Department of Materials Science and Engineering

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Introduction

The Department of Materials Science and Engineering addresses the education and technological challenges of creating, applying and characterizing new materials for the 21st century. The Department of Materials Science and Engineering is committed to training students at the undergraduate and graduate levels in all aspects of modern materials including metals, ceramics, polymers, electronic and optical materials and materials characterization. Students have opportunities for hands-on instruction and research with modern equipment and facilities. The department has strong collaborative programs with industries in the Dallas–Fort Worth region and with universities both locally and throughout the world.

The department offers bachelor of science, master of science and doctoral degrees, all with a major in materials science and engineering. The undergraduate program was approved in July 2006 and started admitting students immediately. Presently, the department has 11 tenured or tenure track faculty who divide their time between teaching and research in the different areas mentioned above. Research support comes from a variety of federal, state and industrial entities. The department has one of the most advanced analytical characterization facilities in the country and both undergraduate and graduate students receive training on state-of-the-art equipment. Finally, the department has strong connections to local industries and is setting up relationships for cooperative education experiences and internships so that students can receive practical training in addition to the classroom and laboratory instruction. Students who graduate with a bachelor of science degree with a major in materials science and engineering can expect a very healthy job market and relatively high starting salaries in a variety of industries. In fact, materials science and engineering graduates are heavily sought after by industries of all types, including automotive, chemical, aerospace, microelectronics, magnetic storage, transportation, sports, defense, forensics, and manufacturing. A BS degree with a major in materials science and engineering also prepares students for continuing their education with a master's or a PhD degree either in materials science and engineering or in a related field.

Vision and Mission

The vision of the Department of Materials Science and Engineering at the University of North Texas is to: have a world-class materials science and engineering research program with local, national and international scientific and technological impact; provide an outstanding educational experience for a diverse student population; and provide a collegial environment for students, staff and faculty.

The mission of the Department of Materials Science and Engineering is to provide a high quality engineering education to our diverse student population by maintaining a balance between the theoretical and applied aspects of materials science and engineering through course work, laboratories and independent research topics. The department provides national and international leadership in research and scholarship, and strives to build mutually beneficial partnerships with both internal and external collaborators, with alumni and with the professional and business communities. Finally, the department facilitates a collegial atmosphere that is conducive to the intellectual and scholarly pursuits of its faculty and students.

Research The Laboratory of Polymers and Composites works on reliability and prediction of service performance, polymer liquid crystals and their blends, fiber reinforced composites and polymer solutions. Mechanical, thermophysical and rheological properties are investigated using computer simulations, statistical mechanics and a variety of experimental techniques (DMTA, TMA, TSD, DSC, TGA, PV-T relations, computerized tension, compressions, blending and impact testing).

The Electron and Ion Microscopy Laboratory currently houses an FEI Tecnai F20ST TEM, an FEI Analytical Dual Beam FIB, an FEI Quanta Environmental SEM, an Imago Local Electrode Atom Probe, a Phillips EM420 TEM, a JEOL 5800 SEM

and several optical microscopes for characterization of virtually any material. This equipment is being used to characterize a range of materials including semiconductors, nanocomposites, crystalline and amorphous alloys, advanced ceramics, polymers and polymer composites, and biomaterials.

The Material Mechanics Laboratory is engaged in investigations of interrelationships between morphology and mechanical properties through the influences of time and temperature. A Mechanical Testing System (MTS810) equipped with an environmental chamber, video and thermal wave imaging provides stress pattern-temperature relationships around propagating cracks. Dynamic Mechanical Thermal Analysis provides viscoelastic and rheological property evaluation. The laboratory is also engaged in thermally stimulated depolarization experimental techniques of polymer blends.

The Materials Synthesis and Processing Laboratory has research interests focused on the development of ferroelectrics, aerogels, and other novel ceramics for energy, sensor and high temperature applications. Equipment includes a critical point dryer, a BET surface area analyzer, electrical conductivity apparatus, high temperature furnaces and a controlled atmosphere glove box.

