

**of  
Courses**

- 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 462; PHY 840; or approval of department.  
Crystalline macrostructure and microstructure of ceramics and glasses; dependence of microstructure on amounts, 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) MMM 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) MMM 851.  
Applications of ceramic materials. Glass-ceramics, nuclear fuel elements, hot-pressed translucent oxides, pre-stressed ceramics, ceramic coating, pyrolytic materials.
- 860. Theoretical Metallurgy I**  
Fall. 3(3-0) MMM 342.  
Metallurgical thermodynamics, introduction to statistical thermodynamics, kinetics of metallurgical processes.
- 861. Theoretical Metallurgy II**  
Winter. 3(3-0) MMM 860.  
Introduction to quantum theory of metals, physical properties of metals and alloys.
- 875. Ferrous Metallurgy**  
Fall. 3(3-0) MMM 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) MMM 462.  
Stoichiometric material and heat balance calculation in nonferrous extractive metallurgy.
- 880. Metals and Alloys I**  
Fall. 3(3-0) MMM 372.  
Topics in engineering properties and application of wrought steels for engineers other than metallurgical.
- 881. Metals and Alloys II**  
Winter. 3(3-0) MMM 372.  
Similar to MMM 845, but with reference to non-ferrous alloys.
- 882. Metals and Alloys III**  
Spring. 3(3-0) MMM 372.  
Similar to MMM 845 but with reference to cast alloys.
- 885. Seminar**  
Fall, Winter, Spring. 1 credit. MMM 899 concurrently.

- 890. Selected Topics**  
Fall, Winter, Spring, 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.
- 900. Special Problems**  
Fall, Winter, Spring, Summer. 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.
- 909. Elastic Thin Shells**  
Spring. 4(4-0) MMM 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, Pucher's stress function, deformation and bending of shells of revolution and shallow shells.
- 911. Theory of Elastic Stability**  
Fall of odd-numbered years. 4(4-0) MMM 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) MMM 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.
- 915. Theory of Elasticity II**  
Spring. 3(3-0) MMM 813 or approval 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) MMM 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**  
Winter of odd-numbered years. 4(4-0) MTH 422; M E 823 or approval of department. Interdepartmental with the Department of Mechanical Engineering.  
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**  
Spring of odd-numbered years, Summer. 4(4-0) MMM 920 or approval of department. Interdepartmental with the Department of Mechanical Engineering.  
Nonlinear oscillations. Resonance; subharmonics; self-sustained motions; stability. Methods of Poincare, van der Pol, etc. Random vibrations. Parametric excitations; stochastic processes; power spectra. Applications.
- 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**

- 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. 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, 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.
- 310. Food Safety and Microbiology**  
Fall. 4(3-3) Juniors; CEM 132 or concurrently or approval of department. Not open to students with credit in FSC 440. Interdepartmental with and administered by Food Science.  
Effects of food handling, preparation and service on food safety. Microorganisms in foods, sanitation, food borne disease and food service regulations.
- 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(2-6) 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 mycoses.

**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 LBS 141.

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.

**417. General Parasitology Laboratory**

Fall. 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. Biology 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**

Winter. 3(3-0) MPH 301, MPH 302; BCH 401 or BCH 452 or concurrently.

Cell structure and function, macromolecular synthesis and control.

**422. Microbial Physiology Laboratory**

Winter. 2(0-6) MPH 421 or concurrently.

Laboratory work based upon the subject matter in MPH 421.

**423. Microbial Genetics**

Spring. 3(3-0) MPH 421, MPH 301, ZOL 441.

Principles of genetics as exemplified in microorganisms.

**424. Microbial Genetics Laboratory**

Spring. 2(0-6)  
Laboratory work in microbial genetics.

**425. Microbial Ecology**

Spring. 4(4-0) MPH 301 or approval of department.

Fundamental concepts of microbial ecology. Emphasis will be placed on aquatic and soil habitats.

**427. Immunobiology**

Winter. 3(3-0) B S 212; BCH 200 or BCH 401.

Biological and biochemical mechanisms of the immune response. Emphasis is on concepts of immunity.

**428. Immunobiology Laboratory**

Winter. 2(0-6) MPH 427 or concurrently.

Basic laboratory techniques in immunobiology.

**429. Microbiology of Infectious Diseases**

Spring. 5(2-8) MPH 302, MPH 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.

**431. Bacterial Diversity**

Spring. 5(3-6) MPH 421.

Morphological and physiological properties of diverse groups of bacteria, and how these properties relate to their ecological niche and importance. Representative groups will be isolated and characterized.

**437. Introductory Medical Parasitology**

Fall. 5(3-5) B S 210, B S 211, B S 212. Primarily for Medical Technology students.

Biology of protozoan, helminth, and arthropod infections of humans. Laboratory diagnosis of these infections.

