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.  
Referral patients with gastrointestinal problems are seen as either in- or outpatient. 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 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.

619. Clinical Pharmacology Clerkship  
Fall, Spring. 4 to 8 credits. H M 602; MED 608 and H D 608.  
Understanding and use of drugs; adverse effects; and misuse of drugs.

620. Endocrinology and Metabolism Clerkship  
Fall, Winter, Spring. 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, electrocardiograms, endocrine hypertension or diabetes mellitus.

621. Computer Medicine Clerkship  
Fall, Winter, Summer. 4 to 16 credits. May re-enroll for a maximum of 16 credits. H M 602.  
Learning BASIC computer language; preparing flow chart for elementary management of medical problems.

622. Diabetes and Metabolism Clerkship  
Fall, Winter, Summer. 4 credits. H M 602; MED 608 and H D 608.  
Clinical experience with diabetic patients and other related endocrine disorders.

624. Geriatrics Clerkship  
Fall, Winter, Spring, Summer. 16 credits. H M 602; MED 608 and H D 608.  
Experience to a wide variety of geriatric medical problems.

625. Internal Medicine Clerkship  
Fall, Winter, Spring, Summer. 4 to 18 credits. May re-enroll for a maximum of 16 credits. H M 602; MED 608 and H D 608.  
Elective experiences in internal medicine.

METALLURGY, MECHANICS AND MATERIALS SCIENCE

College of Engineering

201. Introduction to Engineering Mechanics  
Winter. 4(4-0) PHY 237, Interdepartmental with the Department of Engineering. Laws of mechanics governing the behavior of rigid and deformable bodies. Emphasis on 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; 216 or concurrently. MTH 215.  
Deformable solids, stress and strain, principal axes, material behavior (elastic, plastic, viscous), temperature-dependent behavior, boundary value problems, torsion, beams. Instability, columns.

218. Materials Testing Laboratory  
Fall, Winter, Spring. 1(0-3) 311 or concurrently.  
Physical properties of engineering materials. Residence to primary types of static loading.

351. Materials Chemistry II  
Spring. 4(4-0) CET 361 or M E 311.  
An integrated treatment of the physical chemistry of metals and engineering materials presented in 341 and 342. Thermochemistry, solutions, phase equilibria; electrochemistry; corrosion; reaction kinetics; solids and liquids; diffusion; surface phenomena.

342. Materials Chemistry III  
Spring. 4(4-0) 341.  
Continuation of 341.

360. Physical Metallurgy I  
Fall. 4(4-0) CET 153 or approval of department.  
Relationship of structures 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 380.

370. Metals and Alloys I  
Fall. Winter. 4(3-3)  
Principles of physical metallurgy applied to engineering metals and alloys.
382. Physical Metallurgy Laboratory III
Spring. 1(0-3) 381.
Continuation of 381.

400. Special Problems
Fall, Winter, Spring. 1 to 3 credits. May re-enroll for a maximum of 9 credits. Approval of department.
Individualized reading and research.

404. Dynamics of Mechanical Systems
Fall. 3(3-4) 306.

411. Mechanics of Deformable Solids II
Spring. 3(3-4) 311.
Continuation of 311. Unsymmetrical bending, curved beams, torsion of non-circular shapes, shear center, beam columns. Introduction to energy theorems with applications to determine indeterminate beams, and rings.

413. Applied Solid Mechanics
Winter. 3(3-4) 311.
Methods of solution of problems in elasticity, plasticity and viscoelasticity. One- and two-dimensional mathematical models will be considered.

414. Principles and Techniques of Experimental Solid Mechanics
Spring. 3(3-4) 311.
Fundamental concepts and current technology for static and dynamic measurement of strain and acceleration. Main topics discussed are resistance strain gages, photoelasticity, accelerometers; brittle coatings, Moire patterns, and holography.

430. X-Ray Crystallography
Fall. 4(3-3) 342 or approval of department.
Symmetry, elementary crystallography, general properties of X-rays, introduction to radiation safety, interaction of X-rays with matter, application of X-ray diffraction to materials problems.

440. Color and Appearance of Materials
Spring. 3(3-4) Approval of department.
Color in art and technology, light and its interaction with colored materials; light sources and illuminants; color notation and classification; colored materials.

455. Advanced Physical Metallurgy I
Winter. 3(3-4) PHY 346 or approval of department.
Atomic theory of metals and alloys. Nature of chemical and metallic bonds, Lattice vibration and specific-heat theory. Relation of electron energy bands in metals to cohesion, structure, electrical and magnetic properties.

