graduate Program website.

Code	Title	Hours
Please see the following links for more information about degree requirements and policies:		
Graduate Engineering Requirements		
Graduate University Requirements		

Consult departments/programs regarding the Graduate University Requirements as some departments/programs have stricter degree requirements.