941.   International Business Research Issues
Spring of odd years. 3(3-0) P: MSC 940. R: Open only to Ph.D. students.
Scientific methods of research on international business. Topics include cultural bias and organizing multi-country studies.
SA: ML 941, MTA 941

990.   Independent Study
Fall, Spring. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to Ph.D. students.
Intensive reading and research on a marketing topic of mutual interest to a faculty member and a Ph.D. student.
SA: ML 924, MTA 924

995.   Directed Research Paper
Fall, Spring, Summer. 1(1-0) R: Open only to Ph.D. students in the Department of Marketing and Supply Chain Management.
Production of research paper under the direction of a senior faculty member.
SA: ML 995, MTA 995

999.   Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 99 credits in all enrollments for this course. R: Open only to Ph.D. students in the Department of Marketing and Supply Chain Management. Approval of department.
SA: ML 999, MTA 999

MASTER OF BUSINESS ADMINISTRATION   MBA

The Eli Broad College of Business and The Eli Broad Graduate School of Management

800.   The Global Organization and the Firm's Strategic Position
Fall, Spring. 3(3-0) R: Open only to MBA students.
Organizational goals, design, and control of the global business enterprise. Strategies for implementing new organizational forms. Defining the value chain, competitive positioning, and sustainable competitive advantage.

802.   Accounting and Financial Strategies
Fall, Spring. 5(5-0) R: Open only to MBA students.
Financial accounting model, valuation, and reporting concepts and uses. Time value of money, interest rates, valuing securities, financial statement analysis, and cash flows. Budgeting, decision analyses, cost estimation and accumulation, capital budgeting, and international financial concepts.

804.   Applied Data Analysis for Managers
Fall, Spring. 2(2-0) P: STT 315. R: Open only to MBA students. Not open to students with credit in MSC 833.
Analysis of business and economic data to support managerial decision-making. Building, interpreting, and applying regression models. Time series and forecasting. Offered half of semester.

806.   Business Ethics and Critical Thinking Concepts
Fall, Spring. 1(1-0) R: Open only to MBA students.
Creating a critical thinking approach to business problem solving. Developing a framework for identifying, analyzing, and resolving ethical dilemmas in business. Offered half of semester.

814.   Applied Economics
Fall, Spring. 2(2-0) R: Open only to MBA students.
The economic view of the firm. Modeling market mechanics in supply and demand, marginal concepts, elasticity, market characteristics, pricing with market power, and strategic behavior. Applications to business problems and situations. Principal-agent relationships and wealth maximization. Offered half of semester.

816.   Business Presentations
Fall, Spring. 1(1-1) R: Open only to MBA students.
Development of effective interpersonal communications skills. Emphasis is on oral communications in business settings.

820.   Managing the Firm's Value Chain
Spring, Summer. 5(5-0) P: MBA 800. R: Open only to MBA students.
Integration of product innovations, marketing strategies, supply chain strategies, and regulatory environment. Global marketing strategies and consumer behaviors. Coordination of purchasing, manufacturing, operations, and logistics to enhance competitiveness.

822.   Financial Management
Spring, Summer. 2(2-0) P: MBA 802. R: Open only to MBA students.
Investment decisions by firms. Value creation, risk and return, pricing models, and financial markets. Financing alternatives, market efficiency, capital budgeting, and leverage and risk relationships. Optimizing firm value. Agency problems and effects on investment and financing decisions. Offered half of semester.

824.   Managing the Workforce
Spring, Summer. 3(3-0) R: Open only to MBA students.
Role of workforce management in carrying out the goals and mission of the organization. Theories and applications of management principles to acquiring, motivating, and rewarding employees and structuring their work. Legal, domestic, and internationalissues in the workplace.

826.   International, Comparative, and Cross-Cultural Business
Spring, Summer. 2(2-0) R: Open only to MBA students.
Defining international businesses' approaches to global markets, economic trade issues, methods of entry, and organizational alternatives. Cross-cultural differences and their impacts on business practices. Trade agreements, strategic alliances, negotiations, and cultural consequences. Offered half of semester.

840.   Applied Business Experience
Fall, Summer. 3(0-9) R: Open only to MBA students.
Student teams work on projects in organizations identified by a company sponsor and approved by a faculty adviser.

850.   Integrative Case Experience and Future Global Strategies
Fall, Spring. 2(2-0) R: Open only to MBA students.
Future trends in management. Strategic positioning of organizations for success. An integrative case experience focusing on a specific corporate situation. Use of library and computer network sources. Case presentation to faculty and business managers.

