

MATHEMATICS

- 991*** *Special Topics in Algebra*
Fall, Spring. 3 to 6 credits in increments of 3 credits. May reenroll for a maximum of 18 credits.
P: Approval of department
Advanced topics in algebra.
QA: MTH 993
- 992*** *Special Topics in Analysis*
Fall, Spring. 3 to 6 credits in increments of 3 credits. May reenroll for a maximum of 18 credits.
P: Approval of department
Advanced topics in analysis.
QA: MTH 992
- 993*** *Special Topics in Geometry*
Fall, Spring. 3 to 6 credits in increments of 3 credits. May reenroll for a maximum of 18 credits.
P: Approval of department
Advanced topics in Geometry.
QA: MTH 991
- 994*** *Special Topics in Applied Mathematics*
Fall, Spring. 3 to 6 credits in increments of 3 credits. May reenroll for a maximum of 18 credits.
P: Approval of department
Advanced topics in Applied Mathematics.
QA: MTH 994
- 995*** *Special Topics in Numerical Analysis and Operations Research*
Fall, Spring. 3 to 6 credits in increments of 3 credits. May reenroll for a maximum of 18 credits.
P: Approval of department
Advanced topics in numerical analysis or operations research.
- 996*** *Special Topics in Topology*
Fall, Spring. 3 to 6 credits in increments of 3 credits. May reenroll for a maximum of 18 credits.
P: Approval of department
Advanced topics in topology.
- 998*** *Special Topics in Combinatorics and Graph Theory*
Fall, Spring. 3 to 6 credits in increments of 3 credits. May reenroll for a maximum of 18 credits.
P: Approval of department
Advanced topics in combinatorics and graph theory.
- 999*** *Doctoral Dissertation Research*
Fall, Spring, Summer. 1 to 9 credits. May reenroll for a maximum of 99 credits.
P: Approval of department R: Mathematics
QA: MTH 999
- MECHANICAL ENGINEERING**
- 201.** *Thermodynamics*
Fall, Spring. 3(3-0)
P: CEM 141, MTH 234 or concurrently.
R: Not open to students with credit in CHE 311 or MMM 351.
Basic concepts of thermodynamics. Property evaluation of ideal gases and incompressible substances. Theory and application of the first and second laws of thermodynamics. Entropy and Carnot efficiency.
QP: MTH 215 CEM 141 QA: ME 311

- 332*** *Fluid Mechanics*
Fall, Spring. 4(3-3)
P: MMM 306; CHE 311 or ME 201 or MMM 351; ME 391 or concurrently. R: Open only to Mechanical Engineering and Mechanics students.
Statics, control volume equations, similitude, exact fluid solutions. Turbulence, pipe flow, boundary layer flow, external flow.
QP: ME 311 MMM 306 ME 351 QA: ME 332
- 371*** *Mechanical Design I*
Fall, Spring. 3(3-0)
P: MMM 306 or concurrently. R: Open only to Mechanical Engineering and Mechanics majors.
Analysis of displacement, velocity and acceleration in mechanical linkages. Kinematics and dynamics of machines.
QP: MMM 306 QA: ME 320
- 410*** *Heat Transfer*
Fall, Spring. 3(3-0)
P: ME 332. R: Open only to Mechanical Engineering and Mechanics majors.
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.
QP: ME 332 QA: ME 411
- 411*** *Applied Thermal Science*
Fall, Spring. 3(3-0)
P: ME 410 or concurrently. R: Open only to Mechanical Engineering majors.
Thermodynamic principles as applied to gas and vapor power and refrigeration cycles for reciprocating and turbo machinery. Combustion. Analysis and design of heat exchangers. Numerical analysis of heat conduction.
QP: ME 411 QA: ME 312
- 412*** *Heat Transfer Laboratory*
Fall, Spring. 1(1-2)
P: ME 411 or concurrently. R: Open only to Mechanical Engineering majors.
Practices and measurement techniques for heat transfer and thermal systems. Experimental problem solving applied to heat transfer.
QP: ME 312 ME 411 QA: ME 413
- 415*** *Solar Energy Conversion*
Spring. 3(3-0)
P: ME 410. R: Open only to Mechanical Engineering majors.
Solar radiation: terrestrial diffuse and direct-beam insolation. Flat-plate and focusing collectors. Energy storage systems. Solar-assisted heat pumps. Photovoltaic, biomass and wind energy conversions.
QP: ME 411 QA: ME 415
- 416*** *Computer Assisted Design of Thermal Systems*
Fall. 3(4-0)
P: ME 411. R: Open only to Mechanical Engineering majors.
Classifying, cataloging and processing design information. Modeling of thermal equipment. Simulation and optimization of thermal systems. Computer based design projects.
QP: ME 312
- 422*** *Introduction to Combustion*
Fall. 3(3-0)
P: ME 332. R: Open only to Mechanical Engineering majors.
Thermodynamics, chemistry, fluid mechanics, and heat transfer principles applied to combustion.
QP: ME 332

