

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

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

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

981. Methods of Complex Analysis I
Fall of even-numbered years. 3(3-0) 823 or approval of department.
Application of functions of a complex variable to contour integrals, conformal mapping, asymptotic methods, integral transform methods, Wiener-Hopf methods and special functions.

982. Methods of Complex Analysis II
Winter of odd-numbered years. 3(3-0) 981.
Continuation of 981.

983. Methods of Complex Analysis III
Spring of odd-numbered years. 3(3-0) 982.
Continuation of 982.

991. Advanced Topics in Geometry
Fall, Winter, Spring, Summer. Variable credit.

992. Advanced Topics in Analysis
Fall, Winter, Spring, Summer. Variable credit.

993. Advanced Topics in Algebra
Fall, Winter, Spring, Summer. Variable credit. Approval of department.
Structure of rings and algebras, Lie algebras, Jordan algebras, advanced algebraic number theory, advanced matrix theory, and advanced topics in group theory, Lattice theory.

994. Advanced Topics in Applied Mathematics
Fall, Winter, Spring, Summer. Variable credit. Approval of department.
Nonlinear differential equations, asymptotic theory in differential equations, existence theorem, diffraction theory, Wiener-Hopf techniques.

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

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

MECHANICAL ENGINEERING M E

College of Engineering

201. The Science of Sound I: Rock, Bach and Oscillators
Winter. 3(3-0) or 4(4-0) Interdepartmental with and administered by the Physics Department.

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 Physics Department.
Nature, generation, and propagation of sound. Acoustical phenomenon and measurements. Storage and manipulation of sound in numerical form. Music programming.

255. Computer Models in Science and Engineering
Spring. 3(3-0) CPS 110 or 120 or equivalent FORTRAN. Interdepartmental with the Computer Science Department.

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.

280. Manufacturing Processes
Fall, Winter, Spring. 3(3-0)

An introduction to the materials and processes used in manufacturing, to convert ideas into products, machines, and structures for the use of mankind. Extensive use is made of audiovisual techniques.

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 Engineering Department.

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, Winter, Summer. 3(3-0) MTH 215 or concurrently.

Zeróth, 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) 311.

Continuation of 311. Gas and vapor relations, reactive and non-reactive mixtures. Thermodynamic principles as applied to gas and vapor power and refrigeration cycles for reciprocating and turbo machinery.

315. Thermodynamics Laboratory I
Fall, Winter, Summer. 1(0-3) 311 concurrently.
Laboratory experiments applying the basic laws of thermodynamics.

316. Thermodynamics Laboratory II
Winter, Spring. 1(0-3) 312 concurrently.

Laboratory experiments investigating gases and liquid behavior and combustion from a thermodynamic viewpoint.

320. Kinematics of Machines I
Fall, Spring, Summer. 4(3-3) EGR 260; MMM 306 or concurrently.

Absolute and relative displacements, velocities, and accelerations in rigid body systems; analysis and synthesis of multi-bar linkages and rotational mechanisms.

332. Fluid Mechanics I
Winter, Spring. 4(3-3) 311; 351 or concurrently; MMM 306.

Fluid statics; Bernoulli equation; nondeformable control volume applied to conservation of mass, momentum and energy; derivation of differential equations of continuity and momentum; similitude.

333. Fluid Mechanics II
Fall, Spring. 4(3-3) 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 120. Interdepartmental with the Department of Computer Science.

Numerical control, Computer-Aided Numerical Control, Direct Numerical Control, and adaptive control applied in present day manufacturing. Use of the APT language to control NC machines.

351. Mechanical Engineering Analysis
Fall, Winter, Summer. 4(4-0) CPS 120 or concurrently, MTH 215.

Application of analytical and numerical methods to the solution of problems encountered in mechanical engineering.

