928. Harmonic Analysis II
Winter of odd-numbered years. 3(3-0)
MTH 928.

929. Harmonic Analysis III
Spring of odd-numbered years. 3(3-0)
MTH 928.
Selected topics from Fourier analysis on compact groups, singular integrals, harmonic analysis in Rn, Hp theory in one and several variables or differentiation of integrals.

931. Non-Associative Algebras I
Fall of odd-numbered years. 3(3-0)
MTH 838.
Non-associative algebras, radicals, idempotent decomposition of simple algebras.

932. Non-Associative Algebras II
Winter of even-numbered years. 3(3-0)
MTH 931.
Continuation of MTH 931. Nil algebras, structure and representations, Lie algebras.

933. Non-Associative Algebras III
Spring of even-numbered years. 3(3-0)
MTH 932.
Continuation of MTH 932. Relations between non-associative algebras, representations and cohomology theory.

934. Advanced Group Theory I
Fall. 3(3-0) MTH 836.
Permutation groups, characters, *-properties, automorphisms, lattices of subgroups, classes of infinite groups, group rings, recent literature.

935. Advanced Group Theory II
Winter. 3(3-0) MTH 934.
Continuation of MTH 934.

936. Advanced Group Theory III
Spring. 3(3-0) MTH 935.
Continuation of MTH 935.

937. Commutative Algebra I
Fall of even-numbered years. 3(3-0)
MTH 836.
Algebraic number theory, Noetherian rings, Dedekind domains and classical ideal theory, valuation theory, power series rings, local rings.

938. Commutative Algebra II
Winter of odd-numbered years. 3(3-0)
MTH 937.
Continuation of MTH 937.

939. Commutative Algebra III
Spring of odd-numbered years. 3(3-0)
MTH 938.
Continuation of MTH 938.

948. Fluid Dynamics III
Spring of odd-numbered years. 3(3-0)
MTH 885.
General theory of perfect fluids including motion of incompressible fluids in two and three dimensions and applications to problems of wing profiles. Viscous and compressible fluids discussed briefly.

951. Approximation Theory I
Fall of odd-numbered years. 3(3-0)
MTH 823 or approval of department.
Tchebycheff approximations with polynomials, rational approximations, and general linear families; the Weierstrass problem; degree of approximation; Bernstein polynomials, Berlekamp algorithm, uniform approximation with constraints.

952. Approximation Theory II
Winter of even-numbered years. 3(3-0)
MTH 951.
Continuation of MTH 951. General methods of measuring error: Approximation in L1 and Lp norms, least-square approximation and orthogonal functions; spline functions, approximation in normed linear spaces.

953. Approximation Theory III
Spring of even-numbered years. 3(3-0)
MTH 952.
Continuation of MTH 952.

954. Algebraic Topology I
Fall. 3(3-0) MTH 834, MTH 862.
Simplicial and singular homotopy theory, Eilenberg-Steenrod axioms, chain complexes, cell complexes, applications to Euclidean spaces.

955. Algebraic Topology II
Winter. 3(3-0) MTH 964.
Continuation of MTH 964 including category and functor theory, general coefficient and cohomology theory.

956. Algebraic Topology III
Spring. 3(3-0) MTH 965.
Continuation of MTH 965 including homology groups, products, Eilenberg-Zilber theorems, cohomology products, differential topology.

996. Advanced Topics in Topology
Fall, Winter, Spring, Summer. Variable credit. Approval of department.
Topological groups, topology of Euclidean spaces, axiomatic homotopy theory, homotopy theory, function spaces.

999. Doctoral Dissertation Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

MECHANICAL ENGINEERING

College of Engineering

201. The Science of Sound I: Rock, Bach and Oscillators
Winter. 3(3-0) or 3(4-0) Interdepartmental with the Department of Physics. Man-sound relationship. Production, propagation, detection of sounds. Voice-hearing, scales, timbre, musical instruments. Room acoustics. Electronic reproduction and synthesis of music. Demonstrations emphasized.

202. The Science of Sound II
Spring. 3(3-0) or 4(4-0) PHY 201. Interdepartmental with the Department of Physics.

255. Computer Models in Science and Engineering
Spring. 3(3-0) COMP 110 or equivalent FORTRAN. Interdepartmental with the Computer Science Department of the College of Computing.
Problem-solving; development of student's ability to formulate computable models based on finite physical elements, examples from statics, dynamics, electrical resistance, and conduction heat transfer.

300. Technology and Utilization of Energy
Winter. 3(3-0) Initial course in any sequence of courses in the Department of Natural Science. Interdepartmental with the Department of Engineering.
Problems of energy technology and its impact: energy sources, conversions, waste and environmental effects, future outlook for mankind.

