Materials Science and Engineering

The Materials Science and Engineering Department is the oldest and most diversified program in North Texas. It is a university-wide, highly-interdisciplinary graduate program with eight core materials faculty and approximately 25 affiliated faculty spanning from physics and chemistry to electrical, mechanical, aerospace, civil and bio engineering. It offers minor, masters and doctoral degree programs in Materials Science and Engineering. It has courses in nanoscale materials and nanotechnology, magnetic, optical and energy materials, bio/nano materials, cementitious materials, computational materials, surface engineering, and thin film technology. The department's growth is aided by high levels of research funding from NSF, NIH, DOE, ONR, NASA, DOD, SRC and other federal, industrial and state sources in the areas of micro/nano electronic devices, self-assembled nanomaterials, multifunctional nanocomposite thin films, biomaterials, construction materials, optoelectronics, biosensor, solar cells and materials for clean energy, advanced lubricants, and coatings.

Undergraduate Degree

- Minor in Materials Science and Engineering (http://catalog.uta.edu/engineering/materialsscience/undergraduate/#minortext)
- Minor in Nanotechnology (http://catalog.uta.edu/engineering/materialsscience/undergraduate/#minortext)
- Certificate in Nanotechnology (http://catalog.uta.edu/engineering/materialsscience/undergraduate/#certificatetext)

Graduate Degrees

- Materials Science and Engineering, M.Engr. (http://catalog.uta.edu/engineering/materialsscience/graduate/#masterstext)
- Materials Science and Engineering, M.S. (http://catalog.uta.edu/engineering/materialsscience/graduate/#masterstext)
- Materials Science and Engineering, B.S. to Ph.D. (http://catalog.uta.edu/engineering/materialsscience/graduate/#doctoraltext)
- Materials Science and Engineering, Ph.D. (http://catalog.uta.edu/engineering/materialsscience/graduate/#doctoraltext)
- Materials Science and Engineering - Physics Fast Track (http://catalog.uta.edu/science/physics/undergraduate/)
- Materials Science and Engineering - ME Fast Track (https://catalog.uta.edu/engineering/mechanical/undergraduate/#fasttracktext)

COURSES

MSE 3300. INTRODUCTION TO MATERIALS SCIENCE AND ENGINEERING. 3 Hours.
Introduction to the atomic bonding, crystal structure, defects in materials, diffusion processes, phase diagram and phase transformation, and their relation to the mechanical, electrical, optical and thermal properties of metals, semiconductors, ceramics, polymers and composites. Prerequisites: CHEM 1442 or CHEM 1465; PHYS 1444.

MSE 4191. ADVANCED PROBLEMS IN MATERIALS SCIENCE & ENGINEERING. 1 Hour.
The investigation of special individual problems in materials science and engineering under the direction of a faculty member. Prerequisite: consent of the head of the department.

MSE 4291. ADVANCED PROBLEMS IN MATERIALS SCIENCE & ENGINEERING. 2 Hours.
The investigation of special individual problems in materials science and engineering under the direction of a faculty member. Prerequisite: consent of the head of the department.

