

- 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.
- 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.
- 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.
- 933. Advanced Elasticity**
Spring of even-number years. 3(3-0) 813, 910 or approval of department.
Selected topics in non-linear elasticity.
- 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. 1(0-4) 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 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. 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
(406.) Winter. Summer at W. K. Kellogg Biological Station. 3(3-0) BS 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) BS 212.

Identification and life histories of representative species of major groups of animal parasites. Selected concepts of host-parasite associations will be tested experimentally.

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
(431.) 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.

426. Ecology of Animal Parasites
Summer. 6 credits. BS 212 or approval of department. Given at W. K. Kellogg Biological Station.

Parasitism of animals by protozoa, helminths and arthropods with emphasis on the inter-relationships of host-parasite associations with the natural environments.

427. Immunobiology
Winter. 3(3-0) BS 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) 427 or concurrently.

Basic laboratory techniques in immunobiology.

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.

436. Introductory Medical Parasitology
(309., 336.) Fall. 5(3-5) Primarily for Medical Technology students.

Biology and laboratory diagnosis of protozoan, helminth, and arthropod infections of man.

440. Food Microbiology
Spring. 4(2-6) 200 or 301 or 401. 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
(481.) Spring 3(3-0) 200 or 301 or 401. Interdepartmental with Soil Science.

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.

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. 3(3-0) 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
(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.

618. Infectious Disease Clerkship
Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. HM 602 and MED 608 or HD 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
(830.) Fall, Winter, Spring, Summer. 1(1-0).

813. Molecular Virology
Fall. 3(3-0) 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 sub-science 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.

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.

MUSIC

MUS

College of Arts and Letters

094. Band
Summer. Zero credit. Membership determined by audition.
Attendance at all rehearsals and public concerts obligatory. See 118.

100. Theory Review
Fall, Summer. 2(3-2) 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(2-3)
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.

146. Music Foundations II
Winter, Spring. 3(3-1) 145.

Continuation of 145 with particular emphasis on music literature as a basis for development of enlarged musical understanding. Music writing skills are also stressed.

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.