The Laboratory for Electronic Materials and Devices is working on basic and applied research for novel materials for advanced electronic devices of all kinds. The laboratory provides semiconductor-related materials growth and characterization capabilities that are available in only a few academic laboratories in the world. The laboratory is centered around a cluster multichamber MBE Group IV Metallization and Dielectric deposition system, coupled to a comprehensive surface science system as well as a 3 MV ion beam accelerator for in-situ materials processing and characterization. Research areas include growth, processing and characterization of novel electronic thin film materials such as dielectrics, advanced electrode materials with work function tuning, metallization, diffusion barriers, hydrogen and impurity defects in electronic nanostructures, stability, and interfacial diffusion/reaction in multilayered thin film nanostructures.

The Energy Materials Laboratory works on research that addresses the processing, characterization, and overall device development for energy conversion technologies. Low-temperature processing of ceramic thin films is achieved through the development of oxide polymeric precursors and colloidal suspensions. Deposition techniques such as laser assisted maskless aerosol deposition and spin coating are also studied. Applications of these materials processing techniques include transparent conducting oxides for flexible photovoltaics and displays, low operation temperature thin film solid oxide fuel cells, direct conversion of biofuels, and UV-Vis emitters and phosphors for solid state lighting. Extensive overlap exists between the Energy Materials Laboratory and the Electron Microscopy Laboratory. Additional characterization is available in this laboratory through electrochemical impedance spectroscopy, UV-Vis-NIR spectrophotometry, and X-ray diffraction.

Programs of Study

The department offers undergraduate and graduate programs in the following areas:

- Bachelor of Science,
- Master of Science, and
- Doctor of Philosophy, all with a major in materials science and engineering.

Bachelor of Science with a Major in Materials Science and Engineering

The Bachelor of Science degree with a major in materials science and engineering is designed to provide students with the fundamental principles of how materials are made, how they behave during application, how their structure and properties are measured and quantified, and how to improve the performance of these materials. This information is then used in "materials-specific" courses and hands-on laboratories where students then learn to apply these principles to the different materials classes, namely, metals, ceramics, polymers, electronic materials and biomaterials. Students also learn about nanotechnology and how it is impacting the materials science and engineering discipline. During their last year, students are required to do a senior project with one of the faculty members who specialize in their primary area of interest. Students work either individually or in small groups on projects that provide them with research experiences that help them determine whether they feel better suited to finish their education and go to industry or continue on to graduate school. The course work instills in students ethical and environmental issues and standards expected by industry and society.

The bachelor of science degree with a major in materials science and engineering is a new program designed to meet ABET criteria. Accreditation for this degree will be sought as soon as the program graduates its first class of students.

Degree Requirements

1. **Hours Required and General/College Requirements:** A minimum of 120 semester hours, of which 45 must be advanced, and fulfillment of degree requirements for the Bachelor of Science degree as specified in the "General University Requirements" in the Academics section of this catalog and the College of Engineering requirements.

2. **Major Requirements:** A minimum of 48 semester hours, including MTSE 3010, MTSE 3020, MTSE 3030, MTSE 3040, MTSE 3050, MTSE 3060, MTSE 3070, MTSE 3080, MTSE 3090, MTSE 3100, MTSE 4010, MTSE 4030, MTSE 4050, MTSE 4060, MTSE 4090 and MTSE 4100; two elective MTSE courses.

3. **Other Required Courses:**
   a. MATH 1710, MATH 1720 and MATH 3310.
   b. PHYS 1710/PHYS 1730, PHYS 2220/PHYS 2240 and PHYS 3010.
   c. CHEM 1410/1430 and CHEM 1420.
   d. MEEN 2130, ENGR 2060 and ENGR 2332.
   e. ENGR 3450.

4. **Minor**: Optional.

5. **Electives:** See four-year plan.

6. **Other Requirements:** A grade point average of at least 2.5 is required for all materials science and engineering courses.

BS with a Major in Materials Science and Engineering

Following is one suggested four-year degree plan. Students are encouraged to see their advisor each semester for help with program decisions and enrollment. Students are responsible for meeting all course prerequisites.