MSE 4304. ANALYSIS OF MATERIALS. 3 Hours.
Theoretical understandings and practical applications of various characterization techniques to materials analysis, ranging from x-rays and electron diffraction, x-ray spectroscopy, and surface topography, are discussed. Practice of these techniques in lab class typically includes SEM spectroscopy, powder diffraction, Laue diffraction, and the double crystal x-ray diffraction. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4310. POLYMER MATERIALS SCIENCE. 3 Hours.
Intermolecular forces of attraction in high polymers, polymer synthesis, morphology and order in crystalline polymers, mechanics of amorphous polymers, time-dependent mechanical behavior, transitional phenomena, mechanical behavior of semicrystalline polymers. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4312. MECHANICAL BEHAVIOR OF MATERIALS. 3 Hours.
Concept of stress and strain, theory of plasticity; elementary dislocation theory. Deformation of single crystals; strengthening mechanisms like solid solution strengthening, and precipitation hardening. Fracture mechanics; microscopic aspects of fracture, fatigue, and creep of materials; design and processing of materials for improved mechanical properties. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4315. INTRODUCTION TO COMPOSITES. 3 Hours.
Composite classification, laminate coding, fabrication, processing and properties of composite laminates, point stress analysis and failure prediction of composite laminates, material allowable, issues in composite structural design. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4316. TRIBOLOGY AND LUBRICATION. 3 Hours.
The course provides a comprehensive understanding of the Tribology and Lubrication process in materials. This course will employ theoretical and practical examples. Mechanism of coating deposition for tribological, oxidation and corrosion protection are also examined. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4320. NANOSCALE MATERIALS. 3 Hours.
Introduction to the synthesis and characterization of nano-materials. Fundamental concepts of surface physics and chemistry. Survey of electronic, biological and biomedical applications. The materials presented include semiconductor and metal thin films, nanoparticles and nanowires, carbon fullerenes and nanotubes, and organic nanoparticles. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4321. PHASE TRANSFORMATIONS OF MATERIALS. 3 Hours.
The theory of homogeneous and heterogeneous transformations, nucleation and growth, martensitic transformations, heat treatment and control of microstructure. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4330. CORROSION SCIENCE AND ENGINEERING. 3 Hours.
Corrosion principles and quantitative application of electrochemical principles to corrosion reactions. Effects of material factors and environmental conditions on aqueous corrosion and high temperature oxidation along with principal methods used in corrosion prevention. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4333. INTRODUCTION TO MAGNETIC MATERIALS. 3 Hours.
Classical and quantum mechanical understandings of magnetic properties of materials. Specific applications of these properties to various devices are discussed. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4334. OPTICAL PROCESSES IN SOLID MATERIALS. 3 Hours.
Basic understanding of optical response of materials based on classical and quantum models. Particular focus on all phenomena involving light in semiconductors and their optoelectronic applications. Optical properties of solid materials with reduced dimensionality such as thin films and quantum wells and dots. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4335. ELECTRICAL PROPERTIES OF MATERIALS. 3 Hours.
Advanced discussion of electronic structure, transport mechanisms in metals, semiconductors and superconductors, with applications to materials used in various electronic devices. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4337. FATIGUE OF ENGINEERING MATERIALS. 3 Hours.
Cyclic deformation, fatigue crack initiation and growth in ductile solids. Application of fracture mechanics to fatigue. Mechanisms of crack closure. Variable and multiaxial fatigue and corrosion fatigue. Fatigue of brittle solids. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4339. FRACTURE MECHANICS. 3 Hours.
Theory and applications of fracture mechanics. Stress analysis of cracks, crack-tip plasticity, fatigue crack growth, and stress corrosion cracking. Applicability to materials selection, structural design, failure analysis, and structural reliability. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4343. NANOBIOTECHNOLOGY. 3 Hours.
The objective of this course is to provide students with the fundamental principles of physical and biological sciences at the nanoscale and the basic concepts of applying such interdisciplinary principles to develop new technologies for improving human life and health. The first part of this course introduces the fundamental principles of physics, chemistry, and biology at the nanoscale and the basic techniques to generate, manipulate, and characterize man-made and nature's nanomaterials and systems. The second part of this course covers the state-of-the-art applications of nanobiotechnology, with emphasis on biomedical applications. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4345. CERAMIC MATERIALS. 3 Hours.
Crystal structure of ceramic materials. Phase equilibria in ceramic materials. The processing of ceramics and ceramic matrix composites. Strengthening mechanisms and mechanical properties of ceramics and ceramic matrix composites including flexure, tensile, fracture toughness, fatigue, and creep. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4350. INTRODUCTION TO COMPUTATIONAL MATERIALS. 3 Hours.
This course provides fundamentals of computational materials sciences, such as molecular dynamics, first-principles calculation, density functional theory and phase-field simulation. This course will also provide students with hands-on experience using different materials simulation method including XMD, Quantum Espresso, VASP and phase-field modeling to study different problems such as energy calculation, melting and sintering, vacancy diffusion and phase transition. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4351. CURRENT TOPICS IN NANOTECHNOLOGY. 3 Hours.
Review and discussion of the latest advancements in the field of nanoscale science and technology. Topics include nanoscale electronic materials/devices, energy materials and devices, biological and chemical sensors, cancer diagnosis and cure, self assembly of materials, nanoscale composite materials, techniques for observing and manipulating atoms and molecules, and synthesis of nanoscale materials such as nanoparticles, nanowires, and graphenes. The course will comprise of several sections (several subareas of nanoscale science and technology) and will be taught by several professors who have expertise in each field. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4353. FUNDAMENTALS OF SUSTAINABLE ENERGY. 3 Hours.
Basic concepts and applications of energy generation and storage. Topics cover a broad spectrum of sustainable energy technologies, including thermal, tide, solar, biomass, wind and electrochemical devices, with emphasis on fundamentals in materials and engineering. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4354. ELECTRONIC MATERIALS AND DEVICES. 3 Hours.
Fundamentals and applications of modern electronic devices and materials. Topics include electrical properties of semiconductors, electrons and holes, energy bands, effective electron masses and effective hole masses, p-n junctions, drift current and diffusion current, metal-oxide-semiconductor (MOS) structure, capacitance-voltage (C-V) plots, field-effect transistors, bipolar junction transistors, and integrated circuits. Prerequisites: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4355. MATERIALS FOR ENERGY. 3 Hours.
The course aims to introduce concepts and design of advanced materials for sustainable energy generation and storage systems. It will cover polymer electrolyte materials, metallic nanoparticles, semiconductors, and nano-fabrication in clean energy conversion, energy storage, fuel cells, photovoltaic cells, and other emerging energy harvesting and storage. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4357. SYNTHESIS AND PROPERTIES OF MODERN ENGINEERING MATERIALS. 3 Hours.
In this course, materials science, chemistry, physics, and engineering concepts will be applied to describe, explain, and analyze the structure, properties, processing, and performance of engineering materials. A fundamental understanding of the atomic bonding, thermodynamics and kinetics of dissolution and precipitation processes, phase diagrams, crystalline structures and defects, and chemical and physical surficial and interfacial phenomena will be applied to understand the influences of chemical composition and reactions, and mass transport processes on the evolution of microstructure and properties of modern engineering materials, include cements and concrete, zeolites, glasses, and nanomaterials. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4358. ORTHOPEDIC IMPLANTS - MATERIAL SELECTION AND CHARACTERIZATION. 3 Hours.
Materials science basics, material selection and material characterization for orthopedic implants. Survey of metallic materials, ceramic materials, polymers and composite materials applied in orthopedic implants. Introduction to surface modification, biostability, and tribology of orthopedic implants. Several laboratory practices are included. Prerequisite: Must be in a college of engineering professional program or college of science professional program or department consent.