**440. Food Microbiology**

Spring. 5(3-4) MPH 200 or MPH 301 or approval of department. Interdepartmental with and administered by Food Science.

Major groups of microorganisms of importance to the food industry are studied with emphasis on ecological, physiological, and public health aspects.

**444. Environmental Microbiology**

Spring. 3(2-4) MPH 200 or MPH 301.

Flora, methods of testing, and purification of environmental air and water. Treatment and disposal of sewage.

**IDC. Biological Membranes**

For course descriptions, see Interdisciplinary Courses.

**490. Special Problems in Microbiology**

Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 12 credits. Approval of department.

Tutorial instruction in laboratory or library research for advanced undergraduates.

**503. Cell Biology**

Fall. 5(5-0) Admission to the College of Human Medicine. Interdepartmental with the departments of Biochemistry, Physiology, and Pharmacology and Toxicology.

Principles of cell biology for medical students.

**511. Medical Microbiology and Immunology**

Fall. 1 to 5 credits. May reenroll for a maximum of 5 credits. A biochemistry course. Enrollment in College of Human Medicine or approval of department.

Basic principles of microbiology (bacteriology, virology, mycology and parasitology) and immunology. Selected type-infections relate these principles to disease in humans.

**512. Infectious Diseases**

Winter. 4(3-3) MPH 511, or approval of department. Interdepartmental with the Department of Medicine.

Infectious diseases of humans, including biology of the causative microorganism, epidemiology, pathogenesis, host-parasite relationships, clinical and laboratory diagnosis, and clinical management.

**521. Medical Microbiology and Immunology**

Winter. Variable credit. May reenroll for a maximum of 6 credits. A biochemistry course. Enrollment in College of Osteopathic Medicine or approval of department.

Basic principles of microbiology (bacteriology, virology, mycology and parasitology) and immunology. Selected type-infections relate these principles to disease in man.

**531A. Medical Microbiology: Immunology**

Winter. 4(3-2) Second-term Veterinary Medicine students or approval of department.

Basic principles of immunology (immunobiology and immunochemistry) and their relation to disease in animals.

**531B. Medical Microbiology: Bacteriology and Mycology**

Spring. 5(3-6) Third-term Veterinary Medicine students or approval of department.

Basic principles of bacteriology and mycology and their relation to disease in animals.

**531C. Medical Microbiology: Virology**

Fall. 3(2-2) Fourth-term Veterinary Medicine students or approval of department.

General properties of animal viruses; pathogenesis, immune response and immunopathology in viral diseases; principles of clinical virology.

**531D. Medical Microbiology: Parasitology**

Winter. 4(3-3) Fifth-term Veterinary Medicine students or approval of department.

Basic principles of parasitology (protozoology, helminthology, and entomology) and their relation to disease in animals.

**618. Infectious Disease Clerkship**

Fall, Winter, Spring, Summer. 1 to 17 credits. May reenroll for a maximum of 34 credits. H M 602 and MED 608 or PHD 608. Interdepartmental with and administered by the Department of Medicine.

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.

**800. Seminar**

Fall, Winter, Spring, Summer. 1(1-0) May reenroll for a maximum of 9 credits. Approval of department.

**810. Topics in Microbiology**

Fall, Winter, Spring, Summer. 2 to 4 credits. May reenroll for a maximum of 10 credits if different topic is taken. Approval of department.

Topics will be selected from taxonomic subsciences such as bacteriology, virology, protozoology, mycology, and helminthology; from transacting disciplines such as microbial genetics, immunology, physiology, and ecology.

of  
Courses

**813. Molecular Virology**  
Fall. 4(4-0) Background in biochemistry, and approval of department.

Molecular nature and biochemistry of replication of bacterial and animal viruses. Emphasis is on current advances, research concepts, and the role of viruses in molecular biology research.

**821. Advanced Microbial Physiology**  
Spring. 4(4-0) MPH 421.

Mechanism and regulation of physiologic and metabolic activities unique to prokaryotes including fermentation, photosynthesis, respiration and autotrophy.

**827. Immunochemistry**  
Spring, 3(3-0) MPH 427; 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) MPH 427; MPH 827 or concurrently.

Laboratory based partially on subject matter of MPH 827. Experimental techniques used in immunological assays and immune systems.

**829. Host-Parasite Relationships**  
Fall. 3(3-0) MPH 427, MPH 429 or approval of department.

Pathogenesis and host responses to selected bacterial, parasitic, and fungal pathogens. Emphasis is on current research models which exemplify a variety of host-parasite relationships.

**842. Advanced Soil Microbiology**  
Fall of odd-numbered years. 3(3-0) MPH 425 or approval of department. Interdepartmental with the Department of Crop and Soil Sciences.

Biochemistry, biology, and community ecology of microorganisms indigenous to soil. Emphasis on current research problems.