303. Thermal-Fluid Phenomena
Spring. 3(3-0) MMM 201 or approval of department.
Concepts and principles used to describe, predict, or explain thermal and fluid-flow phenomena. Constraints, approximations, engineering problem solving. Application to socio-technical questions.

311. Thermodynamics I
Fall. 3(3-0) or concurrent. MTH 215.
Zeroth, first and second laws of thermodynamics. General energy equation. Process relations. Concepts of equilibrium, reversibility, and irreversibility. Applications of these to systems describable by two independent properties.
312. Thermodynamics II
Winter, Spring. 3(3-0) M E 311.
Continuation of M E 311. Gas and vapor rela-
tions, reactive and non-reactive mixtures. Thermo-
dynamic principle as applied to gas and vapor prop-
erty and refrigeration cycles for recip-
rocating and turbo machinery.

315. Thermodynamics Laboratory I
Fall, Winter, Spring. 1(0-3) M E 311 concur-
rently.
Laboratory experiments applying the basic laws of
thermodynamics.

316. Thermodynamics Laboratory II
Winter, Spring. 1(0-3) M E 312 concur-
rently.
Laboratory experiments investigating gases and
liquid behavior and combustion from a ther-
dynamic viewpoint.

320. Kinematics of Machines I
Fall, Spring, Summer. 4(3-3) EGR 260, M MM 306 or concurrently.
Analysis of displacement, velocity, and acceleration in mechanical linkages; cam analysis and design; analysis of spur, helical, bevel, and worm gears, including planetary systems.

332. Fluid Mechanics I
Winter, Spring. 4(3-3) M E 311; M E 351 or concurrently; M MM 306.
Fluid statics; Bernoulli equation; nondeforma-
table control volume applied to conservation of mass, momentum and energy, derivation of differential equations of continuity and momentum, similitude.

333. Fluid Mechanics II
Fall, Summer. 4(3-3) M E 332.
Fluid flow phenomena, laminar flow, turbulent flow, pipe flow, inviscid flows; boundary layers; external flow; an introduction to compressible flow.

341. Computer Aided Manufacturing
Spring. 4(3-2) CPS 110 or CPS 120, Inter-
derpartmental with the Department of Com-
puter Science.
Numerical control, Computer-Aided Numerical
Control, Direct Numerical Control, and adap-
tive control applied in present day manufac-
turing. Use of the APT language to control NC
machines.

351. Mechanical Engineering Analysis
Fall, Winter. 4(4-0) CPS 120 or concurrently; MTH 310.
Application of analytical and numerical methods to the solution of problems encoun-
tered in mechanical engineering.

352. Introduction to Systems and Control
Winter. Spring. 4(4-0) PHY 288, MTH 310.
Modeling of a variety of physical systems, using state-variable concepts. Time and frequency re-
sponse of lower order linear systems. Primary ap-
plications to mechanics and hydraulics.

406. Automotive Engines
Spring. 3(3-3) M E 312.
Analysis of internal combustion engines for ve-
cular propulsion.

407. Automotive Vehicles
Fall. 3(3-0) M MM 306.
Analysis of the propulsion, braking, steering, and suspension requirements.

410. Thermomechanical Continua
Fall. 3(3-0) M M M 211.
Reexamination of the continuum concept in the modeling of the deformation of solids and the flow of fluids. Cartesian tensor formulation of the basic physical laws involving stress and strain.

411. Heat Transfer I
Fall. Summer. 3(3-0) M E 311.
Analysis of steady-state and transient heat con-
duction; numerical solutions. Radiant heat transfer; principles and applications including radiation networks. Gaseous radiation exchange.

412. Heat Transfer II
Winter, Spring. 3(3-0) M E 333.
Natural and forced convection based on bound-
ary layer theory. Heat transfer in fluids with phase change. Heat exchangers, mass transfer.

414. Energy Conversion
Winter. 3(3-0) M E 312.
Fundamental principles of energy conversion systems—Direct energy conversion, Ther-
oelectric, thermionic, nuclear, fuel cells, mag-
netohydrodynamic, and other methods of power generation.

415. Solar Energy Conversion
Fall. 4(4-0) M E 311 or approval of de-
partment.
Principles of solar radiation. Calculations of ter-

416. Statistical Thermodynamics
313. Spring, 3(3-0) M E 311.

417. Propulsion
Spring. 3(3-0) M E 332.
Thermodynamics and fluid mechanics will be
used to study rockets, turbomachines, reciprocating engines, propellers, turboprops, and turbosnoots; a specific propulsion system will be designed.