MSE 4359. FAILURE ANALYSIS AND RELIABILITY ENGINEERING. 3 Hours.
The basic scope of this course is to understand 1) various types of failure modes in engineering materials, 2) contributing factors to those failures and 3) analysis and detection methods employed in the relevant industries. The failure of engineering materials under discussion includes those by mechanical, electrical and chemical load. Specific cases of discussion include materials for structural as well as microelectronics applications. Also discussed will be the method of statistical analysis and its modeling. Prerequisite: Department consent and must be in a college of engineering professional program or college of science professional program.

MSE 4390. SPECIAL TOPICS IN MATERIALS SCIENCE & ENGINEERING. 3 Hours.
Special topics pertinent to the field of materials science and engineering, such as electrical, optical, and magnetic properties of materials, will vary from semester to semester depending on the availability of faculty. May be repeated, provided that topics are different. Prerequisite: prior approval by the MSE undergraduate advisor.

MSE 4391. ADVANCED PROBLEMS IN MATERIALS SCIENCE & ENGINEERING. 3 Hours.
The investigation of special individual problems in materials science and engineering under the direction of a faculty member. Prerequisite: consent of the head of the department.

MSE 5141. TRANSMISSION ELECTRON MICROSCOPY LAB. 1 Hour.
Specimen preparation. Operation of the transmission electron microscope. Beam alignment and rotation calibration. Bright field and dark field imaging. Weak beam imaging. Examination of defects.