352. Introduction to Systems and Control
Winter, Spring. 4(4-0) MTH 215 or concurrently.

Modeling of a variety of physical systems, using state-variable concepts. Time and frequency response of low-order linear systems. Primary applications to mechanics and hydraulics.

406. Automotive Engines
Spring. 3(2-3) 312.

Analysis of internal combustion engines for vehicular propulsion.

407. Automotive Vehicles
Fall. 3(2-3) MMM 306.

Analysis of the propulsion, braking, steering, and suspension requirements.

410. Thermomechanical Continua
Fall. 3(3-0) MMM 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. 3(3-0) 311.

Analysis of steady-state and transient heat conduction; numerical solutions. Radiant heat transfer; principles and applications including radiation networks. Gaseous radiation exchange.

**Descriptions — Mechanical Engineering
of
Courses**

412. Heat Transfer II

Winter, Spring. 3(3-0) 333.

Natural and forced convection based on boundary layer theory. Heat transfer in fluids with phase change. Heat exchangers, mass transfer.

414. Energy Conversion

Winter. 3(3-0) 312.

Fundamental principles of energy conversion systems. Direct energy conversion. Thermo-electric, thermionic, nuclear, fuel cells, magnetohydrodynamic, and other methods of power generation.

416. Statistical Thermodynamics

(313.) Spring. 3(3-0) 311.

Kinetic theory, classical statistical mechanics, and quantum statistical mechanics. Derivation of transport coefficients. Applications of statistical mechanics.

417. Propulsion

Spring. 3(3-0) 333.

Thermodynamics and fluid mechanics, theory and performance of rockets, turbojets, reciprocating engines, propellers, turboprops, turbopumps; thermodynamic cycles, component efficiencies, concepts in nuclear and radiation propulsion.

421. Machine Design I

Fall. 4(3-3) MMM 211.

Analysis and synthesis of mechanical systems; fatigue resistance; stress concentration; elasticity; non-linear elements.

422. Machine Design II

Winter. 3(2-2) 421.

Analysis and synthesis of elements of systems; hydrodynamic theory of lubrication; contact stresses; finite and infinite life design factors.

424. Dynamics of Machines

Winter. 3(3-0) 320.

Analysis of static and dynamic forces in rigid body systems; balancing of rotating and reciprocating system elements; inertial guidance; critical speeds.

432. Aerodynamics

Winter. 3(3-0) 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) 312.

Thermodynamic principles applied to the design of cooling systems in range of normal temperatures to ultra-low cryogenic temperature conditions. Psychrometric principles as applied to air conditioning and evaporating systems.

442. Industrial Engineering

Spring. 4(3-2) 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

Winter, Summer. 4(4-0) MMM 306.

Oscillatory phenomena for linear systems with one and two degrees of freedom, non-linear systems, time varying systems with deterministic excitation, and time invariant systems with non-deterministic excitations.

458. Control Theory

Spring. 4(4-0) 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) 332, 411.

Mechanical engineering group projects. Computer-aided design and engineering research. Problem formulation. Optimization.

471. Flight Dynamics

Fall. 3(3-0) MMM 306.

Particle and rigid body dynamics, vacuum trajectories, orbit theory, aerodynamic forces, propulsion, longitudinal, directional and lateral static stability and control, dynamic stability and control, range, speed, payload, and altitude performance.

490. Special Topics

Fall, Winter, Spring, Summer. 1 to 4 credits. May re-enroll for a maximum of 8 credits. Approval of department.

Special topics in mechanical engineering of current interest and importance.

499. Independent Study

Fall, Winter, Spring, Summer. 1 to 6 credits. May re-enroll for a maximum of 12 credits. Approval of department.

813. Convective Heat Transfer

Winter. 3(3-0) 412; MTH 421.

Analysis of convective transfer of heat, mass and momentum in boundary layers and inducted flows. Heat transfer with phase change of fluids.

814. Radiative Heat Transfer

Spring. 3(3-0) Approval of department.

