

**909. Elastic Thin Shells**  
Spring. 4(4-0) 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.

**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 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) 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) 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 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**  
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.

**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. 2(2-0) Freshmen and Sophomores 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) 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) Three terms of Natural Science. Primarily for Nursing students.

Survey of immunology and microbiology with emphasis on pathogenic microorganisms, antimicrobial agents, and laboratory diagnosis.

**301. Introductory Microbiology**  
Fall, Spring. 3(3-0) B S 212; BCH 200.

Fundamentals of microbiology with emphasis on the comparative nature of the various groups of microorganisms, their distribution and activities.

**302. Introductory Microbiology Laboratory**  
Fall, Spring. 2(1-4) 301 or concurrently.

Laboratory based on the subject matter of 301.

**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 re-enroll for a maximum of 8 credits. Approval of department.  
A four-term research project with thesis.

**401. General Microbiology**  
Fall. 5(5-0) BCH 401 or 451 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.

**406. Medical Mycology**  
Fall, Spring. 4(2-6) BOT 402 or approval of department. Interdepartmental with and administered by the Botany and Plant Pathology Department.

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) 427 or concurrently.

Physical, chemical, and biological properties of the viruses.

**414. General Virology Laboratory**  
Winter. 1(0-4) 413 or concurrently.

Laboratory procedures employed for cultivation and identification of viruses.

**416. General Parasitology**  
Winter. Summer at W. K. Kellogg Biological Station. 3(3-0) B S 212.

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**  
Winter. 2(0-4) B S 212, or LBC 140, 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**  
(426.) 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) 401, 402.

Cell structure and function, growth and death, and metabolism of microorganisms.

**422. Microbial Physiology Laboratory**  
Winter. 2(0-6) 421 or concurrently.

Laboratory work based upon the subject matter in 421.

**423. Microbial Genetics**  
Spring. 3(3-0) BCH 401; ZOL 441 recommended.

Fundamental genetic concepts as exemplified in microorganisms.

**424. Microbial Genetics Laboratory**  
Spring. 2(0-6) 423 or concurrently.

Laboratory work based upon the subject matter in 423.

**425. Microbial Ecology**

Summer. 6(3-9) A microbiology course or approval of department. Given at W. K. Kellogg Biological Station.

Lecture emphasizes the biological properties and diversity of naturally occurring microorganisms. The laboratory treats the analytical techniques involved in study of their metabolic activity.

**427. Immunobiology**

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

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

**428. Immunobiology Laboratory**

Winter. 2(0-6) 427 or concurrently. Basic laboratory techniques in immunobiology.

**429. Microbiology of Infectious Diseases**

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.

**436. Introductory Medical Parasitology**

(309., 336.) Fall. 3(3-0) Primarily for Medical Technology students. Biology of protozoan, helminth, and arthropod infections of man.

**437. Introductory Medical Parasitology Laboratory**

Fall. 2(1-4) 436 or concurrently. Laboratory diagnosis of protozoan, helminth, and arthropod infections of man.

**440. Food Microbiology**

Fall. Dietetics majors only. Spring. 5(3-4) 200 or 301 or 401 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.

**442. Soil Microbiology**

Spring. 3(3-0) 200 or 301 or 401. Interdepartmental with the Department of Crop and Soil Sciences.

Major groups of microorganisms of importance in soils are studied with emphasis on ecological, biochemical, and physical aspects.

**444. Environmental Microbiology**

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.

**IDC. Biological Membranes**

For course description, see Interdisciplinary Courses.

**490. Special Problems in Microbiology**

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

Tutorial instruction in laboratory or library research for advanced undergraduates.

**511. Medical Microbiology and Immunology**

Spring. 1 to 6 credits. May re-enroll for a maximum of 6 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 man.

**512. Infectious Diseases**

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

Infectious diseases of man, 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 re-enroll 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**

(531.) Winter. 2(1-2) A course in biochemistry and admission to the veterinary professional program, or approval of department.

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

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

Winter. 3(2-4) A course in biochemistry and admission to the veterinary professional program, or approval of department.

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

**531C. Medical Microbiology: Virology**

Spring. 2(1-2) A course in biochemistry and admission to the veterinary professional program, or approval of department.

Basic principles of virology and their relation to disease in animals.

**531D. Medical Microbiology: Parasitology**

Spring. 3(2-4) Admission to the veterinary professional program, or approval of department.

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

**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**

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**

Fall, Spring. 4(2-6) 536 or approval of department. Continuation of 536.