893.   MBA Internship Experience
Fall, Spring, Summer. 1 credit. A student may earn a maximum of 2 credits in all enrollments for this course. P: Completion of at least one semester in the MBA program. R: Open to to MBA students except students in the Advanced Management Program or Program in Integrative Management.
Internship in business organizations; application of business knowledge and management techniques in a work environment.

MATERIALS SCIENCE AND MECHANICS   MSM

Department of Materials Science and Mechanics College of Engineering

160.   Engineering Communications
Fall, Spring. 3(2-3) P: (MTH 116 or concurrently) or (LBS 117 or concurrently) or (MTH 132) or (MTH 103 and MTH 104)
Computer-aided design and drafting. Freehand sketching. Two and three dimensional visualization. Preparation of spread sheets and technical reports.

205.   Statics
Fall, Spring. 3(3-0) P: (MTH 132 or LBS 118)
Vector description of forces and moments. Two and three dimensional equilibrium of particles and rigid bodies. Analysis of trusses, frames and machines. Coulomb friction.

211.   Mechanics of Deformable Solids
Fall, Spring. 3(3-2) P: (MSM 205) and (MTH 133 or concurrently or LBS 119 or concurrently)
Tension compression and shear stresses. Axially loaded bars. Torsion of circular shafts. Beam theory. Combined stresses. Mohr's circles. Columns.

250.   Materials Science and Engineering
Fall, Spring. 3(3-2) P: (CEM 141 or CEM 151 or LBS 165)
Structure of metals, ceramics and polymers. Phase diagrams, thermomechanical treatments, physical and mechanical properties, diffusion, microstructure studies, environmental effects.

306.   Dynamics
Fall, Spring. 3(3-0) P: (MSM 205) and (MTH 235 or LBS 220) R: Open only to students in the College of Engineering.
Kinematics of particles, rigid bodies, and mass moments of inertia. Kinetics of particles and rigid bodies. Energy and momentum principles.

**351.	Thermochemistry of Materials**
Fall. 3(3-0) P: (CEM 151 or CEM 141 or LBS 165) and (MTH 234 or LBS 220) Not open to students with credit in CHE 311 or ME 201.
State variables, laws of thermodynamics, phase and chemical equilibria.   Gas and condensed phase relationships, solutions, interfaces, point defects, electrochemistry.

**352.	Diffusion in Solids**
Spring. 3(3-0) P: (MSM 250) and (MSM 351 or ME 201) R: Open only to students in the Materials Science and Engineering major.
Diffusion and mass transport. Kinetics of diffusion-controlled processes. Point defects, nucleation and growth, interface motion.

**355.	Mechanical Behavior of Materials**
Fall. 3(3-0) P: (MSM 211 and MSM 250) R: Open only to students in the Department of Materials Science and Mechanics or Department of Mechanical Engineering.
Stress and strain, crystal elasticity, anelasticity and viscoelasticity.   Mechanical properties in tension and torsion. Crystallographic aspects of plasticity.

**356.	Deformation Mechanisms**
Spring. 3(3-0) P: (MSM 355) R: Open only to students in the Materials Science and Engineering major.
Elementary dislocation theory, slip and twinning. Deformation of single and polycrystals. Temperature and strain rate effects. Work hardening, solution and particle strengthening. Creep, fatigue and fracture in metals, ceramics and polymers.

**365.	Physical Metallurgy I**
Fall. 3(3-0) P: (MSM 250) and (MSM 351 or concurrently or ME 201 or concurrently) R: Open only to students in the Engineering Mechanics or Materials Science and Engineering major.
Complex binary and ternary phase diagrams. Solidification.   Recovery, recrystallization and grain growth. Phase transformations.

**366.	Physical Metallurgy II**
Fall of odd years. 3(3-0) P: (MSM 365) R: Open only to students in the Materials Science and Engineering major.
Theory of alloy phases. Surfaces and interfaces. Diffusion controlled phase transformations in ferrous and non-ferrous alloys.   Martensitic transformation. Amorphous structures.

**375.	Materials Science Laboratory I**
Fall. 1(0-3) P: (MSM 355 or concurrently) R: Open only to students in the Engineering Mechanics or Materials Science and Engineering major.
Phase transformations. Recrystallization. Precipitation and aging. Microscopy. Structure-property relations.

