

COURSES FOR METALLURGICAL AND MATERIALS ENGINEERING

Metallurgical and Materials Engineering Courses

MTE121 Introduction to Materials

Hours 1

An introduction to the materials science and engineering profession and history. The course includes selected topics useful in the study of metallurgical and materials engineering.

MTE252 Metallurgical Process Calculations

Hours 3

Mathematical quantitative relations of chemical reactions and physicochemical processes; principles of overall mass and energy balances and the application of these principles to metallurgical systems.

Prerequisite(s): CH 102, ENGR 103 or ENGR 123, and MATH 125

MTE271 Engineering Materials : Structure and Properties

Hours 3

Basic structure of ceramics, alloys, composites, metals, and polymers. Relationships between the structure of materials and their mechanical, electrical, magnetic, thermal, and chemical properties.

Prerequisite(s): CH 100 or CH 101 or CH 117; MATH 125 or MATH 145

MTE275 Engineering Materials Laboratory

Hours 3

Alloy preparation and processing of materials. Materials testing and evaluation, laboratory procedures and techniques, metallography, heat treatment, phase diagrams, hardenability, and mechanical testing. Introduction to technical report writing and application to written laboratory reports.

Prerequisite(s): EN 101

Prerequisite(s) with concurrency: MTE 271

MTE353 Transport Phenomena in Metallurgy

Hours 3

Definition of viscosity, elements of laminar and turbulent flow, and overall mechanical energy balance. Thermal conductivity, steady and transient conduction problems, forced and natural convection, heat transfer, and radiative heat transfer. Definition of binary diffusivity, convection mass transfer, and mass transfer coefficient. The application of the principles covered in the design of specific metallurgical systems.

Prerequisite(s): MATH 238 and MTE 252

Prerequisite(s) with concurrency: MATH 238

MTE362 Thermodynamics Of Materials

C

Hours 4

The fundamentals of thermodynamics applied to typical metallurgical processes and reactions, heterogeneous equilibrium, behavior of solutions, standard states, phase diagrams. Emphasis is placed on the use of basic thermodynamic data, graphical representations of thermodynamic data and equilibrium, and the application of using computational tools to solve problems. Computing proficiency is required for a passing grade in this course.

Prerequisite(s): MTE 252

Computer Science

MTE373 Physical Metallurgy

W

Hours 4

Introduction to the principles of physical metallurgy. Topics include crystal structure, deformation, dislocations, point defects, diffusion, phase diagrams, interfaces, nucleation theory, transformations, and growth. Writing proficiency is required for a passing grade in this course. A student who does not write with the skill normally required of an upper-division student will not earn a passing grade, no matter how well the student performs in other areas of the course.

Prerequisite(s): MTE 271 and MTE 362

Writing

MTE380 Synthesis, Processing and Manufacturing of Materials

Hours 3

Materials Processing fundamentals as they affect dimensions and microstructure of materials and their application in engineering practice. Survey of classical and modern manufacturing processes for engineering materials.

Prerequisite(s): MTE 271

MTE412 Polymer Materials Engineering

Hours 3

Introduction to the manufacture, processing and applications of organic polymeric materials. The chemistry of polymer manufacture, the molecular structure of polymers, and the structure-property relationships for thermoplastic and thermosetting polymers are covered.

Prerequisite(s): CH 102

MTE416 Fundamentals of Foundry Processing

C

Hours 4

Metal casting principles including pattern design, molding materials, conventional and digital molding methods, sand testing, solidification, risering and gating of castings, casting and mold design, microstructure and casting defects and their influence on mechanical properties. Computing proficiency is required for a passing grade in this course.

Prerequisite(s): MTE 362 and MTE 380

Computer Science

MTE439 Metallurgy Of Welding

Hours 3

Thermal, chemical, and mechanical aspects of welding using fusion welding processes. The metallurgical aspects of welding, including microstructure and properties of the weld, are also included.

Prerequisite(s): MTE 380 or permission of instructor

MTE441 Chemical Metallurgy

Hours 4

Application of thermodynamics, fluid flow, and heat and mass transfer to the design and operation of chemical metallurgical processes; roasting, agglomerating, oxidation and reduction reactions, smelting, converting, and refining.

Prerequisite(s): MTE 353 and MTE 362

Prerequisite(s) with concurrency: MTE 443

MTE443 Materials Engineering Design I

Hours 3

Principles of engineering design. Problem formulation, concept design, configuration design, parametric design, detail design, materials selection, manufacturing process selection, prototyping, project planning and cost analysis, application of computer-based design tools, concepts of shared responsibility, teamwork and communication. Analysis of problems, design and development solutions. Oral presentations and written reports. A project will be assigned. Final project presentations will be evaluated by the MTE faculty.

Prerequisite(s): EC 110 or EC 112; MTE 362, MTE 373, MTE 380

Prerequisite(s) with concurrency: MTE 441 and MTE 481

MTE445 Materials Engineering Design II (W)

Hours 3

Capstone design course. Students work in teams on design projects which involve evaluation of industrial based metallurgical or materials problems and emphasize societal impact. Implementation of design principles and the research plan developed in MTE 443. Interim and final design reviews with oral presentations and written reports. Final project presentation will be evaluated by the MTE faculty. Writing proficiency is required for a passing grade in this course.

Prerequisite(s): MTE 416, 441, 443, 455, and 481

MTE449 Powder Metallurgy

Hours 3

The course will cover the topic of powder metallurgy, describing the various types of powder processing and how these affect properties of the components made. Current issues in the subject area, from high production to nanomaterials will be discussed.

Prerequisite(s): MTE 373 and MTE 380

MTE450 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 106 or PH 126, and CH 102, or permission of instructor.

MTE455 Mechanical Behavior Of Materials

Hours 4

Flow and fracture of solids; uniaxial stress-strain as a reference behavior; theories of terminal stability under impact; monotonic, sustained (creep), and repeated (fatigue) loadings of solids under various states of stress.

Prerequisite(s): AEM 250 or permission of instructor.

MTE467 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 from instructor

MTE481 Analytical Methods For Materials

W

Hours 4

Crystallography, physics of X-rays, diffraction by crystalline materials, applications of X-ray, electron and neutron diffraction, and spectrometric analysis of materials. Writing proficiency is required for a passing grade in this course. A student who does not write with the skill normally required of an upper-division student will not earn a passing grade, no matter how well the student performs in other areas of the course.

Prerequisite(s): MTE 271 and MTE 373 or permission of instructor.

Writing

MTE487 Corrosion Science & Engineering

Hours 3

The course is aimed at investigating the underlying fundamental causes of corrosion problems and failures. Emphasis is placed on the electrochemical reactions occurring and the tools and knowledge necessary for predicting corrosion, measuring corrosion rates, and combining these with prevention and materials selection.

Prerequisite(s): MTE 271 and CH 102 or permission of instructor.

MTE491 Special Problems

Hours 1-3

An assigned problem is explored individually. Credit is based on the amount of work undertaken.

MTE492 Special Problems

Hours 1-3

An assigned problem is explored individually. Credit is based on the amount of work undertaken.

MTE519 Solidificatn 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

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 treatments of the fundamentals of symmetry, crystallography, crystal structures, defects in crystals (including dislocation theory), and atomic diffusion.

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

Hours 1-4

Advanced work of an investigative nature. Credit awarded is based on the work accomplished.

MTE592 Special Problems

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

Hours 1-3

Credit awarded is based on the amount of work undertaken.

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