- 432*** *Intermediate Fluid Mechanics*
Spring. 3(3-0)
P: ME 332. R: Open only to Mechanical Engineering majors.
Deformable control volumes, Navier-Stokes equations, vorticity and circulation. Exact solutions. Turbulence, boundary layer flows, compressible flows.
QP: ME 332 QA: ME 333
- 433*** *Intermediate Fluid Mechanics Laboratory*
Spring. 1(0-3)
P: ME 432 or concurrently. R: Open only to Mechanical Engineering majors.
Visualization and measurement of flow, jets and wakes. Flow separation and boundary layers.
QP: ME 333
- 440*** *Aerospace Engineering I*
Fall. 3(3-0)
P: ME 332. R: Open only to Mechanical Engineering and Mechanics majors.
Aerodynamics, propulsion and flight mechanics. Vehicle and propulsion engine performance and design characteristics.
QP: ME 332 QA: ME 432
- 441*** *Aerospace Engineering II*
Spring. 3(3-0)
P: ME 440. R: Open only to Mechanical Engineering and Mechanics majors.
Computer analysis experiments associated with aerospace vehicle design. Application of aerospace engineering principles in design such as propulsion, aerodynamics, stability and control.
QP: ME 432 QA: ME 434
- 451*** *Control Systems*
Fall, Spring. 4(3-3)
P: ME 391, MMM 306, EE 345. R: Open only to Mechanical Engineering and Mechanics majors.
Mathematical modeling of dynamic systems. Standard feedback control formulation. Transient and sinusoidal steady state analysis. Time and frequency domain controller synthesis.
QP: MMM 306 ME 351 EE 345 QA: ME 458
- 461*** *Mechanical Vibrations*
Fall, Spring. 4(3-3)
P: ME 451. R: Open only to Mechanical Engineering and Mechanics majors.
Modeling and analysis of oscillatory phenomena found in linear discrete and continuous mechanical systems.
QP: ME 458 QA: ME 455
- 463*** *Computer Aided Design of Dynamic Systems*
Spring. 3(3-0)
P: ME 451. R: Open only to Mechanical Engineering and Mechanics majors.
Modeling and design of mechanical and mixed-energy dynamic systems. State-space equation representation. Simulation methods.
QP: ME 458 QA: ME 352
- 465*** *Computer Aided Optimal Design*
Fall. 3(3-0)
P: ME 471 or concurrently. R: Open only to Mechanical Engineering majors.
Modeling for mechanical design optimization. Algorithms for constrained and unconstrained optimization. Optimality criteria. Optimization using finite element models. Design projects.
QP: ME 421 QA: ME 465
- 471*** *Mechanical Design II*
Fall, Spring. 3(3-0)
P: ME 371, ME 391. R: Open only to Mechanical Engineering and Mechanics majors.
Engineering design of machine elements and mechanical systems. Computer based analysis in support of design. Design for static and fatigue strength, deflection and reliability.
QP: ME 351 ME 320 QA: ME 421

