# MATERIALS ENGINEERING (MATL)

**MATL 860 Mechanical Aspects of Materials**
**Crosslisted with:** MATL 460
**Prerequisites:** MECH 325 and MATL 360, or equivalent.
**Description:** Emphasizes those principles at the atomistic or molecular level that relate mechanical properties and behavior of different classes of materials to their structure and environment.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded
**Prerequisite for:** MATL 875; MATL 960; MATL 962

**MATL 861 Materials Laboratory II**
**Crosslisted with:** MATL 461
**Prerequisites:** MATL 360.
**Description:** Application of scientific principles in the laboratory to the analysis of materials problems and selection of engineering materials.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded
**Course and Laboratory Fee:** $20

**MATL 862 X-ray Diffraction**
**Crosslisted with:** MATL 462
**Prerequisites:** PHYS 212.
**Description:** Principles of crystallography. Production and properties of X-rays. Interaction of X-rays with atoms and the nature of diffraction (direction and the intensities of diffracted beams). Diffraction patterns and intensity measurements.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded

**MATL 863 Introduction to Materials for Nuclear Energy Systems**
**Crosslisted with:** MATL 463
**Prerequisites:** MATL 260 or MATL 360 or equivalent
**Description:** Introduction to materials in nuclear engineering with a focus on power generation, including concepts related to components of nuclear power stations, generation-IV fission reactors, materials for nuclear reactors, degradation of mechanical properties in irradiation environments, and fusion reactors.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded

**MATL 864 Thin Films and Surface Engineering**
**Prerequisites:** Graduate standing in engineering, physics, chemistry, or permission
**Description:** Thin films play an important role in a myriad of applications ranging from magnetic recording media, architectural glass panels, and microelectronics to coatings for reduction of wear and corrosion in components on board the space shuttle. Includes: vacuum science and technology; pumping systems and instrumentation; thin film deposition techniques; surface modification techniques; characterization of thin film properties; microstructural, physical and mechanical properties; and comparisons of surface enhancement techniques in terms of suitability, performance, and cost.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded

**MATL 865 Applied Physical Metallurgy and Design**
**Crosslisted with:** MATL 465
**Prerequisites:** MATL 360 or equivalent.
**Description:** Principles of alloying; alloy selection; modification of the physical properties of structural alloys by thermal, mechanical, and chemical treatment; solidification and joining phenomena.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded

**MATL 866 Materials Selection for Mechanical Design**
**Crosslisted with:** MATL 466
**Prerequisites:** MATL 360 and MECH 325; or permission.
**Description:** Rational selection procedure for the most suitable materials for each particular mechanical design. Introduction of materials selection charts and the concept of materials performance indices. Case studies in mechanical design, taking materials selections, shape and process into account. Projects on materials selection at the design concept and the design embodiment stages.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded

**MATL 867 Principles of Powder Metallurgy**
**Crosslisted with:** MATL 467
**Prerequisites:** MECH 200; MECH 325; MATL 360 or equivalent.
**Description:** Basic principles of powder metallurgy, with emphasis on methods of producing metal powders, determination of their characteristics; the mechanics of powder compaction; sintering methods and effects; and engineering applications.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded

**MATL 868 Failure Analysis: Prevention and Control**
**Crosslisted with:** MATL 468
**Prerequisites:** MECH 325; MATL 360 or equivalent.
**Description:** Metallurgical tools for analysis of failures; types and modes of failures; sources of design and manufacturing defects. Case histories utilized to illustrate modes of failures and principles and practices for analysis. Design concepts and remedial design emphasized with these case studies. Several projects involving case analyses and design by students included.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded

**MATL 869 Physical Materials Systems**
**Crosslisted with:** MATL 469
**Prerequisites:** PHYS 212 and MATL 360.
**Description:** Development of the principles controlling the formation of the structure of engineering materials. Phase diagrams, diffusion, interfaces and microstructures, solidification and diffusional transformation and diffusionless transformations.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded

**MATL 870 Thermodynamics of Alloys**
**Crosslisted with:** MATL 470
**Prerequisites:** MATL 360 and MECH 200, or equivalent; MATH 208 or parallel.
**Description:** Materials thermodynamics of closed systems, introduction to liquid and solid solution alloys, relationship to gas phase, application to binary systems.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded
**Prerequisite for:** MATL 875; MATL 960; MATL 970; MATL 972