**376.	Materials Science Laboratory II**
Spring. 1(0-3) P: (MSM 355) R: Open only to students in the Materials Science and Engineering or Engineering Mechanics major.
Strengthening.   Yielding, creep, and fracture. Plasticity. Thermal activation. Damping. Marsensite and shape memory.

**380.	Polymeric Materials**
Spring. 3(3-0) P: (CEM 151 or CEM 141 or LBS 165) and (ME 201 or concurrently or MSM 351 or concurrently) R: Open only to students in the Department of Materials Science and Mechanics.
Polymers and engineering plastics. Chemical, physical and mechanical properties. Environmental effects on polymers. Manufacturing processes. Coatings.

**401.	Intermediate Mechanics of Deformable Solids**
Fall. 3(3-0) P: (MSM 211) R: Open only to students in the College of Engineering.
Stress, strain and linearly elastic behavior. Plane stress and plane strain. Torsion. Yield criteria. Elastoplastic behavior of beams, shafts and cylinders. Unsymmetrical bending. Curved beams.

**402.	Computational Mechanics**
Spring. 3(3-0) P: (MSM 401 or ME 471) R: Open only to students in the College of Engineering.
Energy methods with applications.   Finite element methods. Buckling and stability. Green's functions.

**403.	Intermediate Dynamics**
Fall of even years. 3(3-0) P: (MSM 306) R: Open only to students in the College of Engineering.
Kinematics and kinetics of particle and rigid body systems. Virtual work, Lagrangian method, and Euler equations. Basic vibrations of discrete and continuous systems. Elementary wave propagation.

**405.	Experimental Mechanics**
Fall of odd years. 3(2-3) P: (MSM 211) R: Open only to students in the College of Engineering.
Measurement of stress, strain, vibration, and motion using strain gauges, accelerometers, photoelasticity, holography, Moire patterns, laser speckle and electronic imaging.   Transducer design.

**424.	Biomaterials and Biocompatibility**
Spring of even years. 3(3-0) Interdepartmental with Biomedical Engineering. Administered by Biomedical Engineering. P: (PSL 250 and MSM 250)
Materials science of human implants. Design requirements imposed by the body's milieu and the need to protect the body.

**441.	Tissue Mechanics**
Spring of odd years. 3(3-0) Interdepartmental with Biomedical Engineering. Administered by Biomedical Engineering. P: (MSM 211)
Application of solid mechanics to understanding mechanical responses of biological tissues. Microstructure and biological function for soft and hard connective tissues and muscle.

**442.	Biodynamics**
Fall. 3(2-2) P: (MSM 306) R: Open only to students in the Engineering Mechanics major.
Fundamentals of motion analysis of human movement and its application to the study of function and dysfunction of the musculoskeletal system. Solution methods of the inverse dynamics problem.

**444.	Introduction to Composite Materials**
Spring. 3(3-0) P: (MSM 211) R: Open only to students in the Department of Materials Science and Mechanics.
Constituents and interfacial bonding. Manufacturing techniques. Microstructure and micromechanics. Theory of anisotropy. Classical laminate theory. Material characterization. Failure and damage. Composite structure design.

**445.	Biomechanical Design**
Spring. 3(3-0) Interdepartmental with Biomedical Engineering. Administered by Biomedical Engineering. R: Open only to juniors or seniors in the College of Engineering.
Biomechanical product design with application to people or animals. Synthesis, prototyping, and analysis of designs. Project management. Market research.
SA: BME 491A

**451.	X-Ray Crystallography**
Fall. 3(2-3) P: (MSM 250) and (PHY 184 or PHY 184B or concurrently) R: Open only to seniors in the Materials Science and Engineering major or to graduate students in the Materials Science major.
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: (MSM 365) R: Open only to students in the Engineering Mechanics or Materials Science and Engineering or Materials Science major.
Ceramic and glassy materials. High temperature processes. Mechanical and physical properties of technical ceramics.

**455.	Theory of Solids**
Fall. 3(3-0) P: (MSM 250) and (PHY 184 or PHY 184B) R: Open only to students in the Engineering Mechanics or Materials Science and Engineering or Materials Science major.
Atomic theory of materials. Free electron theory of metals. Electrons in a periodic field. Insulators, semiconductors. Thermal properties. Dielectric and magnetic behavior. Superconductivity.