MECHANICAL ENGINEERING

- 481*.** **Mechanical Engineering Design Projects**
 Fall, Spring. 3(1-6)
 P: ME 411 or concurrently; ME 471. R:
 Open only to Mechanical Engineering majors.
 Application of design concepts in mechanical engineering. Problem definition, design specifications. Modeling and analysis methods. Design optimization, economics, reliability. Manufacturing considerations in design. Capstone design projects.
 QP: ME 411 ME 421ME 312 QA: ME 422
- 490*.** **Independent Study in Mechanical Engineering**
 Fall, Spring, Summer. 1 to 3 credits.
 May reenroll for a maximum of 6 credits.
 R: Open only to Mechanical Engineering majors. Approval of department.
 Independent study in mechanical engineering.
 QA: ME 499
- 491*.** **Selected Topics in Mechanical Engineering**
 Fall, Spring. 1 to 4 credits. May reenroll for a maximum of 8 credits.
 R: Open only to Mechanical Engineering majors. Approval of department.
 Topics selected to supplement and enrich existing courses.
 QA: ME 490
- 802*.** **Advanced Classical Thermodynamics**
 Fall. 3(3-0)
 P: ME 411, ME 391 or equivalent
 Postulational treatment of the laws of thermodynamics. Equilibrium and maximum entropy postulates. Principles for general systems.
 QP: ME 312 MTH 422ORMTH 424 QA: ME 815
- 812*.** **Conductive Heat Transfer**
 Fall. 3(3-0)
 P: ME 411, ME 391 or equivalent
 Theory of steady and unsteady heat conduction. Derivation of various describing equations and boundary conditions. Numerical methods. Nonlinear problems. Duhamel's integral. Green's functions.
 QP: ME 411 ME 351 QA: ME 817
- 814*.** **Convective Heat Transfer**
 Spring. 3(3-0)
 P: ME 410 or equivalent R: Graduate
 Engineering
 Analysis of convective transfer of heat, mass and momentum in boundary layers and ducts. Thermal instability. Free convection.
 QP: ME 412 MTH 421 QA: ME 813
- 816*.** **Radiative Heat Transfer**
 Fall. 3(3-0)
 P: ME 410 or equivalent
 Electromagnetic theory of radiation. Spectral properties of diffuse and nondiffuse surfaces. Radiation exchange. Radiative transfer in media. Gaseous radiation exchange. Combined modes.
 QP: ME 411 QA: ME 814
- 822*.** **Combustion**
 Spring. 3(3-1)
 P: ME 490, ME 802 R: Graduate
 Review of thermodynamics and chemical kinetics; multicomponent systems; premixed and diffusion flames; flame radiation.
 QP: ME 815 ME 490 QA: ME 863
- 830*.** **Fluid Mechanics I**
 Fall. 3(3-0)
 P: ME 432 or equivalent
 Integral and differential conservation laws, Navier-Stokes' equations, exact solutions, laminar boundary layer theory, similarity solutions, approximate methods, thermal effects, instability phenomena.
 QP: ME 333 QA: ME 844
- 832*.** **Fluid Mechanics II**
 Spring. 3(3-0)
 P: ME 830 or equivalent, MTH 423 Complex Variables or equivalent
 Inviscid flow, vortex motion, flow past bodies, complex variables and conformal mapping, 1-D steady and unsteady compressible flow, shock waves and Prandtl-Meyer expansion, small perturbations theory, method of characteristics.
 QP: ME 844 MTH 423ME 830ME 333 QA:
 ME 841 ME 842
- 834*.** **Turbulence(MTC)**
 Spring. 3(3-0) May reenroll for a maximum of 6 credits.
 P: ME 432 or equivalent
 Subtitles: Turbulence I, Turbulence II.
 QP: MMM 810 QA: ME 843
- 834A*.** **Turbulence I**
 Spring. 3(3-0)
 P: ME 432 or equivalent
 Statistical descriptions of turbulent flows: Isotropic, free shear and wall bounded. Correlation and spectral descriptions. Conditional probabilities and coherent motions. Experimental methods.
 QP: MMM 810 QA: ME 843
- 834B*.** **Turbulence II**
 Spring. 3(3-0)
 P: ME 432 or equivalent
 Fundamental physics of turbulence from dimensional analysis approach. Both classical and coherent structure analysis.
 QP: ME 333 QA: ME 843
- 836*.** **Experimental Methods in Fluid Mechanics**
 Fall. 3(1-2)
 P: ME 432 or equivalent R: Mechanical
 Engineering