**618. Infectious Disease Clerkship**

Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. H M 602 and MED 603 or H D 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 re-enroll for a maximum of 9 credits. Approval of department.

**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.

**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.

**890. Special Problems in Microbiology**

Fall, Winter, Spring, Summer. 2 to 6 credits. May re-enroll for a maximum of 12 credits. Approval of department.

**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**  
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. Evolution of Military Leadership—M S II  
Fall. 0(0-1) Approval of department or M S II standing. HST 235 concurrently.  
C. Military Career Preparation—M S II  
Spring. 0(0-1) Approval of department or M S II standing.  
D. Advanced Camp Preparation—M S III  
Winter. 0(0-1) Approval of department or M S III standing.  
E. Military Staff Organization—M S IV  
Fall. 0(0-1) Approval of department or M S IV standing.

**121. Preview of Military Science**  
Fall, Winter. 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) 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.

**223. Terrain Analysis and Land Navigation**  
Winter, Spring. 3(3-0) 121 and approval of department.  
Military maps, map construction, specifications and uses. Includes both a study of aerial photographs and an introduction to remote energy sensors employed by defense agencies as they relate to tactical operations.

**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) 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 re-enroll 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 re-enroll for a maximum of 18 credits. Approval of department.  
Performance of works for small ensembles.

**118. Band**  
A. MARCHING BAND  
Fall. 1 credit. May re-enroll for credit. Membership determined by audition.  
The Marching Band participates at football games.

B. SPARTAN BRASS  
Winter. 1 credit. May re-enroll for credit. Membership determined by audition.  
The Spartan Brass participates at basketball games.

C. CONCERT BAND  
Fall, Winter, Spring. 1 credit. May re-enroll for credit. Membership determined by audition.  
Public appearances are scheduled on campus each term.

D. SYMPHONIC BAND  
Fall, Winter, Spring. 1 credit. May re-enroll 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 re-enroll 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.

**133. Orchestra**  
Fall, Winter, Spring. 1(0-5) May re-enroll for a maximum of 12 credits. Membership determined by audition.  
Standard overtures and symphonies studied and publicly performed. Attendance at all rehearsals and public concerts obligatory.

**135. Music in Elementary Education**  
Fall, Winter, Spring, Summer. 4(3-3) Elementary education majors.  
Basis, scope and sequence of music instruction in the elementary schools with an introduction to basic knowledge and skills used in elementary school music.

**141. Class Instruments and Voice**  
Fall. 1(0-2) Knowledge of notation. Music majors, or approval of department.  
Class instruction in piano, voice, violin, cello, clarinet, and cornet.

**142. Class Instruments and Voice**  
Winter. 1(0-2) 141.  
Continuation of 141.

**143. Class Instruments and Voice**  
Spring. 1(0-2) 142.  
Continuation of 142.

**145. Music Foundations I**  
Fall, Winter, Spring. 3(3-0) 135 and approval of department.  
Development of understanding and knowledge of music fundamentals, ear training, music reading, rhythm, and other basic music perceptions. Designed specifically for elementary classroom teachers who elect a strong concentration in music.

**147. Elementary Piano**  
Fall, Winter, Spring. 2(2-2) 145 or approval of department. Elementary Education and Physical Education and Recreation majors.  
Beginning class piano instruction. Development of ability to play the three principal chords in all keys and to harmonize simple melodies using these chords. Transposition of simple melodies. Ability to play melodies and rhythms suitable for use in lower intermediate grades or in recreation work.

**148. Elementary Piano**  
Winter, Spring. 2(2-2) 147. Elementary Education majors.  
Continuation of 147.

**150. Keyboard Instruments and Harp**  
Fall, Winter, Spring, Summer. 1 to 4 credits. May re-enroll for a maximum of 24 credits. Audition required.  
Instruction in piano, organ and harp.

**151. Voice**  
Fall, Winter, Spring, Summer. 1 to 4 credits. May re-enroll for a maximum of 24 credits. Audition required.

**152. Stringed Instruments**  
Fall, Winter, Spring, Summer. 1 to 4 credits. May re-enroll for a maximum of 24 credits. Audition required.

**153. Woodwind Instruments**  
Fall, Winter, Spring, Summer. 1 to 4 credits. May re-enroll for a maximum of 24 credits. Audition required.

**154. Brass Instruments**  
Fall, Winter, Spring, Summer. 1 to 4 credits. May re-enroll for a maximum of 24 credits. Audition required.