MEDICINE

College of Human Medicine

512. Infectious Diseases
Spring, 4(3-3) MPH 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 microorganisms, 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.

607. Ambulatory Care Clerkship
Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 9 credits. FMP 602, approval of department.
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.

608. Internal Medicine Clerkship
Fall, Winter, Spring, Summer. 2 to 18 credits. May reenroll for a maximum of 42 credits. FMP 602, approval of department.
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. 2 to 12 credits. May reenroll for a maximum of 12 credits. MED 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. 2 to 12 credits. May reenroll for a maximum of 12 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. 2 to 12 credits. May reenroll for a maximum of 12 credits. MED 608.
A clinical clerkship in which students evaluate in depth patients with cardiac diseases. This includes experiences with special diagnostic procedures including cardiac catheterization, phonocardiography, echocardiography and electrocardiography.

612. Nephrology Clerkship
Fall, Winter, Spring, Summer. 2 to 12 credits. May reenroll for a maximum of 12 credits. MED 608.

613. Dermatology Clerkship
Fall, Winter, Spring, Summer. 2 to 12 credits. May reenroll for a maximum of 12 credits. MED 608.
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. 2 to 12 credits. May reenroll for a maximum of 15 credits. MED 608.
A clerkship covering four aspects of chest disease: tuberculosis, diagnosis, pulmonary function, and physiology. The student works with medical residents, utilizing outpatient and hospital facilities.

615. Gastroenterology Clerkship
Fall, Winter, Spring, Summer. 2 to 12 credits. May reenroll for a maximum of 12 credits. MED 608.
Referred patients with gastrointestinal problems are seen as either inpatient or outpatients. Many long term problems are followed. Patients with psychosocial problems are seen conjointly with Social Service.

616. Allergy Clerkship
Fall, Winter, Spring, Summer. 2 to 12 credits. May reenroll for a maximum of 12 credits. MED 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. 2 to 12 credits. May reenroll for a maximum of 12 credits. MED 608.
A combined office and inpatient 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. 2 to 12 credits. May reenroll for a maximum of 15 credits. MED 608.
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. 2 to 12 credits. May reenroll for a maximum of 12 credits. MED 608.
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.

626. Physical Medicine and Rehabilitation Clerkship
Fall, Winter, Spring, Summer. 2 to 12 credits. May reenroll for a maximum of 12 credits. MED 608.
Experience in prescription writing for physical medicine procedures, occupational therapy and rehabilitation skills.

627. Rheumatology Clerkship
Fall, Winter, Spring, Summer. 2 to 12 credits. May reenroll for a maximum of 12 credits. MED 608.
Combined office and hospital consultative clerkship which develops diagnostic skills in areas of rheumatic diseases.

625. Advanced Internal Medicine Clerkship
Fall, Winter, Spring, Summer. 2 to 18 credits. May reenroll for a maximum of 30 credits. MED 608.
Clinical experiences which refine diagnostic and management skills in general internal medicine.

630. Emergency Medicine Clerkship
Fall, Winter, Spring, Summer. 2 to 18 credits. May reenroll for a maximum of 18 credits. MED 608.
Pathophysiology and other basic concepts will be used to explain the development of emergent conditions. Clinical diagnosis and treatment of emergencies seen in community-emergency departments will be discussed.

632. Occupational Medicine Clerkship
Fall, Winter, Spring, Summer. 2 to 12 credits. MED 608.

METALLURGY, MECHANICS, AND MATERIALS SCIENCE

College of Engineering

160. Engineering Communications
Fall, Winter, Spring. 4(3-3) MTH 108 or MTH 111 or concurrently.
Engineering graphics, descriptive geometry, freehand sketching, graphical, numerical and computer problem solutions. Written technical reports and oral technical presentations.

201. Introduction to Engineering Mechanics
Fall. 4(4-0) PHY 237.
Laws of mechanics governing the behavior of rigid and deformable bodies emphasizing how these laws influence engineering design. Extensive use of demonstrations. Approved through Summer 1991.

