350 Electronic Structure and Properties of Materials
Spring. 3(3-0) P:M (PHY 184 or concurrently) and (CEN 141 or CEN 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. Arhenius 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 Biological Engineering. Radiological 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 (CEN 141 or CEN 151) and (ANTR 350 or concurrently) R: Open only to juniors or seniors in the College of Engineering. Not open to students with credit in MSE 310 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

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

454 Ceramic and Refractory Materials
Fall. 3(3-0) P:M (MSE 310 or concurrently and MSE 320) 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) R: Open only to juniors or seniors in the College of Engineering. SA: MSM 466

476 Physical Metallurgy of Ferrous and Aluminum Alloys
Fall of even years. 3(3-0) P:M (MSE 250) R: Open only to seniors in the College of Engineering. SA: MSM 476

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 College of Engineering, 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 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

Department of Mathematics
College of Natural Science

1005 Fundamentals of Algebra
Summer. 1(1-0)

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.
The Significance of Mathematics
Workshop for the Mathematics
Enrichment Program
Spring, (0-0-4) R: Approval of department
C: MTH 108 concurrently.

The Significance of Mathematics—MTH

Finite Mathematics and Elements of
College Algebra
Fall, Spring, Summer, (5-0) P:M: (MTH 1825) or
designated score on Mathematics placement test.
Functions and graphs. Equations and inequalities.
Systems of equations. Matrices. Linear program-
ing. Simplex algorithm. Probability and statistics.

Trigonometry
Fall, Spring, Summer, (3-0) P:M: (MTH 103)
SA: MTH 104 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. Applica-
tions including identities, indirect measurement
and trigonometric modeling.

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

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

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

Survey of Calculus with Applications I
Mathematics Enrichment Workshop
Fall, (0-0-4) R: Approval of mathematics de-
partment C: MTH 124 concurrently.
Enrichment topics in Survey of Calculus with Appli-
cations for students in the Mathematics Enrichment Program.

Survey of Calculus II
Fall, Spring, Summer, (3-0) P:M: (MTH 124)
Not open to students with credit in
MTH 133 or MTH 153H.
Application of partial derivatives, integrals, optimiza-
tion of functions of several variables and differential
equations.

Calculus I
Fall, Spring, Summer, (3-0) P:M: (MTH 103
and MTH 114) or (MTH 116 or LBS 117)
designated score on Mathematics place-
ment test. Not open to students with credit in
LBS 116 or MTH 152H.
Limits, continuous functions, derivatives and their
applications. Integrals and the fundamental theorem
of calculus.

Calculus I Workshop for the Emerging
Scholars Program
Fall, Spring, (2-0-6) R: Approval of depart-
ment. C: MTH 132 concurrently.
Enrichment topics in Calculus I for students in the
Emerging Scholars Program.

Calculus II
Fall, Spring, Summer, (4-0-4) P:M: (MTH 132
or MTH 152H) Not open to students with
credit in LBS 118 or LBS 119 or MTH 153H.
Applications of the integral and methods of integra-
tion. Improper integrals. Polar coordinates and
parametric curves. Sequences and series. Power
series.

Calculus II Workshop for the Emerging
Scholars Program
Fall, Spring, (1-0-4) R: Approval of depart-
ment. C: MTH 133 concurrently.
Enrichment topics in Calculus II for students in the
Emerging Scholars Program.

Honors Calculus I
Fall, Spring, (3-0) R: Honors College student or
approval of department. Not open to stu-
dents with credit in LBS 118 or MTH 132.
Limits, continuous functions, derivatives, integrals,
total fundamental theorem of calculus. Special emphasis
on concepts and theory.

Honors Calculus II
Fall, Spring, (3-0) P:M: (MTH 152H) Not
open to students with credit in LBS 119 or
MTH 133.
The integral. Improper integrals. Polar coordinates
and parametric curves. Sequences and series. Power
and Taylor series. Special emphasis on concepts and theory.

Intermediate Algebra
Fall, Spring, Summer, (3-0)
Properties of real numbers. Factoring. Roots and
radicals. First and second degree equations. Linear

Mathematical Investigations I
Fall, Spring, Summer, (3-0) P:M: (MTH 103
or MTH 110 or MTH 116 or LBS 117 or
MTH 124 or MTH 132 or MTH 152H or LBS
118) or designated score on Mathematics place-
ment test. R: Open only to students in the
Education major or Special Education
major whose area of emphasis is educational
improvement or deaf education or learning
disabilities or visual impairment or General
Science-Interdepartmental major or Child
Development major or Teacher Certification
Internship-Year Studies program.
Mathematics for prospective elementary teachers.
Numbers, problem solving, geometry, functions,
statistics and probability.