MSE 5190. SPECIAL TOPICS IN MATERIALS SCIENCE AND ENGINEERING. 1 Hour.
May be repeated for credit when topic changes.

MSE 5192. MASTER'S COMPREHENSIVE EXAMINATION. 1 Hour.
Directed study, consultation, and comprehensive examination over coursework leading to the Master of Engineering degree in Materials Science and Engineering. Required of all Master of Engineering students in the semester they plan to graduate.

MSE 5193. SEMINAR IN MATERIALS SCIENCE AND ENGINEERING. 1 Hour.
Selected topics in materials science and engineering presented by faculty, students, and invited lecturers.

MSE 5290. SPECIAL TOPICS IN MATERIALS SCIENCE AND ENGINEERING. 2 Hours.
May be repeated for credit when topic changes.

MSE 5300. INTRODUCTION TO MATERIALS SCIENCE AND ENGINEERING. 3 Hours.
Introduction to the atomic bonding, crystal structure, defects in materials, diffusion processes, phase diagram and phase transformation, and their relation to the mechanical, electrical, optical and thermal properties of metals, semiconductors, ceramics, polymers and composites.

MSE 5304. ANALYSIS OF MATERIALS. 3 Hours.
Theoretical understandings and practical applications of various characterization techniques to materials analysis, ranging from x-rays and electron diffraction, x-ray spectroscopy, and surface topography, are discussed. Practice of these techniques in lab class typically includes SEM spectroscopy, powder diffraction, Laue diffraction, and the double crystal x-ray diffraction.

MSE 5305. SOLID STATE PHYSICS AND THERMODYNAMICS OF MATERIALS. 3 Hours.
This course comprises of three sections, a) solid state physics, b) classical thermodynamics, and c) statistical thermodynamics. The solid state physics covers the physics of crystalline solids. This includes 1) classical theory of electrons in metals, 2) Sommerfeld theory of electrons in solids, 3) reciprocal lattice, 4) Bloch's theorem, 5) energy bands of solids, and 6) electrons in weak periodic potentials. The classical thermodynamics covers macroscopic aspects of thermodynamics. It covers 1) entropy, 2) temperature, 3) first, second, and third laws of thermodynamics, 4) internal energy and free energy, 5) Helmholtz free energy, Gibbs free energy, and 6) Maxwell relations. The statistical thermodynamics covers microscopic aspects of thermodynamic laws. It includes 1) entropy and temperature, 2) second law of thermodynamics, 3) partition function and Boltzmann factor, 4) free energies, and 5) canonical and grand canonical formalisms.

MSE 5312. MECHANICAL BEHAVIOR OF MATERIALS. 3 Hours.
Concepts of stress and strain, theory of plasticity. Elementary dislocation theory. Deformation of single crystals. Strengthening mechanisms like solid solution strengthening, precipitation hardening, etc. Elementary concepts in fracture mechanics. Microscopic aspects of fracture, fatigue, and creep of materials.

MSE 5314. FRACTURE MECHANICS. 3 Hours.
Theory and applications of linear elastic fracture mechanics. Topics include stress analysis of cracks, crack-tip plasticity, fatigue and stress corrosion. Applicability to materials selection, failure analysis and structural reliability reviewed.

MSE 5315. FATIGUE OF ENGINEERING MATERIALS. 3 Hours.
Cyclic deformation, fatigue crack initiation and growth in ductile solids. Application of fracture mechanics to fatigue. Mechanisms of crack closure. Variable and multiaxial fatigue and corrosion fatigue. Fatigue of brittle solids.

MSE 5316. TRIBOLOGY AND LUBRICATION. 3 Hours.
The course provides a comprehensive understanding of the Tribology and Lubrication process in materials. This course will employ theoretical and practical examples. Mechanism of coating deposition for tribological, oxidation and corrosion protection are also examined.

MSE 5320. NANOSCALE MATERIALS. 3 Hours.
Use Experiment-Oriented Just-in-Time Teaching to introduce the synthesis, properties and applications of inorganic thin films and nanoparticles. Before each lab session several lectures will be given that are specifically arranged for this particular experiment, including reviews of all necessary basic knowledge and introductions to new concepts, especially nanoscale size effects. Through such know-how/know-why approach students are expected to learn how all basic knowledge bonds together to apply to nanotechnology.