**465.	Design and Application of Engineering Materials**
Spring. 3(3-0) P: (MSM 355 and MSM 365) R: Open only to students in the Engineering Mechanics or Materials Science and Engineering or Materials Science major.
Fundamental principles of strengthening; toughening, specific strength and stiffness. Material development based on environmental, temperature, wear, damping, fatigue and economic considerations.

**466.	Failure Analysis**
Spring. 3(2-2) P: (MSM 355) R: Open only to students in the Department of Materials Science and Mechanics.
Modes and causes of failure in mechanical components. Non-destructive evaluation. Legal and economic aspects of materials failure. Analysis illustrated through student projects requiring integration of knowledge from several courses.

476. Physical Processing of Materials
Fall of even years. 3(3-0) P: (MSM 365) R: Open only to students in the Materials Science and Engineering or Materials Science major.
Heat treatment and properties of ferrous alloys. Casting and solidification. Effects of alloying elements, high strength low alloy steels, hardenability, case hardening. Joining of materials, welding.

480. Chemical Processing of Materials
Fall of even years. 3(3-0) P: (MSM 352 or CHE 312) R: Open only to students in the Department of Materials Science and Mechanics or Department of Chemical Engineering.
Processing of metals, ceramics, and polymers. Material and energy balances. Reduction and oxidation. Extractive technology of iron, steel, and principal non-ferrous metals. Colloidal preparation of ceramics.

481. Manufacturing Systems I
Fall. 3(3-0) P: (MSM 211 and MSM 250) and completion of Tier I writing requirement. R: Open only to students in the Department of Materials Science and Mechanics.
Manufacturing process planning and design. Discrete parts and assembly processes. Producibility, cost estimation, time standards, materials handling, plant layout principles.

482. Manufacturing Systems II
Spring. 3(3-0) P: (MSM 481) and completion of Tier I writing requirement.
Operations scheduling and control. Applications of artificial intelligence. Optimization of multiple stage manufacturing activities. Manufacturing resource planning. Principles of synchronous manufacturing.

483. Environmental Effects on Materials
Fall of odd years. 3(3-0) P: (MSM 352) R: Open only to students in the Materials Science and Engineering or Materials Science major.
Electrochemical processes and kinetics. Metallic corrosion and protection. Degradation of ceramics, polymers and composites.

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: Approval of department.
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 Materials Science and Mechanics.
Topics in materials science or mechanics of current interest.

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: Completion of Tier I writing requirement. R: Open only to seniors in the Engineering Mechanics or Materials Science and Engineering or Engineering Arts major. Approval of department.
Design and analysis to solve materials and/or mechanics related problem. Preparation of written report, oral presentation, and defense of the project.

801. Advanced Dynamics
Fall. 3(3-0)
Dynamics of systems of particles and rigid bodies. Energy and momentum principles. Lagrangian and Hamiltonian methods. Euler angles. Applications in system dynamics and vibrations.

805. Experimental Mechanics
Spring. 3(2-3) R: Approval of department.
Measurement of strain, displacement, velocity, acceleration using resistance strain gages, accelerometers, and related methods. Detailed study of strain gages and accelerometers. Transducer design. Basic modal analysis.

809. Finite Element Method
Fall, Spring. 3(3-0) Interdepartmental with Civil Engineering; Mechanical Engineering; and Biosystems Engineering.
Theory and application of the finite element method to the solution of continuum type problems in heat transfer, fluid mechanics, and stress analysis.

810. Continuum Mechanics
Fall. 3(3-0)
Mathematical tools of continuum mechanics, stress principles, kinematics of deformation and motion, fundamental laws and equations. Applications in linear elasticity and classical fluids.

813. Linear Elasticity
Spring. 3(3-0) P: MSM 810.
Fundamentals of isotropic linear elasticity. Solution of plane elasticity problems. St. Venant bending and torsion. Singular solutions. Basic three-dimensional solutions.

814. Mechanics of Composite Materials (MTC)
Fall. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course.
Applications of anisotropic elasticity theory, and the inhomogeneity approach, to systems such as macroscopic laminated structures and microscopic fiber-matrix interactions.

815. Advanced Strength of Materials
Spring of odd years. 3(3-0)
General theory of torsion, nonsymmetric bending, transverse shear, thin-walled beams, beams on elastic foundations, thick-walled cylinders. Basic contact mechanics. Failure criteria for solids.

816. Fracture Mechanics and Fatigue
Spring of even years. 3(3-0) P: MSM 813.
Brittle and ductile fracture. Elastic stress fields near cracks. Elastic-plastic analysis of crack extension. Plastic instability. Cyclic crack propagation. Models of cyclic deformation and fatigue failure. Environmental effects. Case studies.

