850. Modern Ceramic Materials I
Fall. 3(3-0) CEM 462; PHY 440; or approval of department.
Crystalline microstructure and macrostructure 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 coatings, pyrolytic materials.

860. Theoretical Metallurgy I
Fall. 3(3-0) MMM 330 or approval of department.
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.

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 credits. 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
Winter 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.
Further topics in linear elasticity. Introduction to finite elasticity and solutions of some basic problems. Nonlinear crack problems.

916. Fracture Mechanics
Fall of even-numbered years. 3(3-0) MMM 812.

917. Fatigue
Spring of even-numbered years. 3(3-0) MMM 411 or approval of department.

918. Theory of Viscoelasticity
Fall of even-numbered years. 3(3-0) MMM 810; MTH 420 or approval of department.

920. Theory of Vibrations II
Winter of odd-numbered years. 4(4-0) MTH 422; M E 523 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, aero-space, and underwater technology.

999. Doctoral Dissertation Research
Fall, Winter, Spring, Summer. Variable credits. Approval of department.
43. Animal Cells and Viruses
Fall, 3(3-0) MPH 407.
Basic features of animal cell structure and function, and of animal viruses as tools to understand eukaryotic gene expression, as pathogens, and as examples of diversity and divergence with cellular mechanisms.

44. Environmental Microbiology
Spring, 3(3-4) MPH 300 or MPH 301.
Flora, methods of testing, and purification of environmental air and water. Treatment and disposal of sewage.

45. Medical Immunology
Winter, 2(2-0) MPH 301, MPH 302.
Students may not receive credit in both MPH 408 and MPH 463.
Humoral and cellular immune responses to bacterial antigens.

46. Medical Microbiology
Winter, 2(2-0) MPH 301, MPH 302.
Fundamental properties of bacterial pathogens and bacterial disease.

47. General Parasitology Laboratory
Fall, 20(4) MPH 415 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.

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

49. Medical Microbiology and Immunology Laboratory
Winter, 2(0-4) MPH 462, MPH 463 or concurrently.
Basic immunologic and taxonomic laboratory techniques of selected bacterial pathogens.

50. Biological Membranes
For course description, see Interdisciplinary Courses.

51. Medical Microbiology and Immunology
Winter, 1 to 5 credits. May reenroll for a maximum of 6 credits. Approval of department. Tutorial instruction in laboratory or library research for advanced undergraduates.

52. Introduction to Medical 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 medical biology for medical students.

53. Medical Microbiology and Immunology
Winter, 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.

54. Infectious Diseases
Spring, 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.

55. Medical Microbiology and Immunology
Winter, 1 to 6 credits. 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 humans.

56. Medical Microbiology: Bacteriology and Mycology
Spring, 3(3-3) Third-term Veterinary Medicine students or approval of department.
Basic principles of bacteriology and mycology and their relation to disease in animals.

57. 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.

58. 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.

59. Infectious Disease Clerkship
Fall, Winter, Spring, Summer, 1 to 17 credits. May reenroll for a maximum of 34 credits. HM 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.

60. Seminar
Fall, Winter, Spring, Summer, 1(1-0) May reenroll for a maximum of 6 credits. Approval of department.

61. 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 subdisciplines such as bacteriology, virology, parasitology, mycology, and helminthology; from transacting disciplines such as microbial genetics, immunology, physiology, and ecology.

62. immunochimistry
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.

63. Advanced Microbial Physiology
Spring, 4(4-0) MPH 431.
Mechanisms and regulation of physiologic and metabolic activities unique to procaryotes including fermentation, photosynthesis, respiration and autotrophy.

64. Immunochimistry
Spring, 3(3-0) MPH 427, BCH 452, or ZOL 441, and CEM 385 recommended.
Structure and reactivity of antigens and antibody molecules; synthesis of immunoglobulins. Emphasis is on current advances and research concepts.

65. 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.
831. Bacterial Diversity
Spring of even-numbered years, 3(3-0)
M PH 303, MPH 304, BCH 401 or BCH 453 or concurrently.
Morphological and physiological properties of diverse groups of bacteria and how these properties relate to their ecological niche and importance.

832. Bacterial Diversity Laboratory
Spring of even-numbered years, 2(0-6)
M PH 831 or concurrently.
Representative groups of bacteria will be isolated and studied.

842. Advanced Soil Microbiology
Fall of odd-numbered years, 3(3-0)
M PH 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)
M PH 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 transacting 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. Leadership Fundamentals
Winter, 0(0-1) Approval of department.
B. Basic Military Skills
Winter, 0(0-1) Approval of department or M S II standing.

C. Advanced Military Skills
Winter, 0(0-1) Approval of department or M S III standing.
D. Leadership Applications
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 Weapon 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.

123. Land Navigation
Winter, Spring, 2(2-0) M S 121 and approval of department.
Use of military topographic maps and special use maps. Development of map profiles and overlays for tactical operations. Land navigation with lensatic and Silva compass.

324. Leadership Through Training
Fall, Winter, 4(4-2) Basic course, approval of department.
Designing, planning, and presenting effective training for individuals and groups.

325. Military Management
Spring, 4(2-0) 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 of military operations. Emphasis is placed on physical and moral leadership during the laboratory sections.

426. Military Law and Unit Administration
Fall, 2(2-0) Approval of department.
Military legal system and the responsibilities of the commander and junior leaders in the application of military justice. Operation and administration in military units to provide personnel and logistic support.

427. Seminar
Spring, 2(2-0) Approval of department.
Military professional ethics. Value inputs, reasoning, and decision making. Current military policies and trends as a pre-commission orientation.

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

112. Chamber Music
Fall, Winter, Spring, Summer, 1(1-0)
May reenroll for a maximum of 15 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.
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.

133A. Symphony Orchestra
Fall, Winter, Spring, 1(0-5) May reenroll for a maximum of 12 credits. Admission by audition.
Preparation and performance of symphony and operatic repertoire under direction of faculty and guest conductors of international reputation.

133B. Chamber Orchestra
Fall, Winter, Spring, 1(0-5) May reenroll for a maximum of 12 credits. Membership determined by audition.
A specialized ensemble of advanced performers concentrating on the repertoire of the classic composers, and modern repertoire for chamber orchestra. Rehearsals and performances with faculty and guest artists.

135. Music in Elementary Education
Fall, Winter, Spring, Summer, 4(3-3)
Elementary education majors.
Study of music learning strategies in the elementary schools. Music concepts and literature are developed through listening, performing, creative and analytical skills. Methods and materials are emphasized.

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