MSE 5321. PHASE TRANSFORMATIONS OF MATERIALS. 3 Hours.
The theory of homogeneous and heterogeneous transformations, nucleation and growth, martensitic transformations, heat treatment and control of microstructure.

MSE 5330. CORROSION SCIENCE AND ENGINEERING. 3 Hours.
Corrosion principles and quantitative application of electrochemical principles to corrosion reactions. Effects of material factors and environmental conditions on aqueous corrosion and high temperature oxidation along with principal methods used in corrosion prevention.

MSE 5333. MAGNETIC PROPERTIES OF MATERIALS. 3 Hours.
Classical and quantum mechanical understandings of magnetic properties of materials. Specific applications of these properties to various devices are discussed.

MSE 5334. OPTICAL PROCESSES IN SOLID MATERIALS. 3 Hours.
Basic understanding of optical response of materials based on classical and quantum models. Particular focus on all phenomena involving light in semiconductors and their optoelectronic applications. Optical properties of solid materials with reduced dimensionality such as thin films and quantum wells and dots.

MSE 5335. ELECTRICAL PROPERTIES OF MATERIALS. 3 Hours.
Advanced discussion of electronic structure, transport mechanisms in metals, semiconductors and superconductors, with applications to materials used in various electronic devices.

MSE 5339. FAILURE ANALYSIS AND RELIABILITY ENGINEERING. 3 Hours.
The basic scope of this course is to understand 1) various types of failure modes in engineering materials, 2) contributing factors to those failures and 3) analysis and detection methods employed in the relevant industries. The failure of engineering materials under discussion includes those by mechanical, electrical and chemical load. Specific cases of discussion include materials for structural as well as microelectronics applications. Also discussed will be the method of statistical analysis and its modeling.

MSE 5341. TRANSMISSION ELECTRON MICROSCOPY IN MATERIALS SCIENCE. 3 Hours.
This course provides theoretical and experimental knowledge on a basic TEM optics, sample requirements, electron diffraction, the imaging modes, high-resolution TEM, and related theories of image formation. This course is intended for graduate students who are potential new users of TEM for study of materials.

MSE 5343. NANOBIOTECHNOLOGY. 3 Hours.
The objective of this course is to provide students with the fundamental principles of physical and biological sciences at the nanoscale and the basic concepts of applying such interdisciplinary principles to develop new technologies for improving human life and health. The first part of this course introduces the fundamental principles of physics, chemistry, and biology at the nanoscale and the basic techniques to generate, manipulate, and characterize man-made and nature's nanomaterials and systems. The second part of this course covers the state-of-the-art applications of nanobiotechnology, with emphasis on biomedical applications.

MSE 5345. CERAMIC MATERIALS. 3 Hours.
Crystal structure of ceramic materials. Phase equilibria in ceramic materials. The processing of ceramics and ceramic matrix composites. Strengthening mechanisms and mechanical properties of ceramics and ceramic matrix composites including flexure, tensile, fracture toughness, fatigue, and creep.

MSE 5347. POLYMER MATERIALS SCIENCE. 3 Hours.
Intermolecular forces of attraction in high polymers, polymer synthesis, morphology and order in crystalline polymers, mechanics of amorphous polymers, time-dependent mechanical behavior, transitional phenomena, mechanical behavior of semicrystalline polymers.

MSE 5348. FUNDAMENTALS OF COMPOSITES. 3 Hours.
Composite structural analysis; structural properties, damage characterization and failure mechanisms; stiffness loss due to damage, notched sensitivity; delamination; impact; fatigue characteristics; composite material testing; material allowables; characteristics of composite joints.

MSE 5350. INTRODUCTION TO COMPUTATIONAL MATERIALS SCIENCE. 3 Hours.
Atomic to mesoscale computational modeling in Materials Science and Engineering, including the random-walk model, molecular dynamics, first-principle methods, density functional theory and phase-field modeling, by using various computational software and codes, such as Matlab, XMD, LAMMPS, Quantum Espresso and Multiphysics COMSOL Modeling.