 Lectures and laboratory experience in use of modern techniques of fluid mechanics measurement and data analysis; pressure, temperature and velocity measurement techniques; optical diagnostics.
 QP: ME 333
- 852*.** **Intermediate Control Systems**
 Spring. 3(3-0)
 P: ME 458 or equivalent R: Graduate
 Design of controllers for dynamic systems encountered in mechanical engineering. Modeling, analysis and simulation.
 QP: ME 458 QA: ME 852
- 855*.** **Digital Data Acquisition and Control**
 Spring of odd-numbered years. 3(2-3)
 P: ME 451 or equivalent R: Engineering
 Real-time digital measurement and control programming for mechanical engineering systems. Analog-to-Digital and Digital-to-Analog Converters, Timer/Counters, and instrument interfaces. Open-Loop and Closed-Loop control. Laboratory projects.
 QP: ME 458 QA: ME 855
- 857*.** **Modeling and Simulation of Dynamic Systems**
 Spring of odd-numbered years. 3(3-0)
 P: ME 451 or equivalent
 Energy-based methods for modeling dynamic engineering components and systems. Systematic formulation of nonlinear state-space equations. Qualitative aspects of response: equilibrium points, linearization. Simulation techniques and design projects.
 QP: ME 458 QA: ME 851
- 860*.** **Theory of Vibrations**
 Fall. 3(3-0) Interdepartmental with the Department(s) of Metallurgy, Mechanics, and Materials Science.
 P: ME 452 or equivalent
 Vibrations of discrete systems and continua. Analytical Mechanics. Variational Principles. Modal analysis. Function spaces. Eigenfunction expansions. Integral transforms. Stability. Approximations. Perturbations.
 QP: ME 455 QA: ME 823
- 863*.** **Nonlinear Vibrations**
 Spring of even-numbered years. 3(3-0)
 P: ME 455 or equivalent
 Perturbation methods. Weakly nonlinear partial and ordinary differential equations. Modal interactions, internal tuning, saturation, sub/supercombination resonances, jump phenomenon. Nonlinear normal modes.
 QP: ME 455 QA: ME 825
- 871*.** **Elastodynamics of Machinery and Robotic Systems**
 Fall of even-numbered years. 3(3-0)
 R: Graduate
 Rigid-body kinematic analysis. Linkage synthesis. Variational formulations, nonlinear phenomena, composites and smart materials.
 QP: NONE QA: NONE
- 873*.** **Design-for-Manufacture Strategies for Composite Materials**
 Spring of odd-numbered years. 3(3-0)
 R: Graduate
 Modeling of fibrous composite materials. Processing techniques for thermoplastics and thermosets. Design-for-Manufacture (DFM) strategies.
 QP: NONE QA: NONE
- 875*.** **Optimal Design of Mechanical Systems**
 Spring of even-numbered years. 3(3-0)
 P: MTH 334, ME 452 or MMM 809, or approval of department R: Graduate Students
 Optimal design for static and dynamic response of mechanical and structural systems. Necessary and sufficient conditions for optimality. Discrete and continuous parameter problems. Sensitivity of response to design variations. Algorithms.
 QP: MTH 334 ME 455MMM 809 QA: ME 856
- 892*.** **Parameter Estimation**
 Spring. 3(3-0)
 P: STT 421 or STT 441 or equivalent
 Nonlinear estimation of parameters in ordinary and partial differential equations. Related concepts in probability and statistics. Least squares and other estimators. Sequential methods. Optimum experiment design.
 QP: STT 421 STT 441 QA: ME 860
- 899*.** **Master's Thesis Research**
 Fall, Spring, Summer. 1 to 8 credits.
 May reenroll for a maximum of 0 credits.
 R: Graduate-MS
 Master's thesis research
 QA: ME 899
- 913*.** **Advanced Heat Conduction**
 Fall of even-numbered years. 3(3-0)
 P: ME 812 or graduate course in partial differential equations.
 Selected advanced topics from inverse and ill-posed problems in heat transfer; function estimation; regularization; adjoint methods; numerical methods in conduction; moving boundaries; ablation; phase change; Green's functions and integral transforms.
 QP: ME 817 CHE 826MTH 841 QA: ME 917

