Semiconductor Science and Engineering

Master of Science in Engineering

For More Information

Campus address: Engineering Teaching Center II (ETC) 4.164, phone (512) 471-0262; campus mail code: C2200

Mailing address: The University of Texas at Austin, Graduate Program, Semiconductor Science and Engineering, 204 East Dean Keeton C2200, Austin TX 78712

E-mail: sse@engr.utexas.edu

URL: https://cockrell.utexas.edu/academics/graduate-education/programs/semiconductor-science-and-engineering

Objectives

The objective of this graduate degree program is to develop graduate students that have a deep understanding of the science of semiconductors and how to engineer and manufacture devices and systems around these core disciplines. Students will also be trained to investigate their own research projects to help them become team leaders and innovators in corporations that have semiconductor-centric applications. Linkage between fundamental science, engineering disciplines and research is a focus for this degree. Graduates of the program will be well prepared to work across varied disciplines involved and help overcome the inherent challenges faced by the semiconductor industry today.

Areas of Study and Facilities

The MSE in Semiconductor Science and Engineering will prepare students to enter the semiconductor workforce in areas such as semiconductor manufacturing, semiconductor device design, semiconductor circuit and system design, semiconductor metrology, semiconductor packaging and heterogeneous integration.

Semiconductor Manufacturing. This track focuses on gaining a fundamental understanding of semiconductor manufacturing processes and tools as well as hands-on experience using those tools. Required laboratories in this track include semiconductor manufacturing, where will gain experience with common semiconductor fabrication methods such as wafer cleaning, spin coating, photolithography, resist development, wet and dry etching, metal deposition, chemical vapor deposition, ion implantation, annealing and wafer bonding, as well semiconductor metrology and characterization, where students will gain experience with common semiconductor metrology methods such as profilometry, optical microscopy, scanning electron microscopy, atomic force microscopy, ellipsometry, interferometry, and electrical probing. Electives in this track include courses focused on analysis, modeling and control of semiconductor manufacturing processes, ultra-large scale integration techniques, optical and machine tool design for semiconductor equipment, plasma processing, lithography, and practical metrology methods.

Semiconductor Circuit and System Design. This track focuses on developing the knowledge and skills necessary to design semiconductor circuits and systems. Required laboratories in this track include very-large scale integration (VLSI) circuit design, where students will explore complementary metal oxide semiconductor (CMOS) technology; static and dynamic CMOS combinational and sequential circuits; design of Datapath elements; performance, power consumption, and testing and the use computer-aided design (CAD) tools for layout, timing analysis, synthesis, physical design, and verification, as well as analog integrated circuit design where students will explore the analysis and design of analog integrated circuits; transistor models and integrated circuit technologies; layout techniques; noise; mismatches; current mirrors; differential amplifiers; frequency response and compensation; feedback and stability; nonlinear circuits; voltage references; and operational amplifiers using state-of-the-art CAD tools for design, simulation, and layout. Electives in this track include application specific integrated circuit design, radio frequency integrated circuit design, power management design, physical design automation and optimization, system-on-chip design, embedded system design, semiconductor memory design and computer architecture.

Semiconductor Heterogenous Integration. This track focuses on gaining a fundamental understanding of advanced packaging and heterogeneous integration for semiconductor manufacturing. Required laboratories in this track include semiconductor manufacturing, where will gain experience with common semiconductor fabrication methods such as wafer cleaning, spin coating, photolithography, resist development, wet and dry etching, metal deposition, chemical vapor deposition, ion implantation, annealing and wafer bonding, as well semiconductor metrology and characterization, where students will gain experience with common semiconductor metrology methods such as profilometry, optical microscopy, scanning electron microscopy, atomic force microscopy, ellipsometry, interferometry, and electrical probing. Electives in this track include courses focused on microelectronics packaging techniques, thermomechanical issues in packaging, reliability related aspects of packaging, thermal management conditions, packaging materials, integration of heterogeneous chiplets, thin films and interfaces, and metallization.

Semiconductor Devices. This track focuses on developing the knowledge and skills necessary to design, fabricate and test new semiconductor devices. Required laboratories in this track include very-large scale integration (VLSI) circuit design, where students will explore complementary metal oxide semiconductor (CMOS) technology; static and dynamic CMOS combinational and sequential circuits; design of Datapath elements; performance, power consumption, and testing and the use computer-aided design (CAD) tools for layout, timing analysis, synthesis, physical design, and verification, as well semiconductor metrology and characterization, where students will gain experience with common semiconductor metrology methods such as profilometry, optical microscopy, scanning electron microscopy, atomic force microscopy, ellipsometry, interferometry, and electrical probing. Electives in this track include courses focused on optoelectronic devices, semiconductor heterostructures, metal-oxide-semiconductor field-effect transistors (MOSFET), bipolar junction transistors (BJT), thin-film transistors, quantum wires, quantum dots, spintronic devices, and emerging 2D devices.

Facilities are available for graduate work in all areas of study within semiconductor science and engineering, and for both experimental and theoretical/computational research. Graduate laboratory activities of the department are housed in the Engineering Education and Research Center,#and in several special-purpose laboratories located in the Peter O'Donnell Jr. building#and on the J. J. Pickle Research Campus. Numerous facilities for experimental research are provided within these well-equipped research laboratories. Among the resources available for computationally intensive research is the Texas Advanced Computing Center, also housed on the J. J. Pickle Research campus. In addition, The University of Texas Libraries provide a rich source of literature to support

graduate activities in electrical and computer engineering, including free online access to essentially all-important journals.

Graduate Studies Committee

The following faculty members served on the Graduate Studies Committee (GSC) in the spring 2025 semester.

Deji Akinwande
Michael Aubrey
Vaibhav Bahadur
Edoardo Baldini
Sanjay K Banerjee
Seth Robert Bank
Chih-Hao Chang
Ray T Chen
Michael Arthur Cullinan
Alexander A Demkov
Dragan Djurdjanovic
Ananth Dodabalapur
Mattan Erez
Andreas Gerstlauer
Feliciano Giustino
Graeme Andrew Henkelman
Qin Huang
Tanya Hutter
Yaoyao Jia
Lizy K John
Brian A Korgel
Jaydeep Prakash Kulkarni
Sensen Li
Xiuling Li
Ruochen Lu
Nathaniel Lynd
Charles B Mullins
Michael E Orshansky
Zhigang Pan
Leonard F Register
Hang Ren
Sean Thomas Roberts
Shyam Shankar
S V Sreenivasan
Earl E Swartzlander Jr
Emanuel Tutuc
Yaguo Wang
Jamie Warner
Edward T Yu

Admission Requirements

Students with a bachelor's degree in engineering or in one of the physical sciences may be admitted to the Semiconductor Science and Engineering degree program upon the recommendation of the Graduate Studies Committee. Students who do not have a background that the committee considers satisfactory for the study of Semiconductor Science and Engineering will be required to take preparatory coursework, some of which may be at the undergraduate level. Completion of some coursework may be required before the student begins the work for the graduate degree.