456. Advanced Physical Metallurgy II
Spring. 3(3-4) 455.

460. Metallurgical Engineering I
Fall. 4(3-2) Approval of department.

461. Metallurgical Engineering II
Winter. 4(3-2) 460 or approval of department.

462. Metallurgical Engineering III
Spring. 4(3-3) 491 or approval of department.

470. The Cast Alloys
Winter. 4(4-0) 372.
Physical metallurgy of the cast alloys. Solidification and transformation, Nucleation and inoculation. Modes of solidification as influencing foundry properties in ferrous and nonferrous alloys. Casting design as related to foundry practice.

475. Alloy Development and Application
Fall. 4(4-0) 361, or approval of department.
Physical metallurgy, development, and applications of special steels and alloys: the high-strength structural steels, machine steels, ultra-high-strength steels, marring steels, corrosion-resistant steels and alloys, high-temperature alloys.

500. Optical Strain Measurement
Winter of even-numbered years. 4(3-3) Approval of department.
Whole-field techniques such as photoelasticity, photoelastic coatings, Moire techniques, and birefringent interferometers and model analysis. Necessary theory of optics is presented.

509. Finite Element Method
Fall. 4(4-0) Approval of department. Interdepartmental with the Department of Agricultural Engineering and Civil Engineering.
Theory and application of the finite element method to the solution of continuum type problems in heat transfer, fluid mechanics and stress analysis.

510. Introduction to the Mechanics of a Continuous Medium
Fall, Summer. 4(4-0) 211; MTH 421 concurrently or approval of department.

513. Theory of Elasticity I
Winter. 4(4-0) 810; MTH 422 or approval of department.

515. Advanced Strength of Materials I
Fall, Summer. 3(3-0) 211.
Elasticity, energy methods, general bending of straight bars, curved beams, shear center, torsion.

516. Advanced Strength of Materials II
Winter. 3(3-0) 815; MTH 215.
Beams on elastic support, beam columns, axially symmetric stress distribution, symmetrical bending of circular plates, introduction to theory of elasticity.

517. Plasticity
Spring. 4(4-0) 810; MTH 422 or approval of department.
Yield conditions, stress-strain relations, plastic potential, hardening theories; torsion, bending, thick-walled spherical and cylindrical shells under internal pressure; plane strain of perfectly plastic material.

523. Theory of Vibrations I
Fall. 4(4-0) M E 435. Interdepartmental with and administered by the Department of Mechanical Engineering.
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.

531. Advanced X-Ray Metallurgy
Winter. 3(3-0) Approval of department.
Development of crystallographic space groups, theory of the intensity of diffracted X-rays; Weissenberg method, crystal structure analysis.

532. Electron Microscopy
Spring. 4(3-3) 831 or approval of department.
Theory of image formation in electron microscopy and intensity of electron diffraction. Transmission and replica microscopy.
840. Symmetry and the Properties of Crystals
Winter. 3(3-0)
Point-group theory and symmetry in tensor properties of crystals; systematic treatment of properties, e.g., electrical polarization, magnetic induction, pyro- and piezo-electricity, elasticity, transport properties and birefringence.

850. Modern Ceramic Materials I
Fall. 3(3-0) CEM 492; PHY 840; or approval of department.
Crystalline microstructure and microstructure of ceramics and glasses; dependence of microstructure on amount, size, shape, and distribution of phases; modification of microstructure by control of nucleation and growth; composite materials.

851. Modern Ceramic Materials II
Winter. 3(3-0) 850.
Properties of ceramic materials with specific reference to mechanical, optical, electrical, magnetic and thermal properties.

852. Modern Ceramic Materials III
Spring. 3(3-0) 850.
Applications of ceramic materials Glass-ceramics, nuclear fuel elements, hot-pressed translucent oxides, pre-stressed ceramics, ceramic coatings, pyrolytic materials.

860. Theoretical Metallurgy I
Fall. 3(3-0) 342.
Metallurgical thermodynamics, introduction to statistical thermodynamics, kinetics of metallurgical processes.

861. Theoretical Metallurgy II
Winter. 3(3-0) 860.
Introduction to quantum theory of metals, physical properties of metals and alloys.

862. Theoretical Metallurgy III
Spring. 3(3-0) 860.
Imperfection in crystalline solids, dislocation theory and mechanical properties of metals and alloys.

