

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) 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.

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

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 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) 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.

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

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.

**Descriptions — Microbiology and Public Health
of
Courses**

- 301. Introductory Microbiology**
Fall, Winter, Spring. 3(3-0) CEM 242, 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) 301 or concurrently.
Methodology of microbiology including microscopy, staining, asepsis, cultural media and quantification.
- 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.
- 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) 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**
Fall. 3(3-0) B S 210, 211, 212 or LBC 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) 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 and Genetics**
Winter. 4(4-0) 301, 302; BCH 401 or 452 or concurrently.
Cell structure and function, macromolecular synthesis and control, genetic capabilities of microorganisms.
- 422. Microbial Physiology Laboratory**
Winter. 2(0-6) 421 or concurrently.
Laboratory work based upon the subject matter in 421.
- 424. Microbial Genetics Laboratory**
Spring. 2(0-6)
Laboratory work in microbial genetics.
- 425. Microbial Ecology**
Spring. 5(4-3) 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 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, 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.
- 437. Introductory Medical Parasitology Laboratory**
Fall, Winter. 2(1-4) 416 or concurrently or approval of department. Primarily for Medical Technology students.
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 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. 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.
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.
- 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 608 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 biochem-
istry, and approval of department.
Molecular nature and biochemistry of replica-
tion 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 Biolog-
ical Station.

Interaction of parasitic animals (protozoa, hel-
minths, and arthropods) with their natural
environment, including host, biotic, and physical
aspects.

827. Immunochemistry
Spring. 3(3-0) 427; BCH 452, or ZOL
441, and CEM 383 recommended.

Structure and reactivity of antigens and anti-
bodies; synthesis of immunoglobulins. Emphasis
is on current advances and research concepts.

828. Immunochemistry Laboratory
Spring. 2(0-6) 427; 827 or concu-
rently.

Laboratory based partially on subject matter of
827. Experimental techniques used in immu-
nological 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. *Varia-
ble credit.* Approval of department.

900. Topics in Microbiology
Fall, Winter, Spring, Summer. 2(2-0)
May re-enroll if different topic is taken. Ap-
proval of department.

Topics will be selected from taxonomic sub-
sciences such as bacteriology, virology, pro-
tozoology, mycology, algology, and helminthol-
ogy; 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. Ap-
proval of department.

Experiments, demonstrations, and discussions of
current research programs in various areas of
microbiology.

999. Research
Fall, Winter, Spring, Summer. *Vari-
able credit.* Approval of department.

MILITARY SCIENCE M S

All University

041. General Military Science
Application of leadership techniques, the deci-
sion making process and staff planning. Military
customs and traditions. Students will concu-
rently enroll in a selected non-Military Science
course to fulfill military professional require-
ments.

A. Military Traditions—M S I
Winter. 0(0-1) Approval of depart-
ment.

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 depart-
ment or M S II standing.

D. Advanced Camp Preparation—M S III
Winter. 0(0-1) Approval of depart-
ment 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, 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) 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 photo-
graphs 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. Empha-
sis is placed on physical and moral leadership
during the laboratory sections.

426. Military Law
Winter. 4(4-0) Approval of depart-
ment.

Jurisdiction and responsibility of the Army
commander and junior leader in the applica-
tion of military justice. Implications of Army
operations as related to the rules of land war-
fare.

427. Seminar
Spring. 1(1-0) Approval of depart-
ment.

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

**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 re-
lated 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 per-
forming 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. Mem-
bership 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. Mem-
bership 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.