MATERIALS SCIENCE & ENGR (MSE)

MSE 101 Introduction to Metallurgy and Materials Science
MSE 101 Introduction to Metallurgy and Materials Science (2 cr)
Earth resources, metallurgy, materials science, and manufacturing. (Fall only)

MSE 201 Elements of Materials Science
MSE 201 Elements of Materials Science (3 cr)
Principles relating properties of metals, ceramics, polymers, and composites to their structures.
Prereq: Chem 111.

MSE 204 (s) Special Topics

MSE 299 (s) Directed Study
MSE 299 (s) Directed Study (cr arr).

MSE 308 Thermodynamics of Materials
MSE 308 Thermodynamics of Materials (3 cr)
Prereq: MSE 201 and Chem 112
Coreq: Math 310.

MSE 313 Physical Metallurgy
MSE 313 Physical Metallurgy (3 cr)
Theory, structure, and properties of materials. (Fall only)
Prereq: MSE 201.

MSE 313L Physical Metallurgy Laboratory
1 credit
Metallographic principles and practices, hardness testing, structure-property correlations. One 2-hr lab per week.
Prereq or Coreq: MSE 313.

MSE 340 Transport and Rate Processes I
MSE 340 Transport and Rate Processes I (4 cr)
See ChE 340.

MSE 341 Particulate Materials Processing
MSE 341 Particulate Materials Processing (4 cr)
Engineering science of particulates; powder production, powder properties, separation; design of systems applied to metals, ores, and concentrates.
Three lec and one hr of lab a wk; two 1-day field trips. Recommended Preparation: CS 211, Phys 212, and Engr 240.
Prereq: Chem 112
Coreq: Math 310.

MSE 393 Materials Engineering Projects
MSE 393 Materials Engineering Projects (1-3 cr, max 9)
Problems of a research exploratory nature.
Prereq: Permission.

MSE 400 (s) Seminar
MSE 400 (s) Seminar (cr arr).

MSE 404 (s) Special Topics
MSE 404 (s) Special Topics (cr arr).

MSE 404 Mechanical Behavior of Materials
MSE 404 Mechanical Behavior of Materials (3 cr)
Theories of elasticity and plasticity, dislocation based plastic deformation, strengthening mechanisms, mechanical properties of solids and relevant testing methods, failure processes and theories, fracture mechanics. Coordinated lecture-lab periods.
Prereq: MSE 201 and Junior Standing; or Permission.

MSE 413 Phase Transformation and Kinetics
MSE J413/J513 Phase Transformation and Kinetics (3 cr)
Free energy minimization algorithms. Construction of phase diagrams for liquid and solid systems. Reaction kinetics in liquid and solid systems. Determination of reaction kinetics parameters (reaction order, activation energy, reaction rate constants, etc.). Coordinated lec-lab periods. Additional projects/assignments reqd for grad cr.
Prereq: Chem 112.

MSE 415 Materials Selection and Design
MSE 415 Materials Selection and Design (3 cr)
Selection of materials for use in structural applications; consideration of environment, stress conditions, cost, and performance as guide to properties; optimization of choice of materials and fabrication methods; open-ended problems of real applications in various industries. Recommended Preparation: MSE 313 and MSE 456. (Spring only)
Prereq: MSE 201 and Engr 350.

MSE 417 Instrumental Analysis
MSE 417 Instrumental Analysis (3 cr)
Principles and laboratory experiments in x-ray diffraction, scanning electron microscopy, transmission electron microscopy, thermal analysis, etc. (Fall only)
Prereq: Junior/Senior standing in an engineering discipline.

MSE 421 Light Metals
MSE J421/J521 Light Metals (3 cr)
Principles behind the physical and extractive metallurgy of the light metals Al, Mg, Ti, Be; discussion of characteristics and applications of alloys based on these metals. Additional projects/assignments reqd for grad cr.
Recommended Preparation: MSE 313.