Statistical mechanics and thermodynamics of radiation. Study of spectral properties. Radiative transfer in media. Selected applications.

815. Advanced Classical Thermodynamics

Fall of odd-numbered years. 3(3-0) 416; MTH 422 or 424 or concurrently.

Postulational treatment of the laws of thermodynamics. Equilibrium and maximum entropy postulates. Development of formal relationships. Principles for general systems. Applications to chemical, magnetic, electric and elastic systems.

817. Conductive Heat Transfer

Fall. 3(3-0) 411, 351.

Theory of steady and unsteady heat conduction in isotropic and anisotropic media. Derivation of various describing equations and boundary conditions. Numerical methods. Nonlinear problems. Heat sources. Extended surfaces. Duhamel's integral.

823. Theory of Vibrations I

Fall. 4(4-0) 455. Interdepartmental with the Metallurgy, Mechanics and Materials Science Department.

Discrete and continuous parameter systems with linear and non-linear 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) 320.

Analysis and synthesis of mechanisms using complex variables. Euler-Savary equation. Polynomial cam design. Synthesis of function generators. Computer mechanisms.

827. Machine Design III

Spring, Summer. 3(3-0) 421.

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) 421.

Application of design theory to the synthesis of complete mechanical and hydraulic systems. Stress waves due to impact loading. Critical speed.

832. Refrigeration

Spring. 3(3-0) 436.

Characteristics of refrigerants; application details pertaining to comfort cooling, food refrigeration, and ultra-low temperature units; refrigeration controls, and control systems.

840. Intermediate Fluid Mechanics

Fall. 3(3-0) 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) 432; MTH 322 or 422 or 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 810; MTH 322 or 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 810 or approval of department.

Basic equations of turbulent motions including momentum, kinetic energy, scalar contaminants, correlation and spectrum functions. Basic elements of statistical descriptions, isotropic and shear flows, phenomenological theories and hot-wire anemometry.

850. Advanced Space and Orbit Ballistics

Fall of odd-numbered years. 3(3-0) MMM 306; MTH 215, 309.

Particle motion; missile trajectories; motion of a rocket; orbits; effects of oblateness on satellite orbit; orbital lifetime; rendezvous transfer in earth-moon system; optimization; low thrust space propulsion systems; trip to Mars.

851. Modeling of Engineering Systems

Fall. 4(4-0) 458 or E E 415.

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

(818.) Spring. 4(4-0) May re-enroll for a maximum of 8 credits when different topics are taken. STT 421 or 441 recommended.

Nonlinear estimation of parameters in ordinary and partial differential equations. Related concepts in probability and statistics. Least squares, maximum likelihood and other estimators. Sequential methods. Optimum experiment design. Model-building.

862. Mechanical and Aerospace Optimization

Winter. 3(3-0) MTH 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.

890. Special Topics

Fall, Winter, Spring, Summer. 2 to 4 credits. May re-enroll for a maximum of 9 credits. Approval of department.

Special topics in mechanical engineering of current interest and importance.

899. Research

(EGR 899.) Fall, Winter, Spring, Summer. Variable credit. Approval of department.

920. Theory of Vibrations II

(MMM 904.) Winter of odd-numbered years. 4(4-0) MTH 422; 823 or approval of department. Interdepartmental with and administered by the Metallurgy, Mechanics and Materials Science Department.

Vibrations of one, two, and three-dimensional models of elastic and inelastic continua. Interaction phenomena. Stability. Variational methods. Applications to aeronautics, aerospace and undersea technology.

921. Theory of Vibrations III

(MMM 903.) Spring of odd-numbered years, Summer. 4(4-0) MMM 920 or approval of department. Interdepartmental with and administered by the Metallurgy, Mechanics and Materials Science Department.

Nonlinear oscillations. Resonance; subharmonics; self-sustained motions; stability. Methods of Poincare, van der Pol, etc. Random vibrations. Parametric excitations; stochastic processes; power spectra. Applications.

