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.

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.

917. *Statistical Thermodynamics and Kinetic Theory of Gases*

Fall of even-numbered years. 3(3-0) 416; MTH 322 or 422; or approval of department.

Relation of statistical mechanics and kinetic theory to thermodynamics. Maxwell-Boltzman, Bose-Einstein, and Fermi-Dirac statistics. Information and communication theory. Jayne's formalism. Applications.

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.

923. *Wave Motion in Continuous Media I*

Winter of even-numbered years. 4(4-0) MTH 422; MMM 810; or approval of department.

Linear and non-linear wave propagation. Reflection, refraction, diffraction. Dispersion. Shock and acceleration waves. Acoustical and optical analogies. Applications to elastic, plastic, viscoelastic, fluid, electromagnetic, elastic dielectric, and stochastic media.

924. *Wave Motion in Continuous Media II*

Spring of even-numbered years. 4(4-0) 923.

Continuation of 923.

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.

930. *Seminar*

Fall, Winter, Spring. 1 credit. May re-enroll for a maximum of 3 credits in master's program; 6 credits in doctoral program. Open to graduate students of all colleges and departments.

Recent developments in space orbit theory, theory of space propulsion, magnetohydrodynamics, re-entry phenomena, ionosphere, space radiation phenomena, design of space vehicles, and developments in the field pertinent to space technology such as external environmental conditions, internal environmental conditions, effects upon space vehicle construction, etc.

941. *Advanced Gas Dynamics II*

Fall of odd-numbered years. 3(3-0) 841.

Transonic flows, blunt bodies in supersonic flows, three-dimensional supersonic flows, hodograph methods, characteristics, unsteady phenomena, physical gas dynamics.

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.

952. *Slip and Free (Newtonian) Molecular Flows*

Spring. 3(3-0) 412, 432.

Distribution function; Boltzmann equation; solutions of Enskog-Burnett, Grad; slip flow; drag coefficient; heat transfer. Free molecule flow; elastic and inelastic reflections; flow around bodies; resistance coefficient; heat; oblation; meteors.

953. *Plasma Dynamics (Magneto-Gas Dynamics)*

Winter. 3(3-0) 432; PHY 491.

Fundamental equations of hydrodynamics; Maxwell equations; continuum; channel flow; boundary layer; shocks; Alfven wave propagation; one and two fluid theories; discrete particle approach; plasma oscillations; flow around bodies and in nozzles; space propulsion systems.

999. *Research*

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

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.

401. *Seminar in Medical Technology*

Fall. 1 credit. Seniors.

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.

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.

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. H M 603.

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. H M 603.

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 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.

METALLURGY, MECHANICS AND MATERIALS SCIENCE MMM

College of Engineering

201. Introduction to Engineering Mechanics

Winter. 4(4-0) PHY 237. Interdepartmental with the Engineering Department.

Laws of mechanics governing the behavior of rigid and deformable bodies emphasizing how these laws influence engineering design. Extensive use of demonstrations.

205. Mechanics I

Fall, Winter, Spring, Summer. 4(4-0) MTH 214 or concurrently.

Vector description of forces and moments. Two and three dimensional equilibrium problems. Statics of frames and machines. Friction. Shear and moments in beams and shafts.

211. Mechanics of Deformable Solids

Fall, Winter, Spring, Summer. 4(4-0) 205 or statics; MTH 215.

Deformable solids, stress and strain, principal axes, material behavior (elastic, plastic, viscoelastic, temperature dependent). Boundary value problems, torsion, beams. Instability, columns.

215. Materials Testing Laboratory

Fall, Winter, Spring, Summer. 1(0-3)

Physical properties of engineering materials, resistance to primary types of static loading.

230. Introduction to Materials Science

Spring. 4(4-0) Sophomores.

A qualitative survey of metals, ceramics, and polymers, and the relationship of electronic, molecular, and crystal structure to the physical, mechanical, thermal, electrical and magnetic properties.

306. Mechanics II

(206.) Fall, Winter, Spring, Summer. 4(4-0) 205, MTH 215 or concurrently.

Dynamics of particles and particle systems. Energy and momentum principles. Two and three dimensional rigid body dynamics.

320. Analytical Mechanics I

Fall. 3(3-0) MTH 215; PHY 289.

Measures of point motion, indicial notation, vector space and time transformations. Newton's, Lagrange's and Hamilton's equations. Motions of point objects; limiting wave forms.

321. Analytical Mechanics II

Winter. 3(3-0) 320.

Schrodinger's equation. Particle motions in various potentials; hydrogen-like atoms and molecules. Continuum models of particle systems; tensor properties, rigid and elastic solids, transfer of heat and electricity, flow relations.

340. Materials Chemistry I

Fall. 4(4-0) CEM 153.

An integrated treatment of the physical chemistry of metals and other engineering materials is presented by 340, 341 and 342. Physicochemical systems; thermodynamics and thermochemistry; equilibrium; solutions and phase equilibrium; electrochemistry; corrosion; reaction kinetics in condensed phases; diffusion; surface phenomena.

341. Materials Chemistry II

Winter. 4(4-0) 340 or approval of department.

Continuation of 340.

342. Materials Chemistry III

Spring. 4(4-0) 341.

Continuation of 340, 341.

360. Physical Metallurgy I

Fall. 4(4-0) CEM 153 or approval of department.

Relationship of properties to microstructure as affected by solidification transformations in heterogeneous systems, cold work, recrystallization, and grain growth. Emphasis on the important commercial metals and alloys.

361. Physical Metallurgy II

Winter. 4(4-0) 360.

Continuation of 360.

362. Physical Metallurgy III

Spring. 4(4-0) 360, 361.

Continuation of 360, 361.

370. Metals and Alloys I

Fall, Winter. 4(3-3)

Principles of physical metallurgy applied to engineering metals and alloys.

371. Metals and Alloys II

Winter. 3(3-0) 370.

Continuation of 370.

372. Metals and Alloys III

Spring. 3(3-0) 371.

Continuation of 371.

375. Failure Analysis

Spring. 3(3-0) Juniors and 211.

Modes and causes of failure of mechanical components. Steps in analyzing failures are illustrated through individual projects. Field trip required.

380. Physical Metallurgy Laboratory I

Fall. 1(0-3) 360 or concurrently.

First of an integrated sequence of laboratory courses designed to illustrate the parallel theory courses. Introduction to metallography, pyrometry, and testing of metals.

381. Physical Metallurgy Laboratory II

Winter. 1(0-3) 380; 361 concurrently.

Continuation of 380.

382. Physical Metallurgy Laboratory III

Spring. 1(0-3) 381; 362 concurrently.

Continuation of 381.

400. Special Problems

Fall, Winter, Spring, Summer. 1 to 3 credits. May re-enroll for a maximum of 9 credits. Approval of department.

Individualized reading and research.