MSE 423 Corrosion
MSE J423/J523 Environmental Degradation of Materials (3 cr)
Engineering aspects of corrosion and its control presented in ways of importance to a practicing engineer. Topics include corrosion economics, detecting and monitoring corrosion, regulations, specifications, safety. Emphasis on corrosion monitoring and corrosion fundamentals: chemical and electrochemical reactions; chemical and electrochemical equilibria— including Pourbaix diagrams; electrochemical kinetics. Selection and use of materials, from stainless steels to plastics. Failure analysis. Additional projects/assignments reqd for graduate credit. (Fall only)
Prereq: Chem 112 and MSE 201 or ChE 223; or Permission.

MSE 427 Ceramics Materials
MSE J427/J527 Ceramics Materials (3 cr)
Crystallography, ceramic crystal structures, phase diagrams, phase transformation; mechanical properties, thermal properties, electrical and magnetic properties. Additional projects/assignments reqd for graduate credit. Recommended Preparation: MSE 313.

MSE 432 Fundamentals of Thin Film Fabrication
MSE 432 Fundamentals of Thin Film Fabrication (3 cr)
Physical deposition, chemical deposition, post deposition process, film characterization, and film properties. (Spring only)
Prereq: Senior standing or Permission.
MSE 434 Fundamentals of Polymeric Materials
MSE 434 Fundamentals of Polymeric Materials (3 cr)
Polymer structure/property relationships and engineering applications. 
Topics include: overview of polymer chemistry and physics as they inform 
structure and properties for real-world applications, including sustainability 
considerations. Coordinated lecture-lab periods.
Prereq: Chem 111 and Chem 112.

MSE 437 Radiation Effects on Materials
MSE J437/J537 Radiation Effects on Materials (3 cr)
Same as NE J437/J537. Interactions between radiation and solids.
Prereq: MSE 201 or Permission.

MSE 438 Fundamentals of Nuclear Materials
MSE J438/J538 Fundamentals of Nuclear Materials (3 cr)
Same as NE J438/J538. This course is designed for students who wish to 
learn about nuclear materials and fuels from a materials science viewpoint. 
Topics to be covered include crystal structure, diffusion, radiation damage 
processes etc. Students who wish to receive credit for the 500 level course 
are required to do term-projects and advanced problems. (Spring only)
Prereq: MSE 201 or NE 450; or Permission.

MSE 453 Process Analysis & Design I
MSE 453 Process Analysis and Design I (3 cr)
See ChE 453.

MSE 454 Process Analysis & Design II
MSE 454 Process Analysis and Design II (3 cr)
See ChE 454.

MSE 456 Metallic Materials
MSE 456 Metallic Materials (3 cr)
Processes for extracting metals; various classes of metallic alloys; 
casting, powder metallurgy, mechanical working, and joining of metals. 
Emphasis on understanding relationship of processing, structure and 
properties. Some lab demonstration of metal fabrication processes 
included.
Prereq: MSE 313 or Permission.

MSE 464 Materials Physics and Engineering
3 credits
Joint-listed with MSE 564, Cross-listed with PHYS 464 
Materials for circuits, Magnetism and magnetic materials, Ferroelectric 
and piezoelectric materials, Semiconductors, Optical properties of 
semiconductor for optoelectronics, thermal properties, electron band 
theory, superconductivity. Additional projects/assignments required for 
graduate credit. (Spring only)
Prereq: Senior standing in an Engineering or Physics major, or PHYS 305 
and PHYS 321; or Permission.

MSE 498 (s) Internship
MSE 498 (s) Internship (cr arr).
MSE 499 (s) Directed Study
MSE 499 (s) Directed Study (cr arr).
MSE 500 Master's Research and Thesis
MSE 500 Master's Research and Thesis (cr arr).
MSE 501 (s) Seminar
MSE 501 (s) Seminar (cr arr).
MSE 502 (s) Directed Study
MSE 502 (s) Directed Study (cr arr).
MSE 504 (s) Special Topics
MSE 504 (s) Special Topics (cr arr).

