

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) 851.

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) 861.

Imperfection in crystalline solids, dislocation theory and mechanical properties of metals and alloys.

870. Ferrous Physical Metallurgy

Fall. 3(3-0) 342, 362.

Theory of steel hardening and hardenability from nucleation, growth, and shear considerations.

871. Nonferrous Physical Metallurgy

Winter. 3(3-0) 342, 361.

Binary, ternary and complex alloy systems, shear mechanism, recrystallization and grain growth, age hardening, and other diffusion mechanisms.

872. Physical Metallurgy of Alloy Steels

Spring. 3(3-0) 870, 871.

Steels for extreme service conditions.

875. Ferrous Metallurgy

Fall. 3(3-0) 462.

Stoichiometric material and heat balance calculations of the blast furnace, open hearth and electric furnace processes.

876. Nonferrous Process Metallurgy

Winter. 3(3-0) 462.

Stoichiometric material 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 engineers other than metallurgical.

881. Metals and Alloys II

Winter. 3(3-0) 372.

Similar to 845, but with reference to nonferrous alloys.

882. Metals and Alloys III

Spring. 3(3-0) 372.

Similar to 845, but with reference to cast alloys.

885. Seminar

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

890. Selected Topics

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

May re-enroll 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. Research

(EGR 899.) Fall, Winter, Spring,

Summer. Variable credit. Approval of department.

900. Special Problems

Fall, Winter, Spring Summer. 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)

Approval of department.

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) 815 or C E 804 or

approval of department; MTH 421. 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 viscosity and viscoelasticity, electroelasticity. General tensors are introduced and used throughout.

911. Theory of Elastic Stability

Fall of odd-numbered years. 4(4-0)

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) 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 ap-

proval of department.

Saint-Venant 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.

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

(904.) Winter of odd-numbered years.

4(4-0) MTH 422; M E 823 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 undersea technology.

921. Theory of Vibrations III

(903.) Spring of odd-numbered years,

Summer. 4(4-0) 920 or approval of department. Interdepartmental with the Mechanical Engineering 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.

933. Advanced Elasticity

Spring of even-number years. 3(3-0)

813, 910 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 803.

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 803.

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

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

(EGR 999.) 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

Winter. 1(1-0) Freshmen and Soph-

omores only.

Science and scientists of microbiology, presented in historical perspective and carried to the forefront of current research. A rigorous preview for students seriously curious about microbiology.

- 200. Elementary Microbiology**
Fall, Winter. 4(3-2) N S 193. 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. 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 212; 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 department.
Tutored reading and experimentation.
- 401. General Microbiology**
Fall. 5(5-0) B S 212; BCH 401 or concurrently.
Comparative biology of microorganisms: viruses, rickettsiae, bacteria, fungi, algae, and protozoa.
- 402. General Microbiology Laboratory**
Fall. 3(1-6) 401 or concurrently.
Laboratory based on the subject matter of 401.
- 413. General Virology**
(463.) Winter. 4(3-4) 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(3-6) 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 monitors 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(2-8) 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.
- 346. Introductory Medical Parasitology**
(309, 336.) 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(2-6) 200 or 301 or 401. Interdepartmental with and administered by the 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**
(566.) 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) 531 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).
- 816. Parasitic Metazoa**
(802.) Spring of odd-numbered years. 4(3-4) 416 or ZOL 481 or approval of department.
Comparative biology, physiology, and host-parasite relationships of parasitic helminths and arthropods.
- 817. Parasitic Protozoa**
(803.) Spring of even-numbered years. 3(2-4) 416 or ZOL 482 or approval of department.
Comparative biology, physiology, and host-parasite relationships of parasitic protozoa.
- 826. Ecology of Animal Parasites**
Summer. 3 credits. 416, approval of department. Given at W. K. Kellogg Biological Station.
Interaction of parasitic animals (protozoa, helminths, and arthropods) with their natural environment, including host, biotic, and physical aspects.
- 827. Immunochemistry**
Spring. 3(3-0) 427; 423, BCH 452, or ZOL 441, and CEM 383 recommended.
Structure and reactivity of antigens and antibodies; synthesis of immunoglobulins. Emphasis is on current advances and research concepts.
- 828. Immunochemistry Laboratory**
Spring. 2(0-6) 427; 827 or concurrently.
Laboratory based partially on subject matter of 827. Experimental techniques used in immunological assays and immune systems.
- 899. Research**
Fall, Winter, Spring, Summer. Variable credit. Approval of department.
- 900. Topics in Microbiology**
Fall, Winter, Spring Summer. 2(2-0) May re-enroll if different topic is taken. Approval of department.
Topics will be selected from taxonomic subsciences such as bacteriology, virology, protozoology, mycology, algology, and helminthology; and from transecting disciplines such as microbial genetics, immunology, physiology, and ecology.
- 901. Experimental Microbiology**
Fall, Winter, Spring, Summer. 3(0-9) May re-enroll for a maximum of 9 credits. Approval of department.
Experiments, demonstrations, and discussions of current research programs in various areas of microbiology.
- 999. Research**
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

MILITARY SCIENCE M S

All University

041. General Military Science
Fall, Winter, Spring. Zero credit. Approval of department.

Application of leadership techniques, the decision making process and staff planning. Military customs and traditions. Students will concurrently enroll in a selected non-Military Science course to fulfill military professional requirements.