Mathematical Investigations II
Fall, Spring, Summer, (3-0) P:M: (MTH 201)
R: Open only to students in the Educa-
tion major or Special Education
major whose area of emphasis is emotional im-
pairment or deaf education or learning dis-
abilities or visual impairment or General
Science-Interdepartmental major or Child
Development major or Teacher Certification
Internship-Year Studies program.
A continuation of MTH 201.

Multivariable Calculus
Fall, Spring, Summer, (4-4-0) P:M: (MTH 133
or MTH 153H or LBS 119) Not open to stu-
dents with credit in MTH 254H.
Vectors in space. Functions of several variables and
partial differentiation. Multiple integrals. Line and
surface integrals. Green’s and Stoke’s theorems.

Differential Equations
Fall, Spring, Summer, (3-3-0) P:M: (MTH 234
or MTH 254H) Not open to students with
credit in MTH 255H.
Separable and exact equations, linear equations and
variation of parameters, series solutions, higher
order linear equations, systems of first order linear
equations, introduction to partial differential
equations and Fourier Series.

Honors Multivariable Calculus
Fall, Spring, Summer, (3-3-0) P:M: (MTH 153H)
Not open to students with credit in LBS 220 or
MTH 234.
Vectors in space. Functions of several variables and
partial differentiation. Multiple integrals. Line and
surface integrals. Green’s and Stoke’s Theorems.

Honors Differential Equations
Fall, Spring, Summer, (3-3-0) P:M: (MTH 254H)
Not open to students with credit in MTH 235.
Topics chosen from separable and exact equations,
linear equations and variation of parameters, series
solutions, higher order linear equations, Laplace
transforms, systems of first order linear equations,
nonlinear equations and stability, introduction to
partial differential equations.

Directed Study
Fall, Spring, Summer, 1 to 4 credits.
A student may earn a maximum of 6 credits in all
enrollments for this course.
Faculty directed study of selected mathematical
topics.

Linear Algebra I
Fall, Spring, Summer, (3-3-0) P:M: (MTH 234
or MTH 254H or LBS 220) and completion
of Tier I writing requirement.
Matrices, systems of linear equations, vector
spaces, linear transformations, inner products and
orthogonal spaces, eigenvalues and eigenvectors,
and applications to geometry. A writing course with
emphasis on proofs.

Abstract Algebra I and Number Theory
Fall, Spring, Summer, (3-3-0) P:M: (MTH
309) and completion of Tier I writing re-
quirement.
Structure of the integers, congruences, polynomial
rings, and ideals. A writing course with emphasis on
proofs.

Matrix Algebra with Applications
Fall, Spring, Summer, (3-3-0) P:M: (MTH
234 or MTH 254H or LBS 220) R: Not open to
students in the Department of Mathematics or
to students in Lyman Briggs Mathematics or
Lyman Briggs Computational Mathematics.
Problem-solving and applications in matrix algebra
for scientists and engineers. Vectors, matrices,
linear transformations, inner products, dimension,
eigenvalues and eigenvectors. Applications to sys-
tems of equations and to geometry.
320 Analysis I  
Fall, Spring, Summer. 3(3-0) P:M: (MTH 234 or MTH 254H or LBS 220) and (MTH 209) Not open to students with credit in MTH 428H.  

330 Higher Geometry  
Fall. 3(3-0) P:M: (MTH 209)  
Topics in transformations: isometries, similarities, inversion. Advanced Euclidean geometry: theorems of Menelaus, Ceva, and Desargue. Cross ratio, harmonic points, analytic, metric and vector methods, convexity.

340 Ordinary Differential Equations I  
Fall, Spring. 3(3-0) P:M: (MTH 209)  
Techniques for solving differential equations, existence and uniqueness theorems, qualitative theory, Fourier series and applications.

341 Abstract Algebra II  
Fall, Spring. 3(3-0) P:M: (MTH 310) Not open to students with credit in MTH 418H.  
Continuation of MTH 310. Permutation groups, groups of transformations, normal subgroups, homomorphism theorems, modules. Principal ideal rings, unique factorization domains, noncommutative rings, rings of fractions, ideals.

360 Theory of Mathematical Interest  
Fall. 3(3-0) P:M: (MTH 234 or concurrently) Measurement of interest rates, basic problems in interest theory, basic annuities, continuous and varying annuities, yield rates, amortization, bonds and other securities, practical applications, and stochastic approaches to interest.