MSE 5351. CURRENT TOPICS IN NANOTECHNOLOGY. 3 Hours.
Review and discussion of the latest advancements in the field of nanoscale science and technology. Topics include nanoscale electronic materials/devices, energy materials and devices, biological and chemical sensors, cancer diagnosis and cure, self assembly of materials, nanoscale composite materials, techniques for observing and manipulating atoms and molecules, and synthesis of nanoscale materials such as nanoparticles, nanowires, and graphenes. The course will comprise of several sections (several subareas of nanoscale science and technology) and will be taught by several professors who have expertise in each field.

MSE 5352. SOLAR ENERGY MATERIALS AND DEVICES. 3 Hours.
Fundamental principles of photovoltaic devices and solar energy materials used for the devices. Topics include thermodynamics of solar energy conversion, carrier generation and recombination, the solid-state device physics of p-n junction under illumination, various state-of-the-art photovoltaic materials, simulation of photovoltaic devices, and solar module technologies.

MSE 5353. FUNDAMENTALS OF SUSTAINABLE ENERGY. 3 Hours.
Basic concepts and applications of energy generation and storage. Topics cover a broad spectrum of sustainable energy technologies, including thermal, tide, solar, biomass, wind and electrochemical devices, with emphasis on fundamentals in materials & engineering.

MSE 5354. ELECTRONIC MATERIALS AND DEVICES. 3 Hours.
Fundamentals and applications of modern electronic devices and materials. Topics include electrical properties of semiconductors, electrons and holes, energy bands, effective electron masses and effective hole masses, p-n junctions, drift current and diffusion current, metal-oxide-semiconductor (MOS) structure, capacitance-voltage (C-V) plots, field-effect transistors, bipolar junction transistors, and integrated circuits.

MSE 5355. MATERIALS FOR ENERGY. 3 Hours.
The course aims to introduce concepts and design of advanced materials for sustainable energy generation and storage systems. It will cover polymer electrolyte materials, metallic nanoparticles, semiconductors, and nano-fabrication in clean energy conversion, energy storage, fuel cells, photovoltaic cells, and other emerging energy harvesting and storage.

MSE 5356. INSTRUMENTATION FOR MATERIALS CHARACTERIZATION. 3 Hours.
This course is composed of two components: lecture and laboratory for several materials characterization techniques. The lecture part includes the instruction of basic principles and theories behind AFM, Raman, FT-IR, XRD, SEM, TEM and spectroscopic techniques. Students in the class are divided into small groups for the laboratory part (4-5 people per group) so that students can gain hand-on experiences on various characterization techniques by operating associated equipment.

MSE 5357. SYNTHESIS AND PROPERTIES OF MODERN ENGINEERING MATERIALS. 3 Hours.
In this course, materials science, chemistry, physics, and engineering concepts will be applied to describe, explain, and analyze the structure, properties, Processing, and performance of engineering materials. A fundamental understanding of the atomic bonding, thermodynamics and kinetics of dissolution and precipitation processes, phase diagrams, crystalline structures and defects, and chemical and physical surficial and interfacial phenomena will be applied to understand the influences of chemical composition and reactions, and mass transport processes on the evolution of microstructure and properties of modern engineering materials, include cements and concrete, zeolites, glasses, and nanomaterials.

MSE 5358. ORTHOPEDIC IMPLANTS - MATERIAL SELECTION AND CHARACTERIZATION. 3 Hours.
Materials science basics, material selection and material characterization for orthopedic implants. Survey of metallic materials, ceramic materials, polymers and composite materials applied in orthopedic implants. Introduction to surface modification, biostability, and tribology of orthopedic implants. Several laboratory practices are included. Prerequisite: Graduate standing in science or engineering, or department consent.

MSE 5390. SPECIAL TOPICS IN MATERIALS SCIENCE AND ENGINEERING. 3 Hours.
Special topics pertinent to the field of materials science and engineering, such as electrical, optical, and magnetic properties of materials, will vary from semester to semester depending on the availability of faculty. May be repeated, provided that topics are different.

