31. Thermodynamics II
Fall, Winter, Spring. 3(3-0) M E 311.
Continuation of M E 311. Gas and vapor relations, reactive and non-reactive mixtures. Thermodynamic principle as applied to gas and vapor power and refrigeration cycles for reciprocating and turbo machinery.

320. Kinematics of Machines I
Fall, Spring, Summer. 4(3-3) EGR 280; M M M 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 M M 306.
Fluid statics; Bernoulli equation; nondeformable control volume applied to conservation of mass, momentum and energy; derivation of differential equations of continuity and momentum; similarity.

333. Fluid Mechanics II
Fall, Spring. 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
Fall. 4(4-0) CPS 110 or CPS 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 APL language to control NC machines.

346. Mechanical Engineering Measurements Laboratory
Winter, Spring. 2(1-3) E E 345.
Mechanical engineering experiments including accuracy, data reduction, and the measurement of pressure, velocity, temperature, heat flow and vibration.

347. Thermosciences and Energy Systems Laboratory
Fall, Spring. 2(1-3) M E 311.
Properties of pure substances; first law energy balances and second law analyses applied to a pump, turbine, refrigerator and combustion process.

351. Mechanical Engineering Analysis
Fall, Winter. 4(4-0) M E 130 or concurrently, MTH 310.
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) PHY 285; MTH 310.
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(3-3) M E 312.
Analysis of internal combustion engines for vehicular propulsion.

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

410. Thermomechanical Continua
Fall. 3(3-0) M M M 311.
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 conduction, 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 322.
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) M E 312.
Fundamental principles of energy conversion systems. Direct energy conversion. Thermoelectric, thermionic, nuclear, fuel cells, magneto-hydrodynamic, and other methods of power generation.

415. Solar Energy Conversion
Fall. 4(4-0) M E 311 or approval of department.

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

417. Propulsion
Spring. 3(3-0) M E 333.
Thermodynamics and fluid mechanics will be used to study rockets, turbojets, reciprocating engines, propellers, turbochargers, and turbosan. A specific propulsion system will be designed.

421. Mechanical Design
Fall, Winter. 3(3-0) M M M 211.
Introduction to design, the design process, design considerations and design procedures. Application of design principles to machine elements.

422. Mechanical Design Projects
Winter, Spring. 3(3-0) M E 421.
Application of design concepts, such as optimization, economics and reliability, through several projects drawn from the basic areas of mechanical engineering (thermodynamics, heat transfer, fluid and solid mechanics).

424. Dynamics of Machines
Winter. 3(3-0) M E 320.
Analysis of static and dynamic forces in mechanical linkages; balancing of rotating and reciprocating machinery; flywheel requirements, gyroscopic forces, critical speeds.
632. Aerodynamics
Winter, Spring, 3-4 credits. 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, 3-4 credits. M E 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.

455. Mechanical Vibrations
Fall, Winter, 4-4 credits. M MM 306.
Oscillatory phenomena for linear systems with one and two degrees of freedom, nonlinear systems, time varying systems with deterministic excitation, and time invariant systems with non-deterministic excitations.

458. Control Theory
Winter, Spring, 4-4 credits. 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-Aided Design I
Winter, 3-2 credits. CPS 120, M TH 534.
Three-dimensional transformations, perspectives, contour surface layout for design and manufacturing, an introduction to finite element applications.

464. Computer-Aided Design II
Spring, 3-2 credits. M E 455, M E 463 and approval of department.
Modal analysis of dynamic systems; identification of nodal characteristics from input-output data; computer techniques including graphics, eigenvalue and Fourier transform computations.

471. Flight Dynamics
Fall, 3-3 credits. M MM 306.
Particle and rigid body dynamics, orbit theory; aerodynamic forces; propulsion; longitudinal, directional and lateral stability and control; range, payload, a specific vehicle will be designed.

490. Special Topics
Fall, Winter, Spring, Summer. 1 to 4 credits. May be reenrolled 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 be reenrolled for a maximum of 9 credits. Approval of department.

814. Radiative Heat Transfer
Spring, 3-3 credits. M E 436.

815. Advanced Classical Thermodynamics
Fall of odd-numbered years, 3-3 credits. M E 416, M TH 422 or M TH 424 or concurrently.

