

## Marketing and Supply Chain Management—MSC

**412 Marketing Technology and E-Commerce**  
Fall, Spring. 3(3-0) Interdepartmental with Information Technology Management. P:M: (MSC 300 and MSC 317 and ITM 309) R: Open only to juniors or seniors in the Eli Broad College of Business, and to students in programs in which MSC 412 is a catalog-listed requirement.

Enabler technologies and their role in creating marketing opportunities, efficiencies, and innovations. Tools, applications, platforms, and infrastructures. Determination of business configurations that foster value creation from enabler technologies.

**413 Sales Management**  
Fall, Spring. 3(3-0) P:M: (MSC 300 and MSC 317) R: Open only to juniors or seniors in The Eli Broad College of Business. SA: ML 413, MTA 413

Planning, implementing, and controlling the firm's personal selling function. Analysis of sales territories. Management of recruitment, selection, training, and motivation of sales personnel. Evaluation of sales performance. Discussion of diversity and ethical issues.

**415 International Marketing Management**  
Fall, Spring. 3(3-0) P:M: (MSC 300) and (MSC 310 or EC 340) R: Open only to juniors or seniors in The Eli Broad College of Business. SA: ML 415, MTA 415

Marketing decisions, strategies, and operations of the firm involved in international business. Researching global market opportunities and formulating market entry strategies. Developing and implementing the international marketing program.

**420 New Product Design and Development**  
Spring. 3(3-0) P:M: (MSC 300 and MSC 317) R: Open only to seniors in The Eli Broad College of Business.

Practical training and experiences in design and testing of new products.

**439 Food Business Analysis and Strategic Planning(W)**  
Fall. 3(3-0) Interdepartmental with Food Industry Management. Administered by Department of Agricultural Economics. P:M: (FIM 220) R: Open only to juniors or seniors SA: ML 439, MTA 439, MSC 439

Principles and techniques of business analysis and strategic planning applied to food firms. Food trend forecasts, market potential, competition and cost analyses, business and strategic planning.

**442 Logistics and Transportation Management**  
Fall, Spring, Summer. 3(3-0) P:M: (MSC 305 and MSC 317) R: Open only to juniors or seniors in The Eli Broad College of Business. SA: ML 442, MTA 442

Microanalysis of logistics and transportation services. Customer service, distribution operations, purchasing, order processing, facility design and operations, carrier selection, transportation costing and negotiation.

**460 Marketing Strategy (W)**  
Fall, Spring, Summer. 3(3-0) P:M: (MSC 302 and MSC 317 and MSC 319) and completion of Tier I writing requirement. R: Open only to seniors in the Marketing major. SA: ML 460, MTA 460

Identification and analysis of managerial marketing issues. Integration of marketing concepts and theories through case analysis. Ethical and international applications.

**470 Supply Chain Application and Policy (W)**  
Fall, Spring. 2(2-0) P:M: (MSC 401 or concurrently and MSC 402 or concurrently and MSC 442 or concurrently) and completion of Tier I writing requirement. R: Open only to seniors in the Supply Chain Management major. SA: ML 470, MTA 470

Analysis and problem solving of supply chain management cases. Purchasing, manufacturing, logistics, and transportation as an integrated supply chain.

**472 Topics in Operations Management**  
Spring of odd years. 3(3-0) P:M: (MSC 402) R: Open only to juniors or seniors in the Supply Chain Management major. SA: ML 404, MSC 404, MTA 404, MGT 404

Managerial aspects of current issues such as total quality, computer integrated manufacturing and simultaneous engineering.

**473 Topics in Logistics and Transportation Management**  
Spring. 3(3-0) P:M: (MSC 442) R: Open only to juniors or seniors in the Supply Chain Management major.

Current topics in logistics and transportation planning, information technology, response based strategies, third party logistics and relationship management.

**490 Independent Study**  
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to juniors or seniors. Approval of department. SA: ML 490, MTA 490

Supervised program of independent library or field research designed to supplement classroom study.

**490H Honors Independent Study**  
Fall, Spring. 1 to 3 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to juniors or seniors in the Honors College. Approval of department. SA: ML 490H, MTA 490H

Supervised program of independent library or field research designed to supplement classroom study.

**491 Topics in Marketing and Supply Chain Management**  
Fall, Spring. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. P:M: (MSC 300 or MSC 303) and (MSC 317) R: Open only to juniors or seniors in The Eli Broad College of Business. SA: ML 491, MTA 491

Current issues in specialized marketing, logistics knowledge of marketing, and environmental analysis. Strategy development for control.

## MATERIALS SCIENCE AND ENGINEERING MSE

### Department of Chemical Engineering and Materials Science College of Engineering

**101 Materials and Society**  
Fall. 2(2-0) RB: High school physics, chemistry, mathematics.

Material capabilities, limitations, and their utilization in the service and advancement of society.