205. Mechanics 1
Fall, Winter, Spring. 4(4-0) MTH 215 or concurrently.

211. Mechanics of Deformable Solids 1
Fall, Winter, Spring. 4(4-0) MTH 305 or concurrently. MTH 215 or concurrently.

212. Mechanics of Deformable Solids 2
Fall, Winter, Spring. 4(4-0) MTH 305 or concurrently. MTH 215 or concurrently.
Instrumentation, properties of materials, comparison of experiment and theory.

230. Introduction to Materials Science
Fall, Winter, Spring. 4(4-0) Non Materials Science majors only.
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.
250. Introduction to Metallurgy
Fall, Winter, Summer. 4(3-2) CEM 141A, MTH 113.
Structure-property relationship in metals and alloys. Mechanical properties, crystal structure, phase diagrams, iron-carbon system. Laboratory includes mechanical property tests, heat treatment, microstructural observations.

306. Mechanics II
Fall, Winter, Spring. 4(4-0) MMM 205, MTH 310.
Dynamics of particles and particle systems. Energy and momentum principles. Two and three dimensional rigid body dynamics.

330. Thermodynamics of Materials
Fall. 3(3-0) CEM 152 or approval of department, MTH 215.

350. Mechanical Properties of Materials I
Fall. 3(3-0) MMM 211, MMM 250.

351. Mechanical Properties of Materials II
Winter. 3(3-0) MMM 350.

352. Mechanical Property Laboratory
Spring. 1(0-3) MMM 350.
Laboratory experiments related to the topics covered in MMM 330.

360. Physical Metallurgy I
Winter. 3(3-0) MMM 250, MMM 330.
Complex binary and ternary phase diagrams. Solidification structures, precipitation, clustering, order-disorder transformation. Recovery, recrystallization and grain growth.

361. Physical Metallurgy II
Spring. 3(3-0) MMM 360.

362. Physical Metallurgy Laboratory
Spring. 1(0-3) MMM 360.

400. Special Problems
Fall. Winter, Summer. 1 to 3 credits. May be reenrolled for a maximum of 9 credits. Approval of department, individualized reading and research.

401. Introduction to Elasticity and Plasticity
(MMM 410.) Fall. 3(3-0) MMM 211.

402. Energy Methods and Finite Elements in Solid Mechanics
(MMM 411.) Winter. 3(3-0) MMM 401 or approval of department.

403. Dynamics and Stability in Solid Mechanics
(MMM 412.) Spring. 3(3-0) MMM 211, MMM 360.

405. Experimental Mechanics
Spring. 3(3-0) MMM 211, MMM 215 or approval of department.
Techniques to measure stress, strain, vibration, motion. Includes strain gauges, accelerometers, photoelasticity, holography and moire techniques.

420. Ceramics and Refractory Materials
Fall. 3(3-0) MMM 250 or approval of department.
Ceramics and glass materials as applied to high temperature and practical service. Mechanical and physical properties of industrial ceramics.

421. Manufacturing Productivity and Process Planning
Fall. 4(3-2) MMM 201 or MMM 205, MMM 230 or MMM 250.
Manufacturing processes and process planning for the manufacturing of discrete parts and assemblies. Productivity and cost estimation as an interface design.

422. Design of Manufacturing Systems
Winter. 3(3-0) MMM 421.
Operation scheduling and control. Optimization of discrete unit single-stage and multiple-stage manufacturing systems. Applications of artificial intelligence.

425. Nondestructive Evaluation and Quality Control
Spring. 3(3-0) MMM 421, STT 315, E E 345.
Nondestructive evaluation techniques, sampling, reliability, product liability. Ultrasonic, eddy-current, X-ray, dye penetrant inspection.

430. X-Ray Crystallography
Winter. 4(3-3) MMM 250.
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.

431. Corrosion and Oxidation
Fall. 3(3-0) MMM 330 or CEM 381.

442. Industrial Engineering
Winter. 3(3-0) MMM 250 or MMM 230.
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.

444. Nonmetallic Composite Materials
Winter. 3(3-0) MMM 350.

452. Diffusion in Solids
Winter. 3(3-0) MMM 330.

453. Phase Transformations
Spring of odd-numbered years. 3(3-0) MMM 330, MMM 361 or concurrently.

454. Electron Theory of Solids
Fall. 3(3-0) PHY 298, MMM 430.
Atomic theory of metals and alloys, free electron theories of metals, electrons in a periodic field and electromagnetic behavior.

