COURSES FOR METALLURGICAL AND MATERIALS ENGINEERING

Metallurgical and Materials Engineering Courses

MTE510 Crystalline Defects in Materials
Hours 3
Advanced work of an investigative nature. Credit awarded is based on the work accomplished. Defects in materials contribute significant to various properties including but not limited to deformation mechanisms, phase transformation pathways, and transport properties. This course provides a fundamental and quantitative overview of point, line, and interfacial imperfections in crystalline materials. In particular, the thermodynamic contributions, structure, and migration of these types of defects will be discussed and their impact on material behavior and/or properties.

MTE519 Solidification Science
Hours 3
Overview of the principles of solidification processing, the evolution of solidification microstructure, segregation, defects and the use of analytical and computational tools for the design, understanding and use of solidification processes.

MTE539 Metallurgy Of Welding
Hours 3
Thermal, chemical, and mechanical aspects of welding using the fusion welding process. The metallurgical aspects of welding, including microstructure and properties of the weld, are also covered. Various topics on recent trends in welding research.
Prerequisite(s): MTE 380

MTE546 Macroscp Transp Mat Proc
Hours 3
Elements of laminar and turbulent flow; heat transfer by conduction, convection, and radiation; and mass transfer in laminar and in turbulent flow; mathematical modeling of transport phenomena in metallurgical systems including melting and refining processes, solidification processes, packed bed systems, and fluidized bed systems.
Prerequisite(s): MATH 238 and MTE 353
Prerequisite(s) with concurrency: MTE 271

MTE549 Powder Metallurgy
Hours 3
It is an elective class for graduate students, and is aimed at providing metallurgical engineering students with in-depth knowledge of powder metallurgy technology which is one of principal technologies for manufacturing near net-shape products. This course covers all processing steps involved in transforming powders into consolidated products, starting from powder fabrication to sintering of compacted powders with emphasis on the scientific principles associated with design and operation of these processes and on the structure and physical properties of the final product. The applications and specific engineering details are used as illustration. The ultimate goal of this course is to make students be able from the materials learned to select and design the optimal processing route for any given product properties.

MTE550 Plasma Processing of Thin Films
Hours 3
This course will cover fundamental technology involved in thin film processing. Plasma deposition and etch technology will be discussed. The basics of plasma processing equipment will be detailed, with special emphasis on sputtering tools. A range of thin film applications will be explored, with examples of magnetics, semiconductor, optical, and medical applications. The fundamentals of process optimization using a Design of Experiments will be taught with a test case of process optimization for the final exam.
Prerequisite(s): PH 105 or with permission of instructor.

MTE556 Advanced Mechanical Behavior
Hours 3
Topics include elementary elasticity, plasticity, and dislocation theory; strengthening by dislocation substructure, and solid solution strengthening; precipitation and dispersion strengthening; fiber reinforcement; martensitic strengthening; grain-size strengthening; order hardening; dual phase microstructures, etc.
Prerequisite(s): MTE 455

MTE562 Metallurgical Thermodyn
Hours 3
Laws of thermodynamics, equilibria, chemical potentials and equilibria in heterogeneous systems, activity functions, chemical reactions, phase diagrams, and electrochemical equilibria; thermodynamic models and computations; and application to metallurgical processes.
Prerequisite(s): MTE 362

MTE565 Atom Probe Tomography
Hours 3
This course introduces the theoretical background and practical information necessary to investigate materials using atom probe microscopy techniques. Topics will include the origins of the technique through field emission microscopy and its evolution into current atom probe to mography methods and instruments. The fundamentals of field emission, evaporation, desorption and other related behaviors is provided to establish an understanding of the physics of how atom probe microscopy operates. The course will also emphasize processes for assessing atom probe data quality, how to represent such data, advancements and limitations in data interpretation, and proper implementation of advanced data mining algorithms. Course instruction will be through lectures and assignments to assess student progress.

MTE567 Strengthening Mechanisms in Materials
Hours 3
Mechanisms and micromechanics of strengthening in engineering materials. This course covers the physical phenomena that contribute towards high mechanical strength in engineering materials. Principles for designing high strength materials will be addressed.
Prerequisite(s): MTE 455 or equivalent: or permission of instructor
MTE579 Advanced Physical Metallurgy  
Hours 3  
Graduate-level treatment regarding how metallurgical processing controls phase transformations and its outcomes on microstructure stability and mechanical strengthening mechanisms found in such microstructures.