875. Ferrous Metallurgy
Fall. 3(3-0) 493.
Stoichiometric and heat balance calculations of the blast furnace, open hearth and electric furnace processes.

876. Nonferrous Process Metallurgy
Winter. 3(3-0) 492.
Stoichiometric and heat balance calculation in nonferrous extractive metallurgy.

880. Metals and Alloys I
Fall. 3(3-0) 372.
Topics in engineering properties and application of wrought steels for engineer other than metallurgical.

881. Metals and Alloys II
Winter. 3(3-0) 372.
Similar to 880, but with reference to nonferrous alloys.

882. Metals and Alloys III
Spring. 3(3-0) 372.
Similar to 880, but with reference to cast alloys.

885. Seminar
Fall, Winter, Spring. 1 credit. 885 concurrently.

900. Special Problems
Fall, Winter, Spring. 1 to 6 credits. May re-enroll for a maximum of 6 credits. Approval of department. Individualized reading and research compatible with the student's interest and ability.

909. Elastic Thin Shells
Spring. 4(4-0) 815 or C E 804 or approval of department; MTH 451. Interdepartmental with and administered by Civil Engineering.
Elements of differential geometry, membrane theory of shells, Focchi's stress function, deformation and bending of shells of revolution and shallow shells.

910. Nonlinear Continua
Winter of even-numbered years. 4(4-0)
Modern nonlinear theories of continua. Equations of balance and constitutive equations. Topics selected from finite elasticity, nonlinear viscoelasticity, dislocation and molecular theories.

911. Theory of Elastic Stability
Fall of odd-numbered years. 4(3-0) 815 or approval of department.
Theory and methods of determining buckling strength and post-buckling behavior of bars, plate and shell elements and of elastic systems.

912. Theory of Plates
Winter. 4(3-0) 815 or C E 804 or approval of department; MTH 451. Interdepartmental with Civil Engineering.
Bending of thin elastic plates with various shapes and boundary conditions; application of energy principles and approximate methods of solution; thick plates; large deflection theory; sandwich plates.

913. Theory of Elasticity II
Spring. 3(3-0) 813 or approval of department.
Saint-Venant bending and torsion. Problems in three-dimensional linear elasticity using the Galerkin vector and Neuber-Papkovitch functions.

918. Theory of Viscoelasticity
Fall of even-numbered years. 3(3-0) 810; MTH 452 or approval of department. Fundamental linear viscoelastic stress-strain relations. Model representation, three dimensional and general deformation laws. Correspondence principle. Quasi-static, dynamic and buckling problems.

920. Theory of Vibrations II
Fall of odd-numbered years. 4(4-0) MTH 452; M E 823 or approval of department. Interdepartmental with the Department of Mechanical Engineering.

921. Theory of Vibrations III
Spring of even-numbered years, Summer. 4(4-0) 920 or approval of department. Interdepartmental with the Department of Mechanical Engineering.
Nonlinear oscillations; Renonescence; subharmonics; self-sustained motions; stability. Methods of Polineuse, van der Pol, etc. Random vibrations. Parametric excitations, stochastic processes; power spectra. Applications.

941. Advanced Topics in Mechanical Metallurgy
Fall of even-numbered years; Winter and Spring of odd-numbered years. 3(3-0) May re-enroll for a maximum of 9 credits. Various aspects of dislocation theory and its application to the mechanical and physical properties of solids.

942. Advanced Topics in the Kinetics of Phase Transformation
Fall of odd-numbered years; Winter and Spring of even-numbered years. 3(3-0) May re-enroll for a maximum of 9 credits.

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

MICROBIOLOGY AND PUBLIC HEALTH MPH

College of Human Medicine
College of Natural Science
College of Osteopathic Medicine
College of Veterinary Medicine

100. Preview of Microbiology
Fall, Winter. 2(3-0) Freshmen and Sophomores only.
Science and scientists of microbiology, presented in historical perspective and carried to the forefront of current research. A rigorous preview for students intensely curious about microbiology.

200. Elementary Microbiology
Fall, Winter. 4(3-0) Three terms of Natural Science. Eligible only for majors outside the College of Natural Science.
Description of bacteria and related forms of life with emphasis on their role in disease, medicine, and industry. Developmental history of the microbe in the laboratory. Modern techniques in microbiology.

234. Elementary Medical Microbiology
Fall. 4(4-4) Three terms of Natural Science. Primarily for Nursing students. Survey of immunology and microbiology with emphasis on pathogenic microorganisms, anti-microbial agents, and laboratory diagnosis.