FRESHMAN YEAR

FALL	HOURS
CHEM 1410, General Chemistry for Science Majors	3
CHEM 1430, Laboratory Sequence for General Chemistry	1
ENGL 1310, College Writing I, or ENGL 1313, Computer Assisted College Writing I*	3
MATH 1710, Calculus I	4
PSCI 1040, American Government I*	3
Social and Behavioral Sciences*	3
Total	17

SPRING	HOURS
CHEM 1420, General Chemistry for Science Majors	3
TECM 2700, Technical Writing**	3
ENGR 2060, Professional Presentations	3
MATH 1720, Calculus II	3
PHYS 1710, Mechanics	3
PHYS 1730, Laboratory in Mechanics	1
Total	16

SOPHOMORE YEAR

FALL	HOURS
HIST 2610, United States History to 1865*	3
MATH 3310, Differential Equations for Engineering Majors	3
MEEN 2130, Statics and Dynamics	4
PHYS 2220, Electricity and Magnetism	3
PHYS 2240, Laboratory in Wave Motion, Electricity, Magnetism and Optics	1
Total	14

SPRING	HOURS
ENGR 2332, Mechanics of Materials	4
ENGR 3450, Engineering Materials	3
HIST 2620, United States History Since 1865*	3
PHYS 3010, Modern Physics	3
Understanding the Human Community*	3
Total	16

JUNIOR YEAR

FALL	HOURS
MTSE 3010, Bonding and Structure	3
MTSE 3020, Microstructure and Characterization of Materials	3
MTSE 3030, Thermodynamics and Phase Diagrams	3
MTSE 3040, Transport Phenomena in Materials	3
MTSE 3090, Materials Science and Engineering Laboratory I	1
Visual and Performing Arts*	3
Total	16

SPRING	HOURS
MTSE 3050, Mechanical Properties of Materials	3
MTSE 3060, Phase Transformations in Materials	3
MTSE, 3070, Electrical, Optical and Magnetic Properties of Materials	3
MTSE 3080, Materials Processing	3
MTSE 3100, Materials Science and Engineering Laboratory II	1
PSCI 1050, American Government II*	3
Total	16

SENIOR YEAR

FALL	HOURS
MTSE 4010, Physical Metallurgy Principles	3
MTSE 4030, Ceramic Science and Engineering	3
MTSE 4050, Polymer Science and Engineering	3
MTSE 4090, Senior Research Project I	2
Humanities*	3
Total	14

SPRING	HOURS
MTSE 4060, Materials Selection and Performance	3
MTSE 4100, Senior Research Project II	2
MTSE Elective (4000 level)	3
MTSE Elective (4000 level)	3
Total	11

See the University Core Curriculum section of this catalog for approved list of course options.
***** See College of Engineering degree requirements section of this catalog for approved list of course options.***

Actual degree plans may vary depending on availability of courses in a given semester.
Some courses may require prerequisites not listed.

Minor

The minor in materials science and engineering requires a total of 18 semester credit hours: 15 hours of materials science and engineering courses, plus ENGR 3450, Engineering Materials. At least 6 of the 15 hours in materials science and engineering should be from any two of the four core courses: MTSE 3010, MTSE 3030, MTSE 3050 and MTSE 3070. The remaining 9 hours can be from any other 3000- or 4000-level materials science engineering courses.

Note: The prerequisite of MFET 2100 for ENGR 3450 is waived for students registering for a minor in materials science and engineering; however, the other prerequisites for ENGR 3450 (CHEM 1410/1430 and MATH 1710) must be completed by students registering for the minor in materials sciences and engineering.

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.

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Miguel Acevedo, Interim Chair

Faculty

Boetcher, Choi, Feng, Plummer, Prasad, Traum

Introduction

The Department of Mechanical and Energy Engineering at the University of North Texas is committed to academic excellence in undergraduate and graduate education and research in all areas pertinent to the discipline of mechanical engineering and in particular to thermal-fluid sciences, energy production, and solid mechanics. The goals of the Department and its faculty are: (1) to provide high quality and innovative educational programs at the undergraduate and graduate levels; (2) to foster lifelong learning by promoting professionalism and ethical standards and helping students develop leadership qualities; (3) to pursue excellence in scholarly research in areas of mechanical and energy engineering; and (4) to collaborate with engineers in industry, national laboratories, and government agencies in finding the solutions to national and global problems related to energy use and its environmental impacts.

Mission and Vision

The mission of the Department of Mechanical and Energy Engineering is to harness the power of ideas by providing a student-centered environment, fostering a strong culture of learning, promoting high quality scholarly activities, serving the engineering profession and society, and advancing regional economic development. We seek to accomplish this mission by:

- Offering high quality and innovative educational programs at the undergraduate and graduate levels.
- Pursuing innovation, excellence, and leadership in scholarly activities.