MTE583 Adv Structure Of Metal  
Hours 3  
Graduate-level treatments of symmetry, crystallography, crystal structures and defects in crystals. Application of analytical techniques to study crystal structures and textures in materials.

MTE585 Materls At Elevd Temps  
Hours 3  
Influence of temperatures on behavior and properties of materials.

MTE587 Corrosion Science & Engr  
Hours 3  
Fundamental causes of corrosion problems and failures. Emphasis is placed on tools and knowledge necessary for predicting corrosion, measuring corrosion rates, and combining this with prevention and materials selection.  
Prerequisite(s): MTE 271 and CH 102 or CH 118

MTE591 Special Problems  
SP  
Hours 1-4  
Advanced work of an investigative nature. Credit awarded is based on the work accomplished.

MTE592 Special Problems  
SP  
Hours 1-3  
Advanced work of an investigative nature. Credit awarded is based on the work accomplished.

MTE598 Non Thesis Research Hours  
Hours 1-12  
Credit is based on the amount of work undertaken on non-thesis related research in a metallurgical and materials engineering area, the outcome of which is a define result presented in a report, paper, manuscript, or formal presentation at a conference or an MTE seminar. Instructor permission required. No prerequisites required.

MTE599 Thesis Research  
Hours 1-12  
No description available

MTE643 Magnetic Materials and Magnetic Recording  
Hours 3  
This course provides knowledge on basic magnetism and magnetic materials of various types, and also introduces the applications. Origin of magnetism, ferro-magnetism, anti-ferro-magnetism, ferrimagnetism, hard- and soft-magnetic materials, spintronics, magnetic recording, magnetic random access memory (MRAM), spin-transfer-torque MRAM, spin transistor and Optical recording.  
Prerequisite(s): MTE 271 and permission of instructor.

MTE655 Electron Microscopy Matl  
Hours 4  
Topics include basic principles of operation of the transmission electron microscope, principles of electron diffraction, image interpretation, and various analytical electron-microscopy techniques as they apply to crystalline materials.

MTE670 Scanning Electron Microscopy  
Hours 3  
Theory, construction, and operation of the scanning electron microscope. Both imaging and x-ray spectroscopy are covered. Emphasis is placed on application and uses in metallurgical engineering and materials-related fields.

MTE680 Advanced Phase Diagrams  
Hours 3  
Advanced phase studies of binary, ternary, and more complex systems; experimental methods of construction and interpretation.

MTE684 Fund Solid State Engineering  
Hours 3  
Fundamentals of solid state physics and quantum mechanics are covered to explain the physical principles underlying the design and operation of semiconductor devices. The second part covers applications to semiconductor microdevices and nanodevices such as diodes, transistors, lasers, and photodetectors incorporating quantum structures.  
Prerequisite(s): MTE 271 or ECE 332

MTE687 Microstructure Evolution of Materials  
Hours 3  
The course will cover the fundamentals and state-of-the-art techniques used in mathematical modeling and computer simulation of microstructure formation and control during the solidification and solid state transformations of materials. The concepts and methodologies covered in this course for net-shape casting and ingot remelt processes can be applied, with some modifications, to model other materials processes such as welding, deposition, and heat treatment processes. Modeling and simulation of microstructure evolution requires complex multi-scale computational areas, from computational fluid dynamics macroscopic modeling through mesoscopic to microscopic modeling, as well as strategies to link various length-scales emerged in modeling of microstructural evolution.

MTE691 Special Problems  
SP  
Hours 1-3  
Credit awarded is based on the amount of work undertaken.  
Special Topics Course
MTE698 Non Dissertation Research Hours
Hours 1-12
Credit is based on the amount of work undertaken on non-dissertation related research in a metallurgical and materials engineering area, the outcome of which is a define result presented in a report, paper, manuscript, or formal presentation at a conference or an MTE seminar. Instructor permission required.

MTE699 Dissertation Research
Hours 1-12
No description available