MECHANICAL ENGINEERING

930*. **Selected Topics in Fluid Mechanics**
Fall. 1 to 3 credits. May reenroll for a maximum of 6 credits.
P: ME 830

Current topics in Fluid Mechanics will be presented.
QP: ME 841 QA: NONE

940*. **Advanced Topics in Thermal Science**
Spring. 3(3-0) May reenroll for a maximum of 12 credits.
P: ME 813, ME 814 or ME 817, or approval of department R: Mechanical Engineering

Advanced topics in thermal sciences, eg., conduction, convection, radiation, phase change and interactive combined modes of heat transfer; mass transfer; irreversible thermodynamics.
QP: ME 813 ME 814 ME 817 QA: ME 980

952*. **Advanced Control Systems**
Fall. 3(3-0)
P: ME 852 R: Graduate

Investigate areas of current interest in control theory that hold promise for improving the design of mechanical systems.
QP: ME 852

955*. **Nonlinear Dynamical Systems and Chaos**
Fall of even-numbered years. 3(3-0)
P: ME 863 or equivalent R: Graduate

Students
Qualitative theory of dynamical systems applied to physical system models. Bifurcation theory for continuous and discrete time systems, chaos, the Smale horseshoe, and Melnikov's method.
QP: ME 825 EE 827 QA: ME 853

960*. **Selected Topics in Vibrations**
Fall. 1 to 3 credits. May reenroll for a maximum of 6 credits.
P: ME 860

Current topics of interest to the student and faculty.
QP: ME 823

963*. **Wave Phenomena**
Spring of even-numbered years. 3(3-0)
P: Approval of instructor.

Linear and non-linear waves in bounded and unbounded media. Reflection, refraction, diffraction. Dispersion. Shock and acceleration waves. Waveguides. Acoustical and optical analogies. Fluid and solid continua.
QP: ME 870 QA: ME 870

971*. **Intelligent Materials and Smart Structures: Applications**
Fall of odd-numbered years. 3(3-0)
P: ME 873 R: Graduate

Design-for-Manufacture issues in smart materials: Biomimetics, nanotechnology, electro-rheological fluids, shape memory alloys, piezoelectric materials, fiberoptics, neural networks.
QP: NONE QA: NONE

990*. **Special Problems in Mechanical Engineering**
Fall, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 6 credits.
R: Graduate

Individualized study of a current problem in mechanical engineering
QA: ME 925

999*. **Doctoral Dissertation Research**
Fall, Spring, Summer. 1 to 12 credits. May reenroll for a maximum of 0 credits.
R: Graduate-PhD

Doctoral dissertation research.
QA: ME 999

MEDICAL TECHNOLOGY MT

212*. **Fundamentals of Laboratory Analysis**
Spring. 3(3-0)
P: CEM 142; MTH 116 or MTH 120; C: MT 213

Chemical, biological and instrumental laboratory analyses: method evaluation, quality assurance, and predictive value theories.
QP: MTH 109 ORMTH 111 AND CEM 142 QA: MT 210

213*. **Application of Clinical Laboratory Principles**
Spring. 1(0-3)
C: MT 212

Microscopy, pipetting, Specimen collection, handling and processing. Laboratory safety, quality control, and method evaluation.
QA: MT 211

414*. **Clinical Chemistry and Body Fluid Analysis**
Spring. 4(4-0)
P: BCH 401, MT 212, PSL 250.

Analytical methods in clinical chemistry and urinalysis. Correlation of laboratory test results with physiology and diseases of renal, hepatic and cardiac systems.
QP: PSL 241 AND MT 210 AND BCH 401 QA: MT 412 MT 410 MT 300 MT 440

415*. **Clinical Chemistry and Body Fluid Analysis Laboratory**
Spring. 1(0-2)
P: MT 213; C: MT 414 R: Open only to Clinical Laboratory Science majors.

