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

552. Modern Ceramic Materials III  
Spring. 3(3-0) 851.  
Applications of ceramic materials: Glass-ceramics, nuclear fuel elements, hot-pressed translucent oxides, pre-stressed ceramics, ceramic coatings, pyrolytic materials.

560. Theoretical Metallurgy I  
Fall. 3(3-0) 542.  
Metallurgical thermodynamics, introduction to statistical thermodynamics, kinetics of metallurgical processes.

561. Theoretical Metallurgy II  
Winter. 3(3-0) 580.  
Introduction to quantum theory of metals, physical properties of metals and alloys.

562. Theoretical Metallurgy III  
Spring. 3(3-0) 861.  
Imperfections in crystalline solids, dislocation theory and mechanical properties of metals and alloys.

570. Ferrous Physical Metallurgy  
Fall. 3(3-0) 542, 562.  
Theory of steel hardening and hardenability from nucleation, growth, and shear considerations.

571. Nonferrous Physical Metallurgy  
Winter. 3(3-0) 542, 581.  
Binary, ternary and complex alloy systems, shear mechanism, recrystallization and grain growth, age hardening, and other diffusion mechanisms.

572. Physical Metallurgy of Alloy Steels  
Spring. 3(3-0) 870, 871.  
Steels for extreme service conditions.

575. Ferrous Metallurgy  
Fall. 3(3-0) 492.  
Stoichiometric material and heat balance calculations of the blast furnace, open hearth and electric furnace processes.

576. Nonferrous Process Metallurgy  
Winter. 3(3-0) 462.  
Stoichiometric material and heat balance calculation in nonferrous extractive metallurgy.

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

581. Metals and Alloys II  
Winter. 3(3-0) 372.  
Similar to 580, but with reference to nonferrous alloys.

582. Metals and Alloys III  
Spring. 3(3-0) 372.  
Similar to 580, but with reference to cast alloys.

585. Seminar  
Fall, Winter, Spring. 1 credit. 899 concurrently.

880. Selected Topics  
Fall, Winter, Spring, Summer. 3(3-0) 850.  
May re-enroll for a maximum of 15 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.

889. Research  
(EGR 889.) Fall, Winter, Spring, Summer. Variable credit. Approval of department.

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.

901. Modern Mathematical Mechanics  
Winter of odd-numbered years. 3(3-0) 860.  
Application of functional analysis and tensor theory to classical and contemporary problems in dynamics and material properties.

909. Elastic Thin Shells  
Spring. 4(4-0) 915 or C E 804 or approval of department, MTH 422, Interdepartmental with and administered by the Civil Engineering Department.  
Elements of differential geometry, membrane theory of shells, Pucher’s stress function, deformation and bending of shells of revolution and shallow shells.

910. Nonlinear Continua  
Winter of even-numbered years. 4(4-0) 810.  
Modern nonlinear theories of continua. Equations of balance and constitutive equations. Topics selected from finite elasticity, nonlinear viscoelasticity and non-elasticity. General tensors are introduced and used throughout.

911. Theory of Elastic Stability  
Fall of odd-numbered years. 4(4-0) 815 or C E 804 or approval of department, MTH 422, Interdepartmental with the Civil Engineering Department.  
Theory and methods of determining buckling strength and post-buckling behavior of bars, plates and shell elements of elastic systems.

912. Theory of Plates  
Winter. 4(4-0) 815 or C E 804 or approval of department, MTH 422, Interdepartmental with the Civil Engineering Department.  
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.

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

918. Theory of Viscoelasticity  
Fall of even-numbered years. 3(3-0) 810; MTH 422 or approval of department.  

920. Theory of Vibrations II  
(924.) Winter of odd-numbered years. 4(4-0) MTH 422; M E 852 or approval of department. Interdepartmental with the Mechanical Engineering Department.

Vibrations of one, two, and three-dimensional models of elastic and inelastic continua, interaction phenomena, stability. Variational methods. Applications to aeronautics, aerospace, and undrivers technology.

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


933. Advanced Elasticity  
Spring of even-numbered years. 3(3-0) 813, 819 or approval of department.

Selected topics in non-linear elasticity.

935. Mechanics of the Fluid State  
Winter of even-numbered years. 3(3-0) 322 or 503.

Boltzmann’s equation and the molecular theory of fluids; equations of state of gases, liquids and plasmas; transfer and flow processes.

936. Mechanics of the Solid State  
Spring of even-numbered years. 3(3-0) 322 or 503.

Particle calculations of typical mechanical, thermal and electrical properties of crystals. Defect theory; elasticity, plasticity and fracture; phonons and electron scattering.

941. Advanced Topics in Mechanical Metallurgy  
Fall of even-numbered years; Winter and Spring of odd-numbered years. 3(3-0) 810.