**843. Soil Microbiology Laboratory**  
Fall of odd-numbered years. 2(0-6) MPH 842 concurrently or approval of department. Interdepartmental with the Department of Crop and Soil Sciences.

Fundamental techniques of dealing with microorganisms indigenous to soil. Metabolic activity of microorganisms. Interaction between microorganisms and plants.

**890. Special Problems in Microbiology**  
Fall, Winter, Spring, Summer. 2 to 6 credits. May reenroll for a maximum of 12 credits. Approval of department.

**899. Master's Thesis Research**  
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

**900. Topics in Microbiology**  
Fall, Winter, Spring, Summer. 2(2-0) May reenroll 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.

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

**MILITARY SCIENCE M S**

**All University**

**041. General Military Science**

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.

**A. Military Traditions--M S I**  
Winter. 0(0-1) Approval of department.

**B. Advanced Drill and Ceremonies**  
Spring. 0(0-1) Approval of department or M S II standing.

**C. Advanced Camp Preparation--M S III**  
Winter. 0(0-1) Approval of department or M S III standing.

**D. Military Justice and Unit Administration**  
Fall. 0(0-1) Approval of department or M S IV standing.

**121. Preview of Military Science**  
Fall, Winter, Spring, Summer. 1(1-0) Approval of department.

Role of the ROTC officer in the Army. Assists the student in planning a curriculum to satisfy requirements for a commission.

**122. Marksmanship and Hunter Safety**  
Fall, Spring. 1(0-2) M S 121 or approval of department.

Small arms marksmanship and safety. Practical exercises on local firing ranges. Individual basic military marksmanship and the skills necessary to participate in a competitive or recreational shooting program.

**221. Fundamentals of Military Art and Tactical Science**  
Fall. 1(1-0) M S 121, M S 041A, M S 122.

Contemporary military tactical doctrine, operations, principles of modern land warfare; analysis of historical examples, application of current doctrine to hypothetical situations.

**223. Terrain Analysis and Land Navigation**  
Winter, Spring. 2(2-0) M S 121 and approval of department.

Military topographic maps, special maps, map profiles, specifications and uses. Terrain analysis for military tactical operations. Land navigation with the lensatic and Silva compass.

**324. Military Teaching**  
Fall, Winter. 4(4-2) Basic course, approval of department.

Methods of teaching manipulative skills to groups with varying educational backgrounds. Emphasis on determination of entry behavior, progress analysis, testing and test construction. Introduction to current teaching aids. Practical experience in simulated field situations is stressed during laboratory.

**325. Military Management**  
Spring. 4(3-2) M S 324 or approval of department.

Task analysis approach to missions. The subject of tactics is used as a teaching vehicle for the managerial approach to the preparation and execution phases of military operations. Emphasis is placed on physical and moral leadership during the laboratory sections.

**426. Military Law**  
Winter. 4(4-0) Approval of department.

Jurisdiction and responsibility of the Army commander and junior leader in the application of military justice. Implications of Army operations as related to the rules of land warfare.

**427. Seminar**  
Spring. 1(1-0) Approval of department.

Precommissioning orientation stressing current military policies, procedures, customs and trends.

**499. Independent Study in Military Science**  
Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 6 credits. Approval of department and Juniors.

Individual research and study in an area related to military science as approved and directed by the Department of Military Science.

**MUSIC MUS**

**College of Arts and Letters**

**100. Theory Review**  
Fall, Summer. 2(2-1) For majors who need theory review.

Basic course in fundamentals and ear training.

**112. Chamber Music**  
Fall, Winter, Spring, Summer. 1(1-0) May reenroll for a maximum of 18 credits. Approval of department.

Performance of works for small ensembles.

**118. Band**  
**A. Marching Band**  
Fall. 1 credit. May reenroll for credit. Membership determined by audition.

The Marching Band participates at football games.

**B. Spartan Brass**  
Winter. 1 credit. May reenroll for credit. Membership determined by audition.

The Spartan Brass participates at basketball games.

**C. Concert Band**  
Fall, Winter, Spring. 1 credit. May reenroll for credit. Membership determined by audition.

Public appearances are scheduled on campus each term.

**D. Symphonic Band**  
Fall, Winter, Spring. 1 credit. May reenroll for credit. Membership determined by audition. A high level of achievement in performing ability is required.

Concerts are scheduled both on and off campus.

**E. Wind Ensemble**  
Fall, Winter, Spring. 1 credit. May reenroll for a maximum of 12 credits. Membership determined by audition. The highest level of performance is required.

Full range of wind literature is performed. Public concerts are presented both on and off campus.

**F. Repertory Band**  
Fall, Winter, Spring, Summer. 1 credit. May reenroll for a maximum of 12 credits. Membership determined by audition.

Public appearances are scheduled on campus each term.