411 Honors Algebra I  
Fall. 3(3-0) P:M: Completion of Tier I writing requirement. RB: (MTH 309) R: Approval of department. Not open to students with credit in MTH 411.  
Theory of groups, Sylow theory, the structure of finite Abelian groups, ring theory, ideals, homomorphisms, and polynomial rings.

412 Analysis II  
Fall, Spring. 3(3-0) P:M: (MTH 320) Not open to students with credit in MTH 424 or MTH 429H.  

413 Honors Algebra II  
Spring. 3(3-0) P:M: (MTH 418H) R: Approval of department. Algebraic field extensions, Galois theory. Classification of finite fields. Fundamental Theorem of Algebra.

414 Linear Algebra II  
Fall. 3(3-0) P:M: (MTH 309 or MTH 314) Not open to students with credit in MTH 414.  
Linear transformations on finite dimensional vector spaces. Invariant subspaces, rank, eigenvalues and eigenvectors. Canonical forms. Bilinear and multilinear forms.

415 Applied Linear Algebra  
Fall. Spring. 3(3-0) P:M: (MTH 235 or MTH 255H or LBS 220) R: Not open to students in the Mathematics major. Not open to students with credit in MTH 415.  

416 Introduction to Algebraic Coding  
Fall. 3(3-0) P:M: (MTH 309)  
Concepts and techniques of abstract algebra applied to the design of communication systems for use in imperfect circumstances. Theory of codes designed by algebraic means.

417 Topics in Number Theory  
Spring of even years. 3(3-0) P:M: (MTH 310)  
Congruences of higher degree, primitive roots and quadratic reciprocity. Number-theoretic functions, algebraic continued fractions. Dirichlet Series, p-order expansion, continued fractions.

418H Honors Algebra I  
Fall. 3(3-0) P:M: Completion of Tier I writing requirement. RB: (MTH 309) R: Approval of department. Not open to students with credit in MTH 411.  
Theory of groups, Sylow theory, the structure of finite Abelian groups, ring theory, ideals, homomorphisms, and polynomial rings.

421 Honors Analysis I  
Fall. Spring. 3(3-0) P:M: (MTH 320) Not open to students with credit in MTH 424 or MTH 429H.  
Honors analysis with emphasis on metric topology, differentiation, and integration in higher dimensional settings. Convergence of sequences of functions.

422H Honors Analysis II  
Spring. 3(3-0) P:M: (MTH 428H) R: Approval of department. Not open to students with credit in MTH 424 or MTH 429H.  
Honors analysis with emphasis on metric topology, differentiation, and integration in higher dimensional settings. Convergence of sequences of functions.

423H Honors Analysis III  
Spring. 3(3-0) P:M: (MTH 428H) R: Approval of department. Not open to students with credit in MTH 424 or MTH 429H.  
Honors analysis with emphasis on metric topology, differentiation, and integration in higher dimensional settings. Convergence of sequences of functions.

424 Applied Advanced Calculus  
Spring. 3(3-0) P:M: (MTH 224 or MTH 255H or LBS 220) R: Not open to students in the Mathematics major. Not open to students with credit in MTH 414 or MTH 429H.  
Vector analysis for scientists and engineers. Inverse and implicit function theorems, divergence and curl, Stokes's theorem. Sequences and series, uniform convergence.

425 Complex Analysis  
Fall, Spring. 3(3-0) P:M: (MTH 224 or MTH 254H or LBS 220)  
Analytic functions of a complex variable: Cauchy integral theorem, conformal maps, bilinear transformation, harmonic functions. Classification of singularities, residues, conformal mappings.

426H Honors Complex Analysis  
Spring. 3(3-0) P:M: (MTH 428H) R: Approval of department. Not open to students with credit in MTH 320.  
Honors analysis with emphasis on metric topology, differentiation, and integration in higher dimensional settings. Convergence of sequences of functions.

427H Honors Partial Differential Equations  
Spring. 3(3-0) P:M: (MTH 428H) R: Approval of department. Not open to students with credit in MTH 424 or MTH 429H.  
Continuation of MTH 428H. Convergence of sequences of functions, inverse and implicit function theorems, integration in higher dimensional settings.

428H Honors Real Analysis  
Spring. 3(3-0) P:M: (MTH 428H) R: Approval of department. Not open to students with credit in MTH 424 or MTH 429H.  
Continuation of MTH 428H. Convergence of sequences of functions, inverse and implicit function theorems, integration in higher dimensional settings.