418. Mechanical Design
Fall, Winter. 3(3-0) M M M 211.
Introduction to design, the design process, de-
sign considerations and design procedures. Ap-
plication of design principles to machine ele-
ments.

421. Mechanical Design Projects
Winter, Spring. 3(3-0) M E 421.
Application of design concepts, such as optimi-
ization, economics and reliability, through sev-
eral projects drawn from the basic areas of me-
canical engineering (thermodynamics, heat trans-
fer, fluid and solid mechanics).

424. Dynamics of Machines
Winter. 3(3-0) M E 326.
Analysis of static and dynamic forces in mecha-
nical linkages, balancing of rotating and recip-
rocating machinery, flywheel requirements, gyroscopic forces, critical speeds.

432. Aerodynamics
Winter. 3(3-0) M E 333.
Fundamentals of fluid mechanics, potential flows about bodies and airfoils, compressible flow, perturbation methods, viscous flow, boundary layers on airfoils, transition, turbulence, separation, aerodynamics of wings and bodies.

436. Cooling Processes
Winter. 3(3-0) M E 312.
Thermodynamic principles applied to the de-
sign of cooling systems in range of normal tem-
peratures to ultra low cryogenic temperature conditions. Psychrometric principles as applied to air conditioning and evaporating systems.

442. Industrial Engineering
Spring. 4(3-2) M M M 280.
Theory and techniques used by industry in planning for manufacturing. Process selection and design, work methods planning, production time standards, materials handling, and plant layout planning.

455. Mechanical Vibrations
Fall. Winter. 3(4-0) M M M 306.
Oscillator phenomena for linear systems with one and two degrees of freedom, nonlinear sys-
tem, time varying systems with deterministic excitation, and time invariant systems with non-deterministic excitations.

458. Control Theory
Winter. Spring. 4(4-0) M E 352.
Closed-loop control systems; application of transfer function analysis; design for a definite degree of stability; on-and-off controllers.

463. Computer Assisted Design
Spring. 3(2-2) M E 332, M E 411.
Mechanical engineering group projects. Computer-aided design and engineering re-

471. Flight Dynamics
Fall, 3(3-0) M M M 306.
Particle and rigid body dynamics; orbit theory; aero-
dynamic forces; propulsion; longitudinal, directiona-
al and lateral stability and control. Ranges; payload, a specific vehicle will be de-
signing.

490. Special Topics
Fall, Winter, Spring, Summer. 1 to 4 credits. May not exceed a maximum of 8 cre-
its. Approval of department.
Topics in mechanical engineering of cur-
rent interest and importance.

499. Independent Study
Fall, Winter, Spring, Summer. 1 to 6 credits. May not exceed a maximum of 8 cre-
its. Approval of department.

510. Intermediate Heat/Mass Transfer
Fall. 4(4-0) Approval of department.
Diffusion of heat and mass in stationary and mov-
ing media. Steady-state and transient proc-
ces. Combined heat and mass transfer. Radiant heat transfer.

813. Convective Heat Transfer
Winter. 3(3-0) M E 412; MTH 421.
Analysis of convective transfer of heat, mass and momentum in boundary layers and induced flows. Heat transfer with phase change of fluids.
814. Radiative Heat Transfer
Spring, 3(3-0) Approval of department.

815. Advanced Classical Thermodynamics
Fall of odd-numbered years, 3(3-0) M E 416; MTH 422 or MTII 424 concurrently.

817. Conductive Heat Transfer
Fall, 3(3-0) M E 411, M E 351.

823. Theory of Vibrations I
Fall, 4(4-0) M E 455. Interdepartmental with the Department of Metallurgy, Mechanics and Materials Science.
Discrete and continuous parameter systems with linear and nonlinear characteristics. Variational principles, equations of motion. Matrices, quadratic forms; self-adjoint operators; eigenvalues. Transient and random excitations. Theory developed through physical problems.

826. Kinematics of Machines II
Fall, 3(3-0) M E 520.

827. Machine Design III
Spring, Summer, 3(3-0) M E 491.
Strain energy method for analyzing statically indeterminate machine members, theories of failure, fatigue, use of statistics in selection of tolerances for parts in mass production. Optimum design.

828. Machine Design IV
Winter, 3(3-0) M E 421.
Application of design theory to the synthesis of complete mechanical and hydraulic systems. Stress waves due to impact loading. Critical speed.

832. Refrigration
Spring, 3(3-0) M E 436.
Characteristics of refrigerants; application details pertaining to comfort cooling, food refrigeration, air conditioning, water temperature units; refrigeration controls, and control systems.