**250 Materials Science and Engineering**  
Fall, Spring, Summer. 3(2-2) P:M: (CEM 141 or CEM 151 or LBS 171) SA: MSM 250  
Structure of metals, ceramics and polymers. Phase diagrams, thermomechanical treatments, physical and mechanical properties, diffusion, microstructure studies, environmental effects.

**310 Energy and Bonding within Solids**  
Fall. 3(3-0) P:M: (MSE 250 or concurrently) and (MTH 234 or MTH 254H or LBS 220) R: Open only to juniors or seniors in the College of Engineering. Not open to students with credit in MSE 351.

Enthalpy, entropy, free energy, phase changes in metal, ceramic and polymer materials systems. Application to alloying, phase diagram determination, electrochemistry.

**320 Mechanical Properties of Materials**  
Fall. 3(3-0) P:M: (ME 222 or concurrently) and (MSE 250) R: Open only to juniors or seniors in the Materials Science and Engineering major. Not open to students with credit in MSE 355.

Mechanical behavior of metals, ceramics and polymers. Three-dimensional stress-states. Stress, strain and compliance tensors. Test methods. Elastic, viscoelastic, and plastic deformation. Fracture, fatigue and creep.

**324 Biomaterials and Biocompatibility**  
Spring. 3(3-0) Interdepartmental with Biomedical Engineering. P:M: (PSL 250 or concurrently) and (MSE 250) R: Open only to students in the College of Engineering. SA: MSM 424

Materials science of human implants. Design requirements imposed by the human body. Need for bodily protection.

**331 Materials Characterization Methods I**  
Fall. 1(0-2) P:M: (MSE 310 or concurrently and MSE 320 or concurrently) R: Open only to juniors or seniors in the Materials Science and Engineering major. Not open to students with credit in MSE 375.

Thermal analysis. Optical and Scanning Electron Microscopy Laboratory for characterizing microstructure-property relationships. Effects of processing on microstructures, properties, and fracture surfaces in metal, ceramic and polymer systems.

