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

626. Physical Medicine and Rehabilitation Clerkship
Fall, Winter, Spring, Summer 4 to 8 credits. May reenroll for a maximum of 12 credits.
H M 602, MED 608 and H D 608.
Experience in prescription writing, physical medicine procedures, occupational therapy and rehabilitation skills.

627. Rheumatology Clerkship
Fall, Winter, Spring 4 credits. H M 602, MED 608 and H D 608.
Combined office and hospital consultative clerkship which develops diagnostic skills in areas of rheumatic diseases.

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

630. Emergency Medicine Clerkship
Fall, Winter, Spring, Summer 4 to 8 credits. May reenroll for a maximum of 8 credits.
H M 602, MED 608 or SUR 608, H M 602.
Interdepartmental with the Department of Surgery.
Pathophysiology and other basic concepts will be used to explain the development of emergent conditions. Clinical diagnosis and treatment of emergenies seen in community emergency departments will be discussed.

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 emphasizing how these laws influence engineering design. Extensive use of demonstrations.

205. Mechanics I
Fall, Winter, Spring, Summer. 4(4-0) MTH 215. Concurrently, for A E, C E, M E majors.
Vector description of forces and moments. Two and three dimensional equilibrium problems. States of frames and machines. Friction. Shear and moments in beams and shafts.

211. Mechanics of Deformable Solids
Fall, Winter, Spring, Summer. 4(4-0) MMM 205, MTH 215, MMM 215 concurrently, for A E, C E, M E majors.
Deformable solids, stress and strain, principal axes, material behavior (elastic, plastic, viscoelastic, temperature dependent). Boundary value problems, torsion, beams. Instability, columns.

215. Solid Mechanics Laboratory
Fall, Winter, Spring, Summer. 1(0-2) MMM 211 concurrently.
Instrumentation, physical properties of materials, comparison of experiment and theory.

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
Fall, Winter, Spring, Summer. 4(4-0) MMM 205, MTH 215.
Dynamics of particles and particle systems. Energy and momentum principles. Two and three dimensional rigid body dynamics.

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

342. Materials Chemistry III
Spring. 4(4-0) MMM 341.
Continuation of MMM 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) MMM 360.
Continuation of MMM 360.

370. Metals and Alloys I
Fall, Winter. 4(3-0)
Principles of physical metallurgy applied to engineering metals and alloys.

371. Metals and Alloys II
Winter. 3(3-0) MMM 370.
Continuation of MMM 370.

372. Metals and Alloys III
Spring. 3(3-0) MMM 371.
Continuation of MMM 371.

375. Failure Analysis
Spring. 3(3-0) Juniors and MMM 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) MMM 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) MMM 380, MMM 361 concurrently.
Continuation of MMM 380.

382. Physical Metallurgy Laboratory III
Spring. 1(0-3) MMM 381.
Continuation of MMM 381.

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

404. Dynamics of Mechanical Systems
Fall. 3(3-0) MMM 306.

411. Mechanics of Deformable Solids II
Spring. 3(3-0) MMM 211.
Continuation of MMM 211. Unsymmetrical bending, curved beams, torsion of non-circular shapes, shear center, beam columns. Introduction to energy theorems with applications to determinate and indeterminate beams, and rings.

414. Principles and Techniques of Experimental Solid and Materials Science
Spring. 3(3-0) MMM 211.
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(3-0) MMM 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(3-0) 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(3-0) PHY 364 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(3-0) MMM 455.
460. Metallurgical Engineering I  
Fall. 4(3-2) Approval of department.  

461. Metallurgical Engineering II  
Winter. 4(3-2) MMM 490 or approval of department.  

462. Metallurgical Engineering III  
Spring, 4(3-2) MMM 461 or approval of department.  

465. Mechanical Failure Analysis  
Spring, 3(3-0) MMM 211, MMM 218, MMM 320 or MMM 370 or approval of department.  
Modes and causes of failure of mechanical components. Analysis illustrated through student projects requiring integration of knowledge from several areas.

470. The Cast Alloys  
Winter. 4(4-0) MMM 372.  
Physical metallurgy of the cast alloys. Solidification and transformation. Nuclearization and inoculation. Mode 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) MMM 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, maraging steels, corrosion-resistant steels and alloys, high-temperature alloys.

500. Metallurgical Thermodynamics  
Fall, 3(3-0) Approval of department.  
Thermodynamics of metals, reaction systems, equilibrium, and the properties of materials. Theories of heat and work, interactions of matter. Examination of the theoretical foundations of metallurgical phenomena.

505. Strain and Motion Measurement  
Spring, Summer. 4(3-3) Approval of department.  
Resistance strain gages and accelerometers are examined in detail with particular regard to the analysis and design of the whole measuring system. Student project involving transducer design. New measurement techniques.