Quantitative analysis of blood and body fluids. Spectrophotometry, electrophoresis, chromatography, enzymatic assays, and immunoassays.
QA: MT 401 MT 441

416*. **Clinical Chemistry**
Fall. 4(5-0)
P: MT 213.

Analytical methods in clinical chemistry. Correlation of laboratory test results with physiology and diseases of the endocrine system, pregnancy, and cancer. Therapeutic drug monitoring and automation.
QA: MT 412 MT 300 MT 410

422*. **Hematology and Hemostasis**
Fall. 4(4-0)
P: MT 212.

Structure and function of normal blood cells with changes seen in benign and malignant diseases, and in acquired and hereditary diseases.
QP: MT 210 QA: MT 420 MT 440

423*. **Hematology and Hemostasis Laboratory**
Fall. 1(0-2)
P: MT 213; C: MT 422 R: Open only to Clinical Laboratory Science majors.

Diagnostic assessment of blood cells and hemostatic function.
QA: MT 421 MT 441

432*. **Clinical Immunology and Immunohematology**
Fall. 5(5-0)
P: MT 212.

Cellular and humoral immunity, diseases of immunity. Clinical serology and immunology, blood group serology, and transfusion practices.
QP: MT 210 QA: MT 430 MPH 427

454*. **Problem Solving Across Clinical Laboratory Disciplines**
Spring. 3(3-0)
P: MT 415, MT 416, MT 423, MT 432, MT 433, MPH 463. R: Open only to Clinical Laboratory Science majors.

Problem-oriented approach integrates topics from previous courses in clinical laboratory sciences, social sciences, and humanities. Emphasis on published primary research literature and its critical appraisal.
QA: MT 451 MT 452

471*. **Advanced Clinical Chemistry Laboratory**
Fall, Spring, Summer. 3(-)
C: MT 472 R: Open only to seniors in Clinical Laboratory Science majors. Approval of Medical Technology Program.

Application and integration of theory and technical skills of chemistry and biochemistry.
QA: MT 481

472*. **Advanced Clinical Chemistry**
Fall, Spring, Summer. 1(-)
C: MT 471 R: Open only to seniors in Clinical Laboratory Science. Approval of Medical Technology Program.

Theoretical aspects of clinical chemistry. Chemical and biochemical reactions. Statistical analysis, pathophysiological relationships, and methodologies.
QA: MT 481

473*. **Advanced Clinical Hematology and Body Fluids Laboratory**
Fall, Spring, Summer. 4(-)
C: MT 474 R: Open only to seniors in Clinical Laboratory Science. Approval of Medical Technology Program.

Application of the theory of hematology, hemostasis, and body fluid analysis.
QA: MT 482 MT 486 MT 487

474*. **Advanced Clinical Hematology and Body Fluids**
Fall, Spring, Summer. 1(-)
C: MT 473 R: Open only to seniors in Clinical Laboratory Science. Approval of Medical Technology Program.

Theoretical aspects of advanced hematology, hemostasis and body fluid analysis. Integration of cognitive material with test results.
QA: MT 482 MT 486 MT 487

475*. **Advanced Clinical Immunology and Immunohematology Laboratory**
Fall, Spring, Summer. 2(-)
C: MT 476 R: Open only to seniors in Clinical Laboratory Science. Approval of Medical Technology Program.

Application of immunology and immunohematology principles.
QA: MT 483 MT 485

476*. **Advanced Clinical Immunology and Immunohematology**
Fall, Spring, Summer. 1(-)
C: MT 475 R: Open only to seniors in Clinical Laboratory Science. Approval of Medical Technology Program.

Theory of immunology and immunohematology. Integration of cognitive material with test results.
QA: MT 483 MT 485

477*. **Advanced Clinical Microbiology Laboratory**
Fall, Spring, Summer. 3(-)
C: MT 478 R: Open only to seniors in Clinical Laboratory Science. Approval of Medical Technology Program.

Application of clinical microbiology.
QA: MT 484