**MATL 871 Electron Microscopy of Materials**
**Crosslisted with:** MATL 471
**Prerequisites:** PHYS 212.
**Description:** Introduction to electron beam instruments. Electron interactions with materials. Basic aspects of electron diffraction, image formation and spectrum generation by materials. Acquisition and analysis of images, diffraction patterns and spectral data. Resolution and sensitivity limits of electron probe methods. Practical experience in the use of electron microscopes for characterization of materials.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded

**MATL 872 Kinetics of Alloys**
**Crosslisted with:** MATL 472
**Prerequisites:** MATL 360 or equivalent; MATH 221/MATH 821.
**Description:** Kinetics of gas-liquid-solid reactions in alloy systems; analysis of diffusion models applicable to such systems.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded

**MATL 873 Corrosion**
**Crosslisted with:** MATL 473
**Prerequisites:** CHEM 109A and CHEM 109L or equivalent.
**Description:** Fundamentals of corrosion engineering, underlying principles, corrosion control, and materials selection and environmental control.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded

**MATL 874 Extractive Metallurgy**
**Crosslisted with:** MATL 474
**Prerequisites:** MATL 360 and MECH 200 or equivalent.
**Description:** Unit operations and processes utilized in production of ferrous, nonferrous, and refractory metals. Examples of production techniques for metal bearing ores, scrap metals, and domestic waste. Control of impurity and alloy content and their relationship to physical properties.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded

**MATL 875 Glass and Ceramic Materials**
**Prerequisites:** MATL 860 and 870, or permission
**Description:** Principles underlying the processing and microstructure evolution in nonmetallic materials, particularly glasses and ceramics. Structure-property relations in ceramics for engineering applications.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded

**MATL 877 Organic and Inorganic Electronic Materials and Devices**
**Crosslisted with:** MATL 477
**Prerequisites:** Permission.
**Description:** The course introduces the optical and electronic processes in inorganic and organic molecules and polymers that govern the behavior of practical organic electronic and optoelectronic devices.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded

**MATL 892 Special Topics**
**Crosslisted with:** MATL 492
**Description:** Special topics in materials engineering and related areas.
**Credit Hours**: 1-6
**Min credits per semester:** 1
**Max credits per semester:** 6
**Max credits per degree:** 24
**Grading Option:** Graded

**MATL 960 Materials Aspects of Fracture**
**Prerequisites:** MATL 860; MATL 870
**Description:** Utilization of certain aspects of applied elasticity, plasticity, and materials physics to explain the relationship between materials structures and mechanical properties. Includes review of various types of material failure and mechanical tests employed to predict behavior of materials with emphasis on metals.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded

**MATL 962 Imperfections in Crystals**
**Prerequisites:** CHEM 882; MATL 860
**Description:** Fundamental properties of defects in solids. Energy considerations for point, line, and plane defects. Equilibrium and nonequilibrium concentrations of defects and annealing theory. Mutual interactions of defects and formation of secondary defects. Interaction of defects with other perturbations of the crystal lattices.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded

**MATL 970 Advanced Thermodynamics of Materials**
**Prerequisites:** MATL 870, MATH 821 or equivalent
**Description:** Applications of thermodynamic concepts to phase equilibria in materials systems. Systematics of solution theories and lattice modeling. Experimental methods; computer modeling in materials thermodynamics.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded

**MATL 972 Transformation in Materials**
**Prerequisites:** CHEM 882; MATL 870
**Description:** Classical nucleation theory, homogeneous and heterogeneous nucleation. Precipitation studies in solids including transition precipitates. Kinetics of growth of precipitates. Diffusion controlled transformation process.
**Credit Hours**: 3
**Max credits per semester:** 3
**Max credits per degree:** 3
**Grading Option:** Graded

**MATL 997 Research Other Than Thesis**
**Prerequisites:** Advanced graduate standing and permission
**Description:** Supervised non-thesis research and independent study.
**Credit Hours**: 1-6
**Min credits per semester:** 1
**Max credits per semester:** 6
**Max credits per degree:** 24
**Grading Option:** Graded

**MATL 998 Advanced Materials Topics**
**Prerequisites:** Permission
**Description:** Course offered as the need arises to teach advanced topics in materials characterization, processing, synthesis or properties not covered in other 900-level courses.
**Credit Hours**: 1-3
**Min credits per semester:** 1
**Max credits per semester:** 3
**Max credits per degree:** 9
**Grading Option:** Graded