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) 810.

May re-enroll for a maximum of 9 credits.

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

MICROBIOLOGY AND PUBLIC HEALTH  
MPH  
College of Human Medicine  
College of Veterinary Medicine  
College of Osteopathic Medicine  
College of Natural Science  
College of Veterinary Medicine  
College of Veterinary Medicine  
College of Veterinary Medicine
234. Elementary Medical Microbiology
Fall, Winter. 4(3-2) N S 103. Primarily for majors outside the College of Natural Sciences. Description of bacteria and related forms of microorganisms, their growth and nature, their application in industry, and their control in public health.

235. Elementary Medical Microbiology
Fall. 5(4-4) N S 193. Primarily for Nursing students. Survey of immunology and microbiology with emphasis on pathogenic microorganisms, antimicrobial agents, and laboratory diagnosis.

301. Introductory Microbiology
Fall. 4(3-4) B S 213; BCH 200. Fundamentals of microbiology with emphasis on the comparative nature of the various groups of microorganisms, their distribution and activities.

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 Work
Fall, Winter, Spring, Summer. 1 to 6 credits. May re-enroll for a maximum of 12 credits. Approval of instructor. Tutoring reading and experimentation.

401. General Microbiology
Fall. 5(5-6) B S 212; BCH 401 or concurrently. Comparative biology of microorganisms: viruses, rickettsiae, bacteria, fungi, algae, and protozoa.

402. General Microbiology Laboratory
Fall. 3(4-6) 401 or concurrently. Laboratory based on the subject matter of 401.

413. General Virology
(463) Winter. 4(4-3) 427 or concurrently. Physical, chemical, and biological properties of viruses; laboratory procedures employed for cultivation and identification of viruses.

416. General Parasitology
(406) Winter. Summer at W. K. Kellogg Biological Station. 3(2-4) B S 212. Biology of parasitic animals.

421. Microbial Physiology
(331) Winter. 5(2-6) 401, 402. Cell structure and function, growth and death, and metabolism of microorganisms.

423. Microbial Genetics
(431) Spring, 5(3-6) BCH 401; ZOL 441 recommended. Fundamental genetic concepts as exemplified in microorganisms.

425. Microbial Ecology
Summer. 6(3-9) 402. Given at W. K. Kellogg Biological Station. Lecture emphasizes biological and biochemical properties of diverse naturally occurring microorganisms. The laboratory stresses the analysis and description of natural metabolic activity. Methodology includes enrichment techniques but also qualitative and quantitative methods of environmental changes.

427. Immunobiology
(460) Winter, 5(3-6) B S 212; BCH 200 or BCH 401. Biological and biochemical mechanisms of the immune response. Emphasis is on concepts of immunity and basic laboratory techniques.

429. Microbiology of Infectious Diseases
(461) Spring, 5(3-3) 301 or 402 and 427. Biology, immunology, pathogenicity, and medical aspects of microorganisms associated with infectious diseases of man. Methods of isolation and identification are emphasized in the laboratory.

436. Introductory Medical Parasitology
(309, 338) Fall. 5(3-6) Primarily for Medical Technology students. Biology and laboratory diagnosis of protozoan, helminth, and arthropod infections of man.

440. Food Microbiology
(371) Spring, 4(3-3) 200 or 301 or 401. Interdepartmental with Food Science Department. Major groups of microorganisms of importance to the food industry are studied with emphasis on ecological, physiological, and public health aspects.

442. Soil Microbiology
(481) Spring, 4(3-4) 200 or 301 or 401. Interdepartmental with the Soil Science Department. Major groups of microorganisms of importance in soils are studied with emphasis on ecological, biochemical, and physical aspects.

444. Environmental Microbiology
(351) Spring, 3(2-4) 200 or 301 or 401. Flora, methods of testing, and purification of environmental air and water. Treatment and disposal of sewage.

531. Medical Immunology and Microbiology
(556) Fall, Spring. 8 credits. Professional medical students or approval of department. General immunology, comparative biology of microorganisms that have medical significance.

532. Veterinary Microbiology and Public Health
(567) Winter, Summer. 8(5-11) or approval of department. Biology, immunology, pathogenicity, and medical aspects of microorganisms associated with infectious diseases of animals. Epidemiology of animal diseases significant to human health.

536. Veterinary Parasitology I
(501) Winter, Summer. 4(3-4) Veterinary Medicine students or approval of department. Distribution, biology, and control of parasitic animals of importance to veterinary medicine.

537. Veterinary Parasitology II
(502) Fall, Spring, 4(2-6) 536 or approval of department. Continuation of 536.

800. Seminar
(830) Fall, Winter, Spring. Summer. 1(1-0).