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

316. Thermodynamics Laboratory II
Winter, Spring. 1(0-3) ME 312 concurrently.
Laboratory experiments investigating gases and liquid behavior and combustion from a thermodynamic viewpoint.

320. Kinematics of Machines I
Fall, Spring. 4(3-3) EGR 260, 336 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) ME 311; ME 332 or concurrently, MTH 356.
Fluid flow; Bernoulli equation; nondimensional 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) ME 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(3-3) CPS 110 or CPS 120 or equivalent FORTRAN. 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 machine.

351. Mechanical Engineering Analysis
Fall, Winter, Spring. 4(4-0) ME 370 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) PHY 288, 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 312.
Analysis of internal combustion engines for vehicular propulsion.

407. Automotive Vehicles
Fall. 3(2-3) MME 306.
Analysis of the propulsion, braking, steering, and suspension requirements.

410. Thermomechanical Continua
Fall. 3(3-0) MME 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) ME 311.

412. Heat Transfer II
Winter, Spring. 3(3-0) ME 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) ME 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) ME 311 or approval of department.

416. Statistical Thermodynamics
Spring. 3(3-0) ME 313.

417. Propulsion
Winter. 3(3-0) ME 333.
Thermodynamics and fluid mechanics will be used to study rockets, turboprops, reciprocating engines, propellers, turboprop, and turbofans; a specific propulsion system will be designed.

421. Mechanical Design
Fall, Winter. 3(3-0) MME 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) ME 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) ME 320.
Analysis of static and dynamic forces in rigid body systems; balancing of rotating and reciprocating system elements, inertial guidance; critical speeds.

432. Aerodynamics
Spring. 3(3-0) ME 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 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) M E 290 or approval of department.
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. 4(4-0) M M 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. 4(4-0) M F 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 M 332, M E 411.

471. **Flight Dynamics**  
Fall. 3(3-0) M M 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 reenroll 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 reenroll for a maximum of 12 credits. Approval of department.

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

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

823. **Theory of Vibrations I**  
Fall. 4(4-0) M E 435. Interdepartmental with the department of Metallurgy, Mechanics, and Materials Science.

826. **Kinematics of Machines II**  
Fall. 3(3-0) M E 320.

827. **Machine Design III**  
Spring. 3(3-0) 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(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. **Refrigeration**  
Spring. 3(3-0) M E 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) 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 322 or 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. **Inertial Fluids**  
Spring. 3(3-0) M M 810; MTH 322 or MTH 423.
Kinematics; dynamical equations; potential flows, transformations, Helmholtz flows; added masses, forces and moments, vortex motion; wave motion.

851. **Modeling of Engineering Systems**  
Fall, 4(4-0) M E 455 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. SST 421 or SST 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.

861. **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.

867. **Wave Motion in Continuous Media I**  
Winter of even-numbered years. 4(4-0) MTH 422, MTH 810 or approval of department. Linear and nonlinear waves in bounded and unbounded media. Reflection, refraction, diffraction, dispersion. Shock and acceleration waves. Waveguides, acoustical and optical analogies. Application to elastic, viscoelastic, plastic and fluid media.

890. **Special Topics**  
Fall, Winter, Spring, Summer. 2 to 4 credits. May reenroll for a maximum of 8 credits. Approval of department. Special topics in mechanical engineering of current interest and importance.

899. **Research**  
Fall, Winter, Spring. Variable credit. Approval of department.

920. **Theory of Vibrations II**  
Winter of odd-numbered years. 4(4-0) MTH 422, M M 823 or approval of department. Interdepartmental with and administered by the Department of Metallurgy, Mechanics, and Materials Science.
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.

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

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

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

Medical Technology - Descriptions of Courses

College of Human Medicine

512. Infectious Diseases
Fall, 4(3-3) MPH 511, or approval of department. Interdepartmental with and administered by the Department of Microbiology and Public Health.
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 reenroll 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 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 34 credits. MED 608.
Development of skills in data collection, problem solving and management related to common hematologic disorders in children and adults.

610. Oncology Clerkship
Fall, Winter, Spring, Summer. 1 to 17 credits. May reenroll for a maximum of 34 credits. MED 608.
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 34 credits. MED 602.
A clinical clerkship in which students evaluate in depth patients with cardiac diseases. This includes experiences with special diagnostic procedures including cardiac catherization, phonocardiography, echocardiography and electrocardiography.

612. Nephrology/Urology Clerkship
Fall, Winter, Spring, Summer. 1 to 17 credits. May reenroll for a maximum of 34 credits. MED 602.

613. Dermatology Clerkship
Fall, Winter, Spring, Summer. 1 to 17 credits. May reenroll for a maximum of 34 credits. MED 602.
Office based experience with a dermatologist to learn clinical skills in dermatology and develop observational and diagnostic skills in skin disease.

Medical Chest Clerkship
Fall, Winter, Spring, Summer. 1 to 17 credits. May reenroll for a maximum of 34 credits. MED 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.

Gastroenterology Clerkship
Fall, Winter, Spring, Summer. 1 to 17 credits. May reenroll for a maximum of 34 credits. H M 602.
Referred patients with gastrointestinal problems are seen as either inpatients or outpatients. Many long-term problems are followed. Patients with psychosocial problems are seen conjointly with Social Service.

Allergy Clerkship
Fall, Winter, Spring, Summer. 1 to 17 credits. May reenroll for a maximum of 34 credits. MED 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.

Neurology Clerkship
Fall, Winter, Spring, Summer. 1 to 17 credits. May reenroll 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.

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

Clinical Pharmacology Clerkship
Fall, Spring. 4 credits. MED 602.
Understanding and use of drugs; adverse effects; and misuse of drugs.

Endocrinology and Metabolism Clerkship
Fall, Winter, Spring, Summer. 4 to 16 credits. May reenroll 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.

Computer Medicine Clerkship
Fall, Winter, Summer. 4 to 16 credits. May reenroll for a maximum of 16 credits. H M 602.
Learning BASIC computer language: preparing flow chart for elementary management of medical problem.

Diabetes and Metabolism Clerkship
Fall, Winter, Spring, Summer. 4 to 16 credits. H M 602.
Clinical experience with diabetic patients and other related endocrine disorders.