925. Mechanical Engineering Problems

Fall, Winter, Spring, Summer. Variable credit. May re-enroll 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 CHE 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.

999. Research

(EGR 999.) Fall, Winter, Spring, Summer. Variable credit. Approval of department.

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 re-enroll for a maximum of 10 credits. Approval of department.

Independent study including assigned reading and reviews of appropriate scientific periodicals.

611. Cardiology Clerkship

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. H M 602.

A clinical clerkship in which students evaluate in depth patients with cardiac diseases. This includes experiences with special diagnostic procedures including cardiac cuticularization, phonocardiography, echocardiography and electrocardiography.

612. Nephrology/Urology Clerkship

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. H M 602.

Integrated concepts of renal physiology and pathophysiology of renal disease. Clinical experience.

613. Dermatology Clerkship

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. H M 602.

Office based experience with a dermatologist to learn clinical skills in dermatology and develop observational and diagnostic skills in skin disease.

614. Medical Chest Clerkship

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. H M 602.

A clerkship covering four aspects of chest diseases: tuberculosis, diagnosis, pulmonary function, and physiology. The student works with medical residents, utilizing outpatient and hospital facilities.

615. Gastroenterology Clerkship

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. H M 602.

Referred patients with gastrointestinal problems are seen as either in- or out-patients. Many long term problems are followed. Patients with psychosocial problems are seen conjointly with Social Service.

616. Allergy Clerkship

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. 608 and H M 602 or H D 608.

Office and hospital based experience to learn and develop diagnostic skills in allergy with a review of basic therapeutics as they relate to allergic diseases.

617. Neurology Clerkship

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. H M 602.

A combined office and in-patient experience that will provide the student with an opportunity to learn the concepts of evaluation and management of neurological disease.

618. Infectious Disease Clerkship

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. H M 602 and MED 608 or H D 608. Interdepartmental with the Microbiology and Public Health Department.

The clerkship emphasizes acquisition in depth of knowledge and skills essential in solution of clinical problems in infectious and immunologic diseases. Integrated basic science input is afforded through relevant seminars.

620. Endocrinology and Metabolism Clerkship

Fall, Winter, Spring, Summer. 4 to 8 credits. May re-enroll for a maximum of 16 credits. H M 602.

Clinical and/or clinical-research clerkship to allow the student to work closely with patients having endocrine diseases, electrolyte abnormalities, endocrine hypertension or diabetes mellitus.

MEDICINE

MED

College of Human Medicine

512. Infectious Diseases

Fall. 4(3-3) MPH 511, or approval of department. Interdepartmental with and administered by the Microbiology and Public Health Department.

Infectious diseases of man, including biology of the causative microorganism, epidemiology, pathogenesis, host-parasite relationships, clinical and laboratory diagnosis, and clinical management.

590. Special Problems in Medicine

Fall, Winter, Spring, Summer. 1 to 6 credits. May re-enroll for a maximum of 12 credits. Human Medicine students or approval of department.

Each student will work under direction of a staff member on an experimental, theoretical or applied problem.

608. Senior Medical Clerkship

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 43 credits. Primary clerkship, third year Human Medicine students.

Based in community hospitals, this clerkship will stress interviewing skills, history, physical examination, along with problem solving and therapy, and care of the whole patient leading to independence in patient management.

609. Hematology Clerkship

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. 608.

Development of skills in data collection, problem solving and management related to common hematologic disorders of children and adults.

610. Oncology Clerkship

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. 608.

Development of skills in data collection, problem solving and management of the more prevalent cancers in children and adults.

MEDICAL
TECHNOLOGY

M T

College of Human Medicine
College of Osteopathic Medicine

201. Medical Technology

Fall. 1(1-0) Approval of school.

Relationship of medical technology to medicine and research, and the necessary interaction with other paramedical sciences.