MSE 507 Microstructures and Defects
MSE 507 Microstructures and Defects (3 cr)
This course correlates microstructure and defects with mechanical, 
physical and chemical properties of engineering materials. The 
fundamental characteristics of point, line, surface and volume defects 
in crystals will be elucidated on an advanced level. The essential 
elements of microstructure and their role in engineering materials will be 
discussed.
Prereq: Graduate standing or Permission.

MSE 511 Nuclear Degradation Mechanisms
MSE 511 Nuclear Degradation Mechanisms (3 cr)
Same as NE 511. Topics include various degradation mechanisms as 
applicable to nuclear structural components, including corrosion, creep, 
radiation damage etc.
Prereq: Graduate standing or Permission.

MSE 512 Nuclear Components Inspection
MSE 512 Nuclear Components Inspection (3 cr)
Same as NE 512. This course will cover various non-destructive 
testing techniques to evaluate the environmental degradation of the 
nuclear structural components. Remnant life estimation of structural 
components exposed to fatigue, creep and stress corrosion cracking 
service conditions will be discussed.
Prereq: Graduate standing or Permission.

MSE 513 Phase Transformation and Kinetics
MSE 513 Phase Transformation and Kinetics (3 cr)
See MSE J413/J513.

MSE 517 Reaction Kinetics
MSE 517 Reaction Kinetics (3 cr)
Application of absolute reaction rate theory; time and temperature 
dependence; kinetics of gas-solid reactions; kinetics of solid-solid 
reactions; corrosion, diffusion, and recrystallization. (Alt/yr)
Prereq: Materials Science Engineering graduate student or Permission.

MSE 521 Light Metals
MSE 521 Light Metals (3 cr)
See MSE J421/J521.

MSE 523 Corrosion
MSE 523 Corrosion (3 cr)
See MSE J423/J523.

MSE 525 Electronic Materials
MSE 525 Electronic Materials (3 cr)
Study of major chemical and physical principles affecting properties 
of solid state engineering materials. Topics include bonding, carrier 
statistics, band-gap engineering, optical and transport properties, novel 
materials systems, characterization, magnetism, and comprehensive 
introduction to physics of solid state devices.
Prereq: Materials Science Engineering graduate student or Permission.

MSE 527 Ceramic Materials
MSE 527 Ceramics Materials (3 cr)
See MSE J427/J527.

MSE 537 Radiation Effects on Materials
MSE 537 Radiation Effects on Materials (3 cr)
See MSE J437/J537.

MSE 538 Fundamentals of Nuclear Materials
MSE 538 Fundamentals of Nuclear Materials (3 cr)
See MSE J438/J538.
MSE 564 Materials Physics and Engineering
3 credits
Joint-listed with MSE 464, Cross-listed with PHYS 564
Materials for circuits, Magnetism and magnetic materials, Ferroelectric
and piezoelectric materials, Semiconductors, Optical properties of
semiconductor for optoelectronics, thermal properties, electron band
theory, superconductivity. Additional projects/assignments required for
graduate credit. (Spring only)
Prereq: Senior standing in an Engineering or Physics major, or PHYS 305
and PHYS 321; or Permission.

MSE 585 Nuclear Fuel Cycles
MSE 585 Nuclear Fuel Cycles (3 cr)
Same as NE 585. Processes to support the existing LWR fuel cycle.
Alternative fuel cycles including U-233, Pu239 and mixed oxide fuels, and
advanced reactor concepts. Recycling and recovery of nuclear materials,
with emphasis on traditional fast reactor recycle.
Prereq: Permission.

MSE 598 (s) Internship
MSE 598 (s) Internship (cr arr).

MSE 599 (s) Research
MSE 599 (s) Non-thesis Master's Research (cr arr).

MSE 600 Doctoral Research & Dissertation
MSE 600 Doctoral Research and Dissertation (cr arr).