456. Strengthening Mechanisms in Solids
Spring. 3(3-0) MMM 351.

461. Heat Treatment and Properties of Ferrous Alloys
Winter of odd-numbered years. 3(3-0) MMM 360.
Relations between microstructure, mechanical or physical properties of steels; effect of alloying elements, high-strength low-alloy steel, tool steels, stainless steels, hardenable steels. T-T-T diagrams, carburizing, case hardening. Design of a heat-treating process for an alloy.

462. Metal Fabrication
Winter of even-numbered years. 3(3-0) MMM 350.

463. Welding Metallurgy
Fall. 4(3-2) MMM 330 or concurrently.

465. Failure Analysis and Prevention
Spring. 4(3-0) MMM 211, MMM 215, MMM 250.
Modes and causes of failures of mechanical components. Analysis illustrated through student projects requiring integration of knowledge from several areas.

476. Alloy Development and Design
Spring. 3(3-0) MMM 330, MMM 458 or concurrently.
Fundamental principles which determine the structure and application of ferrous and nonferrous alloys. Economic analysis of alloy development.
480. Process Metallurgy
Winter, 3(3-0) MMM 330.

481. Powder Technology
Spring, 3(3-0) MMM 250.

499. Senior Research and Design Project
Fall, Winter, Summer. 2 to 4 credits. May reenroll for a maximum of 9 credits. Approval of department.
Investigation on subject approved by a faculty member. Results to show student's ability to solve problems pertaining to metallurgy and materials science. Regular conferences and final examination.

800. Special Problems
Fall, Winter, Spring. 1 to 8 credits. May reenroll for a maximum of 6 credits. Approval of department.
Individualized reading and research compatible with the student's interest and ability.

801. Advanced Dynamics
Spring of even-numbered years. 4(4-0) MMM 306.
Principles of classical dynamics for particle and rigid body systems. Lagrangian and Hamiltonian methods. Applications to engineering problems.

805. Strain and Motion Measurement
Spring. 4(3-0) Graduate students or approval of department.
Resistive strain gages and accelerometers are examined in detail with particular regard to the analysis and design of the whole measuring system. System student involving transducer design. Other motion measurement techniques.

806. Optical Methods of Metrology
Winter of even-numbered years. 4(3-3) Graduate students or approval of department.
Measurement of dimensions, motion, strain by precise optical methods including holography, speckle interferometry, Moiré, photoelasticity, linear and nonlinear characteristics. Variational methods, variational principles; equations of motion. Matrixes, quadratic forms; self-adjoint operators; eigenvalues. Transient and random excitations. Theory developed through physical problems.

Fall of odd-numbered years. 3(3-0) MTH 422 or approval of department.
Energy and variational formulations in solid mechanics. Approximate methods (Ritz, Galerkin) based on energy approach. Applications to vibration and stability problems.

822. Theory of Vibrations I
Winter. 4(4-0) M E 455, MMM 301.
Interdepartmental with the Department of Mechanical Engineering. Discrete and continuous parameter systems with linear and nonlinear characteristics. Variational principles; equations of motion. Matrixes, quadratic forms; self-adjoint operators; eigenvalues. Transient and random excitations. Theory developed through physical problems.

832. Electron Microscopy
Spring. 4(3-3) MMM 430 or approval of department.
Theory of image formation in electron microscopy and intensity of electron diffraction. Transmission and replica microscopy.

849. Engineering Ceramics
Winter of odd-numbered years. 3(3-0) MMM 420, MMM 454.
Physical properties of engineering ceramics. Transport properties, structures, with special attention to tiles and ceramics. Optical ceramic materials.

853. Advanced Topics in Oxidation and Corrosion
Winter of even-numbered years. 3(3-0) MMM 431 or approval of department.
Effects of metallurgical and environmental factors on the kinetics of aqueous and solution of chemical reactions, solubility and passivation reactions.