MSE 5391. ADVANCED STUDIES IN MATERIALS SCIENCE AND ENGINEERING. 3 Hours.
Topics selected from various areas of materials science and engineering. Work performed as a thesis substitute normally will be accomplished under MSE 5391, with prior approval of the Committee on Graduate Studies.

MSE 5392. RESEARCH PROJECT IN MATERIALS SCIENCE AND ENGINEERING I. 3 Hours.
Research course with credit granted according to work performed. The student will have to put together a research plan for the semester with approval of his/her dissertation advisor. End of semester requirement is a written report of research performed with results and discussion. A presentation at the end of the semester on research progress may be required.

MSE 5394. MASTER'S RESEARCH PROJECT IN MATERIALS SCIENCE AND ENGINEERING. 3 Hours.
The student will carry out a hands-on project under a guidance of his/her supervising professor. The student will need to provide a written project report. At the end of semester, the student will present his/her project results to MSE faculty members and students. The MSE faculty members will decide the grade.

MSE 5398. THESIS. 3 Hours.
THESIS.

MSE 5405. PHYS THERMO MAT. 4 Hours.

MSE 5698. THESIS. 6 Hours.

MSE 5998. THESIS. 9 Hours.
THESIS.

MSE 6196. MSE INTERNSHIP. 1 Hour.
For students participating in internship programs. May be repeated for credit.

MSE 6197. ADVANCED STUDIES IN MATERIALS SCIENCE AND ENGINEERING. 1 Hour.
May be repeated for credit.

MSE 6198. RESEARCH IN MATERIALS SCIENCE AND ENGINEERING. 1 Hour.
Individually approved research projects in materials science and engineering. May be repeated for credit.

MSE 6298. RESEARCH IN MATERIALS SCIENCE AND ENGINEERING. 2 Hours.
Individually approved research projects in materials science and engineering. May be repeated for credit.

MSE 6396. MSE INTERNSHIP. 3 Hours.
For students participating in internship programs. May be repeated for credit.

MSE 6397. ADVANCED STUDIES IN MATERIALS SCIENCE AND ENGINEERING. 3 Hours.
May be repeated for credit.

MSE 6398. RESEARCH IN MATERIALS SCIENCE AND ENGINEERING. 3 Hours.
Individually approved research projects in materials science and engineering. May be repeated for credit.

MSE 6399. DISSERTATION. 3 Hours.

MSE 6696. MSE INTERNSHIP. 6 Hours.
For students participating in internship programs. May be repeated for credit.

MSE 6698. RESEARCH IN MATERIALS SCIENCE AND ENGINEERING. 6 Hours.
Individually approved research projects in materials science and engineering. May be repeated for credit.

MSE 6699. DISSERTATION. 6 Hours.

MSE 6996. MSE INTERNSHIP. 9 Hours.
For students participating in internship programs. May be repeated for credit.

MSE 6998. RESEARCH IN MATERIALS SCIENCE AND ENGINEERING. 9 Hours.
Individually approved research projects in materials science and engineering. May be repeated for credit.

MSE 6999. DISSERTATION. 9 Hours.

MSE 7399. DOCTORAL DEGREE COMPLETION. 3 Hours.
This course may be taken during the semester in which a student expects to complete all requirements for the doctoral degree and graduate. Enrolling in this course meets minimum enrollment requirements for graduation, for holding fellowships awarded by The Office of Graduate Studies and for full-time GTA or GRA positions. Students should verify that enrollment in this course meets other applicable enrollment requirements. To remain eligible in their final semester of study for grants, loans or other forms of financial aid administered by the Financial Aid Office must enroll in a minimum of 5 hours as required by the Office of Financial Aid. Other funding sources may also require more than 3-hours of enrollment. Additional hours may also be required to meet to requirements set by immigration law or by the policies of the student's degree program. Students should contact the Financial Aid Office, other sources of funding, Office of International Education and/or their graduate advisor to verify enrollment requirements before registering for this course. This course may only be taken twice. Students who do not complete all graduation requirements while enrolled in this course must enroll in a minimum of 6 dissertation hours (6699 or 6999) in their graduation term. Graded P/F/R.