506. Optical Stress Measurement  
Winter of even-numbered years. 4(3-2) Approval of department.  
Whole-field techniques such as photoelasticity, photoelastic coating, Moiré techniques, and birefringent interferometers and model analysis. Necessity of 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) MMM 211; MTH 421 concurrently or approval of department.  
Stress, deformation and rate-deformation tensors. Balance of mass, momentum, and energy. Field equations. Examples of constitutive equations. Selected special solutions in elasticity and Newtonian fluids.

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

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

516. Advanced Strength of Materials II  
Winter. 3(3-0) MMM 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) MMM 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) ME 455. Interdepartmental with and administered by the Department of Mechanical Engineering.  
Discrete and continuous parameter systems with linear and nonlinear characteristics. Variational principles, equations of motion, matrices, quadratic forms, self-adjoint operators, eigenvalue problems. Transient and random excitations. Theory developed through physical problems.

800. Special Problems  
Fall, Winter, Spring. 1 to 6 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 Engineering Mechanics I  
Fall, Summer. 3(3-0) MMM 306.  
Principles of classical dynamics; Lagrangian equations for systems of rigid bodies and Lagrange's equations for systems of particles. Hamilton-Jacobi theory, engineering applications of the advanced mechanics.

802. Advanced Engineering Mechanics II  
Winter. 3(3-0) MMM 801.  
Rigid-body mechanics: the gyroscope; canonical transformations; Hamilton-Jacobi theory, engineering applications of advanced mechanics.
918. Theory of Viscoelasticity
Fall of even-numbered years. 3(3-0)
MM 810; MTH 422 or approval of department.

920. Theory of Vibrations II
Winter of odd-numbered years. 4(4-0)
MTH 422; M E 820 or approval of department.
Interdepartmental with the Department of Mechanical Engineering.
Vibrations of one, two, and three dimensional models of elastic and plastic continua. Interaction phenomena. Stability. Variational methods. Applications to aeronautics, aerospace, and underwater technology.

921. Theory of Vibrations III
Spring of odd-numbered years, Summer. 4(4-0)
MM 920 or approval of department. Interdepartmental with the Department of Mechanical Engineering.

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 reenroll for a maximum of 9 credits.

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

MICROBIOLOGY AND PUBLIC HEALTH

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

200. Elementary Microbiology
Fall, Winter. 4(3-2) Three terms of Natural Science. Primarily for majors outside the College of Natural Science.
Description of bacteria and related forms of microorganisms, their growth and nature, their application in industry, and their control in public health.

234. Elementary Medical Microbiology
Fall. 3(4-0) 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, Winter, Spring. 3(3-0) CEM 242, CEM 244 or BCH 200.
Fundamentals of microbiology. Ranges of cell structure and activities; nutrition, growth, and importance of major microbial groups.

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

400. Bacteriology for High School Science
Summer. 4(4-4) Bachelor’s degree and teaching certificate.
Fundamental concepts, experiments, and projects useful in secondary school science courses.

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.

406. Medical Mycology
Fall, Spring. 4(2-1) BOT 402 or approval of department. Interdepartmental with and administered by the Department of Botany and Plant Pathology.
Characteristics, habits, and laboratory identification of fungus diseases infecting humans. Emphasis on laboratory techniques and morphological characteristics of the various mycetes.

413. General Virology
Winter. 3(3-0) MPH 427 or concurrently.
Physical, chemical, and biological properties of the viruses.

414. General Virology Laboratory
Winter. 1(0-4) MPH 413 or concurrently.
Laboratory procedures employed for cultivation and identification of viruses.

416. General Parasitology
Fall. 3(3-0) B S 210, B S 211, B S 212 or LBC 141.
Life history, host-parasite relationships (including physiology, immunology, immunopathology and pathology) and epidemiology of selected groups and species of protozoan, nematode, ectiode and nematode parasites.

417. General Parasitology Laboratory
Fall, Winter. 2(0-4) MPH 416 or concurrently or approval of department.
Identification and life histories of representative species of major groups of animal parasites. Selected concepts of host-parasite associations will be tested experimentally.

420. Ecology of Animal Parasites
Summer. 6 credits. B S 212 or approval of department. Given at W. K. Kellogg Biological Station. Interdepartmental with the departments of Fisheries and Wildlife, and Zoology.
Parasitism of animals by protozoa, helminths and arthropods with emphasis on the interrelationships of host-parasite associations with the natural environments.

421. Microbial Physiology and Genetics
Winter. 4(4-0) MPH 301, MPH 302, BCH 401 or BCH 452 or concurrently.
Cell structure and function, macromolecular synthesis and control, genetic capabilities of microorganisms.