861. Theory of Metals
Fall of odd-numbered years. 3(3-0) MMM 825.
Metallic bonding, wave aspects of electrons. Schroedinger equation, free-electron model, zone theory of metals, Brillouin zones, band structure, Fermi surfaces, electrical and thermal conductivity, specific heat, magnetism, superconductivity.

863. Advanced Rate Theory and Diffusion
Fall of even-numbered years. 3(3-0) MMM 885 or approval of department.

871. Advanced Materials Science: Physical Behavior
Spring of even-numbered years. 3(3-0) MMM 885 or approval of department.
Quasichemical theory of alloy phases, crystal defects, ordering and second order transitions, thermal effects, surface tension, solid state reactions, nucleation, recovery, recrystallization, grain growth, crystallographic transformations, solidification, interfaces.

882. Advanced Materials Science: Mechanical Behavior
Spring of odd-numbered years. 3(3-0) MMM 885 or approval of department.
Dislocation-elasticity analysis, thermally-activated dislocation motion, recovery and recrystallization, deformation of polycrystals, Taylor-theory, deformation and recrystallization textures, dynamical aspects, high-temperature deformation, radiation effects.

885. Seminar
Fall, Winter, Spring. 1(1-0) May reenroll for a maximum of 3 credits. MMM graduate students.
Detailed library investigation of a specialized aspect of materials science or presentation of original research projects. Participation generally required each term of residence.

890. Selected Topics
Fall, Winter, Summer. 3(3-0) May reenroll for a maximum of 18 credits if a different topic is taken. Approval of department.
A newly developing area in metallurgy, mechanics, or materials science selected by the department for offering each term. Information on the specific topic to be covered should be obtained from the department office before registration.

899. Master's Thesis Research
Fall, Winter, Spring. Summer. Variable credit. Approval of department.
Individualized reading and research compatible with the student's interest and ability.
909. **Elastic Thin Shells**
Spring, 4(4-0) MTH 815 or C E 804 or approval of department; MTH 421. Interdepartmental with and administered by Civil Engineering.
Elements of differential geometry, membrane theory of shells, Pucker's stress function, deformation and bending of shells of revolution and shallow shells.

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

912. **Theory of Plates**
Winter. 4(4-0) MTH 815 or C E 804 or approval of department; MTH 422. 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.

914. **Theory of Elasticity II**
Spring of odd-numbered years. 3(3-0) MTH 813 or approval of department.
Further topics in linear elasticity including complex variable solutions, elastodynamics, variational principles, St. Venant's principle, anisotropic material behavior.

915. **Theory of Elasticity III**
Spring of even-numbered years. 3(3-0) MTH 813 or approval of department.

916. **Fracture Mechanics**
Fall of even-numbered years. 3(3-0) MTH 813.

917. **Fatigue of Engineering Structures**
Fall of odd-numbered years. 3(3-0) MTH 402 or approval of department.

918. **Theory of Viscoelasticity**
Winter of even-numbered years, 3(3-0) MTH 810.

940. **Modern Problems in Materials Science**
Fall, Spring. 3(3-0) May reenroll for a maximum of 9 credits. Approval of department.
Current field of research in ceramics, martensitic transformations, oxidation and corrosion, electron microscopy, recrystallization and textures.

941. **Crystal Defects**
Winter of even-numbered years, 3(3-0) MTH 825 or approval of department.

942. **Advanced Topics in Phase Transformations**
Winter of odd-numbered years. 3(3-0) MTH 825 or approval of department.
Precipitation and ripening, gradient energy term, spinodal decomposition, surface and strain effects, allotropic and polytropic transformations, martensitic transformations, electronic effects, charge density waves, thermoelastic and shape memory alloys.

999. **Doctoral Dissertation 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**

101. **Preview of Microbiology**
Winter. 1(1-0) Open only to freshmen or sophomores without previous coursework in Microbiology.
Overview of modern microbiology, emphasizing impact on society.