817. Plasticity
Spring of odd years. 3(3-0) P: MSM 813.
Yield conditions, stress-strain relations, plastic potential, hardening theories, torsion, bending. Thick walled shells under internal pressure. Limit analysis. Slip line theory.

820. Energy Methods in Mechanics
Spring of even years. 3(3-0) P: MSM 813.
Calculus of variations. Variational principles in mechanics. Approximate methods. Energy criteria for stability. Applications to structural dynamics.

851. Thermodynamics of Solids
Fall. 3(3-0)
Use of Jacobians. Thermodynamic functions. Thermodynamics of solid-solid phase transformation. Thermoelastic solids, rubber elasticity, and stressed solids. Surfaces and interfaces, point defects in solids. Thermodynamics of solids under high pressure.

855. Advanced Rate Theory and Diffusion
Spring. 3(3-0) P: MSM 851.
Review of Fick's Laws. Atomistic aspects of diffusion. Defects in solids. Probabilistic basis of random walk. Green's function solutions.

860. Theory of Vibrations
Fall. 3(3-0) Interdepartmental with Mechanical Engineering. Administered by Mechanical Engineering.
Discrete systems and continua. Analytical mechanics. Variational principles. Modal analysis. Function spaces. Eigenfunction expansions. Integral transforms. Stability. Approximations. Perturbations.

862. Dislocation Theory
Fall. 3(3-0)
Advanced theory of dislocations and other crystal defects in metals, ceramics, aggregates and ordered compounds. Elasticity theory of straight dislocations, dislocation strain energy, mobility, obstacle interactions, reactions, and core effects.

865. Advanced Theory of Solids
Spring. 3(3-0)
Quantum mechanics. Free electron theory. Energy bands, semiconductors. Dielectrics and ferroelectrics. Dia-, para-, ferro-, and antiferromagnetism. Superconductivity. Thermal properties.

870. Electron Microscopy in Materials Science
Spring. 3(2-3) R: Open only to graduate students in a Materials Science major or approval of department.
Theory of electron diffraction. Electromagnetic lenses. Image formation in transmission electron microscopy. Defect analysis and diffraction contrast.

871. Material Surfaces and Interfaces
Fall of odd years. 3(3-0) Interdepartmental with Chemical Engineering. P: CEM 362 or MSM 351 R: Open only to graduate students in the Department of Chemical Engineering or Department of Chemistry or Department of Materials Science and Mechanics or School of Packaging.
Physical and chemical nature of solid surfaces and their interaction with gases, liquids, and other solids. Characterization of surfaces and solid-solid interfaces. Relation of surface and interfacial structure to engineering phenomena.

875. Engineering Ceramics
Fall of odd years. 3(3-0) P: MSM 851.
Physical properties of engineering ceramics. Transport properties of ceramics, especially in ferrites and garnets. Optical ceramic materials.

876.　　Advanced Polymeric Materials
Fall of even years. 3(3-0) C: MSM 810 concurrently.
Advanced topics in polymer structure and properties. Thermoplastics, thermosets, polyblends and elastomers. Processing techniques. Deformation and mechanical properties. Thermal, optical and chemical properties. Composites.

881.　　Advanced Manufacturing Systems
Fall. 3(3-0) P: MSM 482 R: Open only to juniors or seniors in the Manufacturing Engineering major or to students in the Business Management of Manufacturing major.
Computer Integrated Manufacturing. Information systems, communication, networking, databases, flexible manufacturing systems, manufacturing simulation.

885.　　Seminar
Fall, Spring. 1(1-0)
Oral presentations of students' research or literature survey.

890.　　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: Approval of department.
Individualized reading and research of student's interest.

891.　　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: Approval of department.
Special topics in materials science or mechanics of current importance.

899.　　Master's Thesis Research
Fall, Spring, Summer. 1 to 8 credits. A student may earn a maximum of 24 credits in all enrollments for this course.

905.　　Optical Methods of Measurement
Fall of even years. 3(2-3) R: Approval of department.
Measurement of dimension, position, motion, strain, using optical methods including holography, speckle interferometry, Moire, photoelasticity, laser Doppler, electronic imaging, model analysis. Relevant optics theory.

909.　　Boundary Element Method
Spring of odd years. 3(3-0) P: MSM 813.
Theory and application of the boundary element method to the solution of continuum type problems in heat transfer, fluid mechanics and stress analysis. Computer applications.