- 350 Electronic Structure and Properties of Materials**  
Spring. 3(3-0) P:M: (PHY 184 or concurrently) and (CEM 141 or CEM 151 or LBS 171) Not open to students with credit in MSE 455.  
Fundamentals of electrical, thermal, magnetic and optical properties of metals, dielectrics, semiconductors and polymers. Crystal structure, reciprocal space, quantum mechanics, electron band structure, and phonons. Materials applications in electronics and optoelectronics.
- 360 Fundamentals of Microstructural Design**  
Spring. 3(3-0) P:M: (MSE 310 and MSE 350 or concurrently) R: Open only to juniors or seniors in the College of Engineering. Not open to students with credit in MSE 352.  
Fick's laws of diffusion. Models of solid state diffusion. Arrhenius plots. Use of non-equilibrium energy storage from solidification, phase changes, and deformation to predict and control microstructural changes and stability during processing in metal, ceramic and polymer systems.
- 370 Physical Processing of Materials**  
Spring. 3(3-0) P:M: (MSE 310 and MSE 350 or concurrently) R: Open only to juniors or seniors in the Materials Science and Engineering major. Not open to students with credit in MSE 365 or MSE 380.  
Physical processing of powders. Mixing; casting. Surface modification of ceramic, polymeric and metallic materials in order to engineer the microstructure, properties and form of components.
- 381 Materials Characterization Methods II**  
Spring. 2(1-2) P:M: (MSE 360 or concurrently) and (MSE 370 or concurrently) R: Open only to juniors or seniors in the Materials Science and Engineering major. Not open to students with credit in MSE 376.  
X-ray and infrared spectroscopic analysis laboratory for characterizing microstructure-property relationships. Effects of processing on microstructures, properties, and fracture surfaces in metal, ceramic and polymer systems.
- 401 Quantitative Human Biology**  
Spring. 3(4-0) Interdepartmental with Biomedical Engineering; Radiology; Human Anatomy. Administered by College of Engineering. P:M: (MTH 235 and PHY 184) and (PSL 250 or concurrently or PSL 431 or concurrently) and (CEM 141 or CEM 151) and (ANTR 350 or concurrently) RB: (CSE 131 or concurrently or CSE 231 or concurrently or PSL 410)  
Qualitative description and quantitative engineering analysis of selected, tractable human-biological systems. Multi-disciplinary problem-solving among medical and engineering professionals.
- 426 Introduction to Composite Materials**  
Spring. 3(3-0) Interdepartmental with Mechanical Engineering. P:M: (ME 222) R: Open only to students in the Department of Chemical Engineering and Materials Science. SA: MSM 444  
Constituents and interfacial bonding. Manufacturing techniques. Microstructure and micromechanics. Theory of anisotropy. Classical laminate theory. Material characterization. Failure and damage. Composite structure design.
- 451 Microscopic and Diffraction Analysis of Materials**  
Spring. 3(2-3) P:M: (MSE 350 and MSE 381) and (PHY 184 or concurrently or PHY 184B or concurrently) R: Open only to seniors or graduate students in the Materials Science and Engineering major. SA: MSM 451  
General properties, generation and detection of x-rays. Interaction with solids. Crystallography, reciprocal lattice, diffraction analysis and techniques. Single crystal methods, stereographic projection. X-ray microanalysis.
- 454 Ceramic and Refractory Materials**  
Fall. 3(3-0) P:M: (MSE 310 or concurrently and MSE 320) RB: (MSE 381) R: Open only to juniors or seniors in the College of Engineering. SA: MSM 454  
Ceramic and glassy materials. High temperature processes. Mechanical and physical properties of technical ceramics.
- 465 Design and Application of Engineering Materials (W)**  
Spring. 3(3-0) P:M: (MSE 331 and MSE 381) and completion of Tier I writing requirement. R: Open only to students in the Engineering Mechanics or Materials Science and Engineering major. SA: MSM 465  
Fundamental principles of strengthening: toughening, specific strength and stiffness. Material development based on environmental, temperature, wear, damping, fatigue and economic considerations.
- 466 Fracture and Failure Analysis**  
Fall. 3(2-3) P:M: (MSE 331) RB: (MSE 381) R: Open only to juniors or seniors College of Engineering. SA: MSM 466  
Modes and causes of failure in mechanical components. Non-destructive evaluation. Legal and economic aspects of materials failure. Analysis illustrated in student projects requiring integration of prior course work.
- 476 Physical Metallurgy of Ferrous and Aluminum Alloys**  
Fall of even years. 3(3-0) P:M: (MSE 250) RB: (MSE 310) and (MSE 360) and (MSE 370) R: Open only to seniors in the College of Engineering. SA: MSM 476  
Heat treatment and properties of ferrous and aluminum alloys. Casting and solidification. Effects of alloying elements, high strength low alloy steels, hardenability, case hardening. Joining of materials, welding.
- 477 Manufacturing Processes**  
Fall. 3(3-0) Interdepartmental with Mechanical Engineering. Administered by Department of Mechanical Engineering. P:M: (ME 222 and MSE 250) and completion of Tier I writing requirement. R: Open only to students in the Engineering Arts, Engineering Mechanics, Manufacturing Engineering and Materials Science and Engineering majors. SA: MSM 481  
Fundamentals of manufacturing processes such as casting, heat treating, particulate processing, forming, machining, joining and surface processing. Selection of manufacturing processes based on design and materials.
- 490 Independent Study**  
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to juniors or seniors in the College of Engineering. Approval of department. SA: MSM 490  
Individualized reading and research.
- 491 Selected Topics**  
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to students in the Department of Chemical Engineering and Materials Science. SA: MSM 491  
Topics of current interest in materials science or engineering.
- 499 Senior Research and Design Project (W)**  
Fall, Spring, Summer. 2 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. P:M: Completion of Tier I writing requirement. R: Open only to seniors in the Materials Science and Engineering or Engineering Arts major. Approval of department. SA: MSM 499  
Design and analysis to solve materials and/or mechanics related problem. Preparation of written report, oral presentation, and defense of the project.

## MATHEMATICS MTH

### Department of Mathematics College of Natural Science

- 1005 Fundamentals of Algebra**  
Summer. 1(1-0)  
Factoring. Rational and exponential expressions. Linear and quadratic relations. Fractions and distributive laws. Functions
- 100E Intermediate Algebra Workshop for the Mathematics Enrichment Program**  
Fall, Spring. 1(0-4) R: Approval of department. C: MTH 1825 concurrently.  
Enrichment topics in intermediate algebra for students in the Mathematics Enrichment Program.
- 103 College Algebra**  
Fall, Spring, Summer. 3(3-0) P:M: (MTH 1825) or designated score on Mathematics placement test. Not open to students with credit in LBS 117 or MTH 116.  
Number systems; functions and relations; exponents and logarithms; elementary theory of equations; inequalities; and systems of equations.
- 103E College Algebra Workshop for the Mathematics Enrichment Program**  
Fall, Spring. 1(0-4) R: Approval of department. C: MTH 103 concurrently.  
Enrichment topics in college algebra for students in the Mathematics Enrichment Program.
- 106 The Significance of Mathematics**  
Fall, Spring, Summer. 3(3-0) P:M: (MTH 103) or designated score on Mathematics placement test.  
Numbers and numeracy, geometry, growth patterns, and statistics. Selected applications to the arts, sciences, and social sciences.