839. Quantum Mechanics III
Spring. 3(3-0) 838.
Collision processes and scattering theory, applications; many-particle systems.

847. Electromagnetic Theory I
Fall. 3(3-0) 428, 448.
Electrostatics; Laplace's equation, Poisson's equation; Green's theorem; solution of problems by method of images; inversion; boundary-value problems in Cartesian, spherical and cylindrical coordinates; spherical harmonics; Bessel functions.

848. Electromagnetic Theory II
Winter. 3(3-0) 847.
Multipole and multipole expansions; electrostatics of macroscopic materials; dielectrics, magnetostatics, vector potential, magnetic moment. Maxwell's equations for time-varying fields, energy and momentum conservation. Plane electromagnetic waves and polarization.

849. Electromagnetic Theory III
Spring. 3(3-0) 848.

857. Theoretical Mechanics I
Fall. 3(2-0)
Two-body central force problems, rigid body motion, small oscillations, Hamilton's principle, Lagrangian and Hamiltonian formalism for particles and fields, canonical transformations, relativity.

858. Theoretical Mechanics II
Winter. 2(2-0) Approval of department.
Hamiltonian formalism for particles and fields, variational methods, canonical transformations.

859 Theoretical Mechanics III
Spring. 2(2-0) Approval of department.
Small oscillations, classical fields, relativity.

867. Quantum Mechanics IV
Fall. 3(3-0) 839.
Transformation theory and invariance principles; the rotation group and theory of angular momentum; Wigner-Eckart theorem and applications.

868. Relativistic Quantum Mechanics
Winter. 3(3-0) 867.
Relativistic equations of motion; Dirac equation, free particle solutions and Louton transformations; interaction with electromagnetic fields; quantization of scalar, electromagnetic and Dirac fields.

869. Quantized Fields
Spring. 3(3-0) 869.
Haeinberg representation, S-matrix reduction formulae, Feynman rules, quantum electrodynamics; topics from many-body theory.

877. Equilibrium Statistical Mechanics
Fall. 3(3-0) Approval of department.
Ensembles, partition functions, thermodynamic potentials with applications to simple thermodynamic; topics from many-body theory.

878. Nonequilibrium Statistical Mechanics
Winter. 3(3-0) 877.
Time-dependent Liouville equation, Bloch equation, and master equation, with application to relaxation processes and atomic, molecular, and nuclear systems.

879. Quantum Statistical Mechanics
Spring. 3(3-0) 879.
Green's function techniques with application to transport theory, superconductivity, magnetism.

899. Research
Fall, Winter, Spring, Summer. Variably credit. Approval of department.

907. Sound and Ultrasonics
Fall, Winter, Spring. 4(4-0). May re-enroll for a maximum of 12 credits. MTH 815.
Physical effects and properties of sonic and ultrasonic waves. Special attention to experimental methods for studying sound fields and measuring acoustical quantities. Applications of sonic and ultrasonic energy in chemical, biology, medicine, metallurgy, nondestructive testing communications, and other fields.

927. Elementary Particle Physics
Fall. 3(3-0) 891.
Properties of elementary particles, invariance principles and conservation laws; strong, electromagnetic, and weak interactions; pion physics.

928. Elementary Particle Physics
Winter. 3(3-0) 927.
Baryon and meson resonances, unitary symmetry, dispersion relations.

932. Molecular Structure and Spectra I
Fall of odd-numbered years. 3(3-0) or Concurrently.
Structure and spectra of diatomic molecules.

933. Molecular Structure and Spectra II
Winter of even-numbered years. 3(3-0) 937.
Structure and spectra of polyatomic molecules.

934. Molecular Structure and Spectra III
Spring of even-numbered years. 3(3-0) 938.
Advanced topics in vibration-rotation theory of polyatomic molecules.

947. Solid State Physics I
Fall. 3(3-0) 459 and 839.
Crystal symmetry, crystal binding, lattice vibrations and specific heat, one-electron theory; Hartree-Fock equation, Brillouin zones.

948. Solid State Physics II
Winter. 3(3-0) 947.

949. Solid State Physics III
Spring. 3(3-0) 948.
Ionic crystals. Imperfections in crystals, plastic deformations, color centers. Optical properties. Rectification, transistors, selected topics.

957. Nuclear Physics I
Fall. 3(3-0) 867.
Nucleon-nucleon scattering, nuclear sizes and shapes, multiple particle; shell model; collective states.

958. Nuclear Physics II
Winter. 3(3-0) 957.
Experimental methods and instrumentation; nuclear reactions; inelastic scattering and particle transfer.

959. Nuclear Physics III
Spring. 3(2-0) 958.
Many-body methods in nuclear physics; Bethe-Goldstone equation; effective interaction; nuclear models.

960. Techniques in Nuclear and Particle Physics
Fall. 3(3-0) Approval of department.
Properties of accelerators and particle beams. Passage of radiation through matter, particle detection, pulse electronics, statistics, on-line computation.

984. Advanced Readings in Physics
Fall, Winter, Spring, Summer. Variably credit.

985. Advanced Topics in Physics
Fall, Winter, Spring. 3(3-0) or 4(4-0) In any one term this course will be devoted to a single topic, such as advanced quantum theory, quantum electrodynamics, specialized topics in solid state physics, statistical mechanics, relativity theory and cosmology.

999. Research
Fall, Winter, Spring, Summer. Variably credit. Approval of department.

PHYSIOLOGY

College of Human Medicine
College of Natural Science
College of Veterinary Medicine

240. Introductory Physiology
Fall, Spring, Summer. 4(3-2) Sophomore or approval of department.
Survey of the physiology of circulatory system, respiration, nervous system and special senses, digestion, metabolism and endocrinology.

241. Introductory Physiology
Winter, Summer. 4(3-2) 240.
Continuation of 240. Physiology of muscle function and neuro-muscular relationship, circulation; respiration; changes in organ systems in relation to muscular exercise.

323. Physiology, Anatomy, and Hygiene of the Eye
Fall, Summer of even-numbered years. 3(2-2) 240. Elementary Education or Special Education major, or approval of department.
Basic course in anatomy, physiology, and hygiene of the visual system; includes discussion of normal visual functioning and abnormal visual functioning, with methods of correction and education implications.

331. Human Physiology
Winter. 4(3-2) ANT 310, CSM 122, or approval of department.

332. Human Physiology
Spring. 4(3-2) 331.
412. Introductory Comparative Physiology  
Fall, 4(3-4) 240 or B S 212 and CEM 132. 
A compendium of osmoregulation, digestion, respiration, and other physiological processes in a wide range of organisms.

416. Physiology of the Cell  
Fall 3(3-0) CEM 242 or 353. 
Physiologic mechanisms common to all living cells with emphasis on those of the vertebrates. The functions of the cell membrane and cytoplasm are studied as the basis for the physiologic behavior of vertebrate organs and systems.

417. Physiology of the