817. Conductive Heat Transfer
Fall, 3-4 credits. M E 411, M E 351.

823. Theory of Vibrations I
Fall, 4-4 credits. 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 credits. M E 320.

827. Machine Design III
Spring, Summer. 3-3 credits. M E 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. 3-4 credits. M E 421.
Application of design theory to the synthesis of complete mechanical and hydraulic systems. Stress waves due to impact loading. Critical speeds.

832. Refrigeration
Spring, 3-3 credits. M E 436.
Characteristics of refrigerants; application details pertaining to comfort cooling, food refrigeration, and ultra-low temperature units; refrigeration controls, and control systems.

841. Advanced Gas Dynamics
Spring, 3-3 credits. M E 432; M TH 322 or M TH 422 or M TH 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, 4-4 credits. M MM 410, M TH 322 or M TH 422.
Kinematics; dynamical equations; potential flows, transformations, Helmholtz flows; added masses, forces and moments; vortex motion, wave motion.

843. Turbulence
Winter, Summer. 4-4 credits. M MM 410 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 hotwire anemometry.

851. Modeling of Engineering Systems I
Fall, 3-3 credits. M E 458 or E E 415. Interdepartmental with Systems Science.
Modeling of engineering components and dynamic systems; mechanical, electrical, fluid, thermal, and transducer effects. Linear state-space responses, impedance methods. Simulation of linear models. Design project.

852. Modeling of Engineering Systems II

853. Finite Dimensional Dynamical Systems
Spring, 3-3 credits. M E 851 or SYS 826 or approval of department.
Transition matrices and matrix exponentials, periodicity and reducibility; controllability and observability, weighting patterns, realizations and minimal realizations, least squares theory, fine and fixed endpoint problems, canonical equations, conjugates and focal points.

854. Optimization Theory and Applications
(852.) Winter, 4-4 credits. M TH 424 or approval of department.
Formulation of optimization problems; projection methods and least squares theory; elementary fundamentals of calculus of variations; techniques applied to problems in dynamics, optimization of airfoil shapes, and fuel consumption.
999. Doctoral Dissertation Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

MEDICAL TECHNOLOGY

College of Natural Science

201. Medical Technology
Fall, (1-4) 3 credits, approval of school. Relationship of medical technology to medicine and research, and the necessary interaction with other paramedical sciences.

461. 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. 1 to 5 credits. May reenroll for a maximum of 10 credits. Approval of department. Independent study and reenrollment of assigned readings and reviews of appropriate scientific periodicals.

MEDICINE

College of Human Medicine

512. Infectious Diseases
Winter. 4 credits. MHP 511, or approval of department. Interdepartmental with and administered by the Department of Microbiology and Public Health. Infectious diseases of humans, including biology of the causative microorganism, epidemiology, pathogenesis, host-parasite relationships, clinical and laboratory diagnosis, and clinical management.

520. Biology of Blood Diseases
Spring. 2 credits. Enrollment in a college of medicine or a graduate program in a biological science. Correlates basic science and clinical concepts of hematology.

590. Special Problems in Medicine
Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 12 credits. Human Medicine students or approval of department. Each student will work under the direction of a staff member on an experimental, theoretical, or applied problem.

607. Ambulatory Care Clerkship
Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 9 credits. Human Medicine students or approval of department. Outpatient experience, lasting an equivalent of 48 half days or a period of six months or more, emphasizing continuous and comprehensive patient care under the supervision of appropriate physicians.

608. Senior Medical Clerkship
Fall, Winter, Spring, Summer. 1 to 17 credits. May reenroll 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 reenroll for a maximum of 43 credits. 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 reenroll for a maximum of 43 credits. Development of skills in data collection, problem solving and management of the more prevalent cancers in children and adults.

611. Cardiology Clerkship
Fall, Winter, Spring, Summer. 1 to 17 credits. May reenroll for a maximum of 43 credits. H M 602.

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

612. Nephrology/Urology Clerkship
Fall, Winter, Spring, Summer. 1 to 17 credits. May reenroll for a maximum of 43 credits. H M 602.


613. Dermatology Clerkship
Fall, Winter, Spring, Summer. 1 to 17 credits. May reenroll for a maximum of 43 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 reenroll for a maximum of 43 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 reenroll for a maximum of 43 credits. H M 602.

Patients with gastrointestinal illness are seen as either inpatients or outpatients. Many long term problems are followed. Patients with psychosocial problems are seen jointly with Social Service.

616. Allergy Clerkship
Fall, Winter, Spring, Summer. 1 to 17 credits. May reenroll for a maximum of 43 credits. H M 608 and H M 602 or PHD 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.