430 Advanced Calculus  
Fall, Spring. 3(3-0) P:M: (MTH 224 or MTH 254H or LBS 220) R: Not open to students in the Mathematics major. Not open to students with credit in MTH 414 or MTH 429H.  
Vector analysis for scientists and engineers. Inverse and implicit function theorems, divergence and curl, Stokes's theorem. Sequences and series, uniform convergence.

431 Partial Differential Equations  
Spring. 3(3-0) P:M: (MTH 224 or MTH 254H or LBS 220) R: Approval of department. Not open to students in the Mathematics major. Not open to students with credit in MTH 414 or MTH 429H.  
Classification and canonical forms for second order partial differential equations. Well posed boundary and initial value problems for the wave equation, the heat equation and the Laplace equation.

432 Boundary Value Problems for Engineers  
Fall. 3(3-0) P:M: (MTH 225 or MTH 255H or LBS 220) R: Not open to students in the Mathematics major. Not open to students in the Mathematics major. Not open to students with credit in MTH 414 or MTH 429H.  

451 Numerical Analysis I  
Fall. 3(3-0) P:M: (CSE 101 or CSE 131 or ECE 131 or CSE 220 or ECE 220 or ECE 231) Not open to students in the Mathematics major. Not open to students with credit in MTH 351.  

452 Numerical Analysis II  
Spring. 3(3-0) P:M: (MTH 451) R: Approval of department. Not open to students in the Mathematics major. Not open to students with credit in MTH 351.  

455 Actuarial Models  
Spring. 3(3-0) Interdepartmental with Statistics and Probability. Administered by Department of Statistics and Probability. RB: (STT 441)  
Stochastic models used in insurance. Survival distributions, life insurance, life annuities, benefit premiums, benefit reserves, analysis of benefit reserves.

461 Metric and Topological Spaces  
Fall. 3(3-0) P:M: (MTH 320 or MTH 428H)  

472 Mathematical Logic  
Spring. 3(3-0) P:M: (MTH 234 or MTH 254H or LBS 220)  
Logics and formal systems, syntax and semantics. Completeness and axiomatizability. Decidable and undecidable theories and Godel's theorems. Peano arithmetic.

481 Discrete Mathematics I  
Fall, Spring. 3(3-0) P:M: (MTH 309)  

482 Discrete Mathematics II  
Spring. 3(3-0) P:M: (MTH 481) R: (MTH 310)  
Recurrence and generating functions, Ramsey theory. Block designs, Latin squares, Eulerian and Hamiltonian paths. Minimum spanning trees, network flows.

490 Directed Studies  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Approval of department.  
Faculty directed study in a selected mathematical topic.
Mathematics—MTH

496 Capstone in Mathematics
Fall, Spring. 3(3-0) R: Completion of Tier I writing requirement. Approval of department. A capstone course integrating several areas of mathematics.

MECHANICAL ENGINEERING

Department of Mechanical Engineering
College of Engineering

180 Engineering Graphic Communications
Fall, Spring. 3(4-3) P: MTH 116 or concurrent or LBS 117 or concurrently or MTH 132 or concurrently or MTH 152H or concurrently or MTH 103 and MTH 114 or concurrently) SA: MSM 160

201 Thermodynamics
Fall, Spring. 3(3-0) P: (CEM 141 or CEM 151 or CEM 181H or LBS 171) and (MTH 234 or concurrently or MTH 254H or concurrently or LBS 220 or concurrently) SA: MSM 160

220 Introduction to Solid Mechanics
Spring. 4(4-0) P: MTH 133 or MTH 153H or LBS 119) R: Not open to students in the Civil Engineering or Engineering Arts or Engineering Mechanics or Manufacturing Engineering or Materials Science and Engineering or Mechanical Engineering major. SA: MSM 206 Not open to students with credit in CEE 221 or ME 222.

221 Statics
Fall, Spring. 3(3-0) P: (PHY 183) and (MTH 234 or concurrently or LBS 220 or concurrently or MTH 254H or concurrently) SA: MSM 205
Vector description of forces and moments. Two and three dimensional equilibrium of particles and rigid bodies. Analysis of trusses, frames and machines. Coulomb friction.

222 Mechanics of Deformable Solids
Fall, Spring. 4(3-2) P: (ME 221) SA: MSM 211

285 Computer Aided Design Tools
Spring. 3(4-1) P: (ME 180) R: Open only to students in Manufacturing Engineering and Engineering Arts-Product Design cognate. SA: MSM 260
Advanced 3-D solid modeling, CNC programming, and rapid prototyping.