915.　　Nonlinear Elasticity
Spring of odd years. 3(3-0) P: MSM 813.
Kinematics and kinetics of large deformations. Incompressible and compressible finite elasticity. Solution of basic problems. Nonuniqueness, stability and buckling. Singular fields near cracks and flaws.

918.　　Thermoelasticity and
**　　　　Viscoelasticity**
Spring of even years. 3(3-0) P: MSM 810, MTH 443.
Thermomechanics of solids. Theory of thermoelasticity. Boundary value problems in thermoelasticity. Linear and nonlinear viscoelasticity. Model representation. Boltzmann superposition. Correspondence principle.

964.　　Advanced Physical and
**　　　　Mechanical Properties of**
**　　　　Materials I (MTC)**
Fall of even years. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course.
Topics vary each semester. Topics such as anisotropic crystalline properties and displacive phase transformations.
SA: MSM 960

965.　　Advanced Analytical
**　　　　Techniques (MTC)**
Fall of odd years. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course.
Topics vary each semester. Topics such as environmental effects on materials and advanced techniques in electron microscopy.
SA: MSM 970

974.　　Advanced Physical and
**　　　　Mechanical Properties of**
**　　　　Materials II (MTC)**
Spring of even years. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course.
Topics vary each semester. Topics such as microcracking in brittle materials, or high temperature deformation and processing.
SA: MSM 960

975.　　Advanced Processing
**　　　　Techniques (MTC)**
Spring of odd years. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course.
Topics vary each semester. Topics such as laser and plasma processing and ceramic processing.
SA: MSM 980

990.　　Independent Study
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course.
Individualized reading and research.

991.　　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: Approval of department.
Special advanced topics in materials science and engineering, and mechanics.

999.　　Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 72 credits in all enrollments for this course.

MATHEMATICS　　　　MTH

Department of Mathematics
College of Natural Science

100E.　　Intermediate Algebra Workshop
**　　　　for the Mathematics Enrichment**
**　　　　Program**
Fall, Spring. 1(4-0) 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: (MTH 1825) or designated score on Mathematics placement test. Not open to students with credit in LBS 117 or MTH 110 or MTH 116 or MTH 120.
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(4-0) R: Approval of department. C: MTH 103 concurrently.
Enrichment topics in college algebra for students in the Mathematics Enrichment Program.

104.　　Trigonometry
Fall, Spring, Summer. 3(3-0) P: (MTH 103 or MTH 110) Not open to students with credit in MTH 116.
Radian and degree measure of angles. Definitions and graphs of trigonometric functions and their inverses. Solving trigonometric equations. Applications including identities, law of sines, law of cosines, vectors in the plane, and polar coordinates.

110.　　College Algebra and Finite
**　　　　Mathematics**
Fall, Spring, Summer. 5(5-0) P: (MTH 1825) or designated score on Mathematics placement test. Not open to students with credit in LBS 117 or MTH 103 or MTH 116 or MTH 120.
Functions and graphs. Equations and inequalities. Systems of equations. Matrices. Linear programming. Simplex algorithm. Probability and statistics.

116.　　College Algebra and Trigonometry
Fall, Spring, Summer. 5(5-0) P: (MTH 1825) or designated score on Mathematics placement test. Not open to students with credit in LBS 117 or MTH 103 or MTH 110 or MTH 120.
Functions and graphs. Equations and inequalities. Exponential and logarithmic functions. Trigonometric functions. Systems of equations. Binomial theorem.

116E.　　Precalculus Workshop for the
**　　　　Emerging Scholars Program**
Fall. 1(4-0) R: Approval of department. C: MTH 116 concurrently.
Enrichment topics in precalculus for students in the Emerging Scholars Program.

124.　　Survey of Calculus with
**　　　　Applications I**
Fall, Spring, Summer. 3(3-0) P: (MTH 103 or MTH 110 or MTH 116 or LBS 117) or designated score on Mathematics placement test. Not open to students with credit in LBS 118 or MTH 120 or MTH 132 or MTH 152H.
Study of limits, continuous functions, derivatives, integrals and their applications.

126.　　Survey of Calculus with
**　　　　Applications II**
Fall, Spring, Summer. 3(3-0) P: (MTH 120 or MTH 124) Not open to students with credit in MTH 133 or MTH 153H.
Application of partial derivatives, integrals, optimization of functions of several variables and infinite series.