200. **Elementary Microbiology Lectures**
Winter. 3(3-0) Three terms of Natural Science. Primarily for majors outside the College of Natural Science.
Description of bacteria and related forms of microorganisms, their growth, structure, nature, their application in industry, and their control in public health.

201. **Elementary Microbiology Laboratory**
Winter. 1(0-2) MPH 200 or concurrently.
Fundamentals of microbiological methodology including microscopy, staining, aseptic technique, culture media, growth, and control with disinfectants and antibiotics.

210. **General Biology**
Fall, Spring, 4(4-2) Not open to students with credit in LBS 141. Interdepartmental with the Biological Science Program and the departments of Biochemistry, and Physiology. Administered by Biological Science Program.
Principles of biological organization: scientific method, biochemistry, cell biology, and evolution.

234. **Elementary Medical Microbiology**
Fall. 5(4-4) CEM 130, B S 211, approval of department.
Survey of immunology and microbiology with emphasis on pathogenic microorganisms, antimicrobial agents, and laboratory diagnosis.

301. **Introductory Microbiology**
Fall, Spring. 3(3-0) CEM 242, CEM 244 or BCH 206.
Fundamentals of microbiology. Ranges of cell structure and activities; nutrition, growth, and importance of major microbial groups.

302. **Introductory Microbiology Laboratory**
Fall, Spring. 2(0-4) MPH 301 or concurrently.
Methodology of microbiology including microscopy, staining, asepsis, cultural media and quantification.

303. **Microbiology I: General**
Fall. 4(4-0) BCH 451 or concurrently.
Principles of microbiology emphasizing cell structure and function, metabolism, growth and death, differentiation, diversity, and microbial interaction.

304. **General Microbiology Laboratory I**
Fall. 3(1-5) MPH 303 or concurrently.
Techniques and procedures of general microbiology emphasizing the isolation and identification of bacteria; the qualitative aspects of growth and death, and bacterial interactions.

306. **General Microbiology Laboratory II**
Spring. 3(1-5) MPH 304.
Continuation of MPH 304 with emphasis on immunologic and genetic techniques and procedures.

390. **Current Topics in Microbiology**
Winter. 2(2-0) May reenroll for a maximum of 6 credits. MPH 391, MPH 304, BCH 451, BCH 452 or concurrently, or approval of department.
Students read, present and discuss journal papers treating microbial physiology, ecology or genetics, molecular biology, virology, immunology or host-microbe interactions.

400H. **Honors Research**
Fall, Winter, Spring, Summer. 2 credits. May reenroll for a maximum of 8 credits. Approval of department.
A four-term research project with thesis.

403. **Elements of Cell Function and Structure**
(MPH 403.) Spring. 4(4-0) MPH 407, BCH 452 concurrently. Interdepartmental with the Department of Botany and Plant Pathology.
Cell biology of eukaryotic cells, with an emphasis on the molecular mechanisms that underlie cellular processes.

405. **Medical Mycology**
Fall. 4(2-6) DOT 330 or approval of department. Interdepartmental with and administered by the Department of Botany and Plant Pathology.
Characteristics, habits, and laboratory identification of fungal diseases infecting humans. Emphasis on laboratory techniques and morphological characteristics of the various mycoses.

407. **Microbial Genetics**
Winter. 4(4-0) MPH 303; BCH 452 or concurrently.
Genetics and molecular biology of bacteria and viruses with emphasis on the genetic principles developed from their study.

413. **Virology**
Fall. 3(3-0) BCH 453 or MPH 403.
Viruses and modern molecular biology, stressing principles of viral replication and gene expression of the major classes of viruses; viral diseases; some elements of epidemiology of viral infections.

416. **General Parasiology**
Fall. Summer of odd-numbered years. Given with W. K. Kellogg Biological Station Summer of odd-numbered years. Fall. 3(3-0) Summer of odd-numbered years: 3 credits. B S 210, B S 211, B S 212 or LBS 141. Interdepartmental with the Department of Zoology.
Life history, host-parasite relationships (including physiology, immunology, immunopathology and pathology) and epidemiology of selected groups and species of protozoan, trematode, cestode and nematode parasites.