332 Fluid Mechanics
Fall, Spring. 4(3-3) P: (ME 361) and (CHE 311 or ME 201 or MSE 351) and (ME 391 or concurrently) and completion of Tier I writing requirement. R: Open only to juniors or seniors in the Mechanical Engineering or Engineering Mechanics major.
Statics, control volume equations, similarity, exact fluid solutions. Turbulence, pipe flow, boundary layer flow, compressible flow, and Navier-Stokes equations.

361 Dynamics
Fall, Spring. 3(3-0) P: (ME 221) and (MTH 235 or MTH 255H or LBS 220) R: Open only to students in the College of Engineering. SA: MSM 306

371 Mechanical Design I
Fall, Spring. 3(3-0) P: (ME 361 or concurrently) R: Open only to juniors or seniors in the Mechanical Engineering or Manufacturing Engineering major.
Analysis of displacement, velocity and acceleration in mechanical linkages. Kinematics and dynamics of machines.

372 Machine Tool Laboratory
Fall, Spring. 1(0-2)
Principles and practice of machine tools. Safety, terminology, measurement, and working procedures for hand and machine tools.

385 Introduction to Product Design
Fall. 3(4-1) P: (STA 110) R: Open only to students in Manufacturing Engineering and Engineering Arts-Product Design cognate. SA: MSM 360
Ideation methods, design methodology. 3-D model building, small-scale group and individual projects. Project presentations.

386 Computer Aided Product Design
Spring. 3(4-1) P: (ME 285 or concurrently and ME 385) R: Open only to students in Manufacturing Engineering and Engineering Arts-Product Design cognate. SA: MSM 361
Freeform modeling techniques. Top down product design. Use of computer tools to assist in the development of products.

391 Mechanical Engineering Analysis
Fall, Spring. 3(3-0) P: (MTH 235 or MTH 255H or LBS 220) R: Open only to juniors or seniors in the Mechanical Engineering or Biosystems Engineering or Engineering Mechanics major.
Analytical and numerical methods for the modeling and analysis of mechanical engineering systems. Applications to vibrating elements, heat transfer, linear springs, and coupled spring-mass systems.

410 Heat Transfer
Fall, Spring. 3(3-0) P: (ME 332 or CE 321 or CHE 311) and (ME 391) and completion of Tier I writing requirement. R: Open only to juniors or seniors in the Mechanical Engineering or Engineering Mechanics major. Steady state and transient heat conduction. Natural and forced convection based on boundary layer theory. Application of Nusselt number correlations. Radiant heat transfer principles and applications including radiation networks.

412 Heat Transfer Laboratory
Fall, Spring. 2(1-2) P: (ME 410) and completion of Tier I writing requirement. R: Open only to juniors or seniors in the Mechanical Engineering or Engineering Mechanics major.
Practices and measurement techniques for heat transfer and thermal systems. Experimental problem solving applied to heat transfer.

414 Vehicle Thermal System Design
Spring. 3(2-2) Spring: Engineering Building. P: (ME 410) R: Open only to seniors in the Mechanical Engineering major.
Analysis and design of general heat exchange systems applied to automotive vehicle systems including heaters, air conditioning, electronic, and cabin systems. Students will work in teams to design, build, and test heat exchanger systems. A global engineering experience via the internet may be included.

416 Computer Assisted Design of Thermal Systems
Fall. 3(4-0) P: (ME 410 or concurrently) R: Open only to juniors or seniors in the Mechanical Engineering major. Classifying, cataloging and processing design information. Modeling of thermal equipment. Simulation and optimization of thermal systems. Computer based design projects.

422 Introduction to Combustion
Fall. 3(3-0) P: (ME 222) R: Open only to juniors or seniors in the Mechanical Engineering major. Thermodynamics, chemistry, fluid mechanics, and heat transfer principles applied to combustion.

423 Intermediate Mechanics of Deformable Solids
Fall. 3(3-0) P: (ME 222) R: Open only to students in the College of Engineering. SA: MSM 401

424 Computational Mechanics
Spring. 3(3-0) P: (ME 423 or ME 471) R: Open only to students in the College of Engineering. SA: MSM 402

425 Experimental Mechanics
Fall of odd years. 3(2-3) P: (ME 222) R: Open only to students in the College of Engineering. SA: MSM 405
Measurement of stress, strain, vibration, and motion using strain gauges, accelerometers, photoelasticity, holography, Moire patterns, laser speckle and electronic imaging. Transducer design.

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