840. Intermediate Fluid Mechanics
Fall, 3(3-0) M E 332 or C E 321.
Deformable control volumes, Navier-Stokes equations, dimensionless variables, vorticity and circulation, turbulent flow, inviscid flow, and boundary layer theory.

841. Advanced Gas Dynamics
Spring, 3(3-0) M E 432; MTH 422 or MTH 424 or approval of department.
Compressible subsonic and supersonic flow, shock waves, expansion fans, inviscid equations, perturbation theory, similarity rules, methods of measurement, method of characteristics, hodograph methods.

842. Inviscid Fluids
Spring, 3(3-0) MMM 819; MTH 322 or MTH 423.
Kinematics, dynamical equations; potential flows, transformations, Helmholtz flows, added masses, forces and moments; vortex motion, wave motion.

843. Turbulence
Winter, Summer, 4(4-0) MMM 510 or approval of department.
Basic equations of turbulent motions including momentum, kinetic energy, scalar contaminant, correlation and spectrum functions. Basic elements of statistical descriptions, isotropic and shear flows, phenomenological theories and hotwire anemometry.

851. Modeling of Engineering Systems
Fall, 4(4-0) M E 458 or E E 415. Interdepartmental with Systems Science.
Modeling of engineering devices and components; assembly into systems; bond graph representation; prediction of dynamic behavior by linear, nonlinear and simulation methods; applications to mechanical, electrical, fluid, thermal systems.

860. Topics in Parameter Estimation
Spring, 4(4-0) May reenroll for a maximum of 8 credits when different topics are taken. EIT 421 or EIT 411 recommended.

862. Mechanical and Aerospace Optimization
Winter, 3(3-0) MTII 424.
Elementary fundamentals of calculus of variations, maximum principle. Optimization techniques applied to fluids, gas dynamics, optimization of airfoil shapes, fuel consumption, heat transfer, wave propagation in solids and physical properties in plasmas.

870. Wave Motion in Continuous Media I
Winter of even-numbered years, 4(4-0) ME 450 or MMM 810. Interdepartmental with Systems Science.
Wave motion in continuous media. Solution of wave equations with emphasis on boundary conditions. Waves in solids, liquids, and gases. Applications to mechanical, electrical, fluid, thermal systems.

900. Special Topics
Fall, Winter, Spring, Summer. 2 to 4 credits. May reenroll for a maximum of 9 credits. Approval of department.
Special topics in mechanical engineering of current interest and importance.

919. Master's Thesis Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

920. Theory of Vibrations II
Winter of odd-numbered years, 4(4-0) MTII 422, MME 510 or approval of department.
Wave propagation in solids and fluids, elastodynamics, aeronautics, and structural dynamics. Wave propagation in bounded and unbounded media. Reflection, refraction, diffraction, dispersion, shock waves, and fluid dynamics. Applications to aeronautics, aerospace and underwater technology.

921. Theory of Vibrations III
Spring of odd-numbered years, Summer, 4(4-0) MMM 920 or approval of department. Interdepartmental with and administered by the Department of Metallurgy, Mechanics and Materials Science.

925. Mechanical Engineering Problems
Fall, Winter, Spring. Variable credit. May reenroll for a maximum of 9 credits. Approval of department.
Analysis of advanced engineering problems involving design, thermodynamics, fluid dynamics, gas dynamics, space.

942. Viscous Fluids
Fall of even-numbered years. 3(3-0) MMM 810 or CIE 841.
Exact solutions of Navier-Stokes equations, i.e., Oscillatory Motion, Laminar Jet, Converging Channel, etc.; Hydrodynamic Stability including free convection, surface tension, gravitational and free-surface instabilities, and Tollmien-Schlichting waves.

970. Wave Motion in Continuous Media II
Fall of even-numbered years. 4(4-0) ME 870 or approval of instructor.
Continuation of ME 870.

999. Doctoral Dissertation Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

MEDICAL TECHNOLOGY

College or Human Medicine College of Osteopathic Medicine

201. Medical Technology
Fall, 3(1-0). Approval of school.
Relationship of medical technology to medicine and research, and the necessary interaction with other paramedical sciences.

401. Seminar in Medical Technology
Spring, 1 credit. Juniors.
Acquaints students with the operation and administration of a hospital, the philosophy and understanding of the entire profession of medical technology.

495. Independent Study
Fall, Winter, Spring, Summer. 1 to 5 credits. May reenroll for a maximum of 10 credits. Approval of department.
Independent study including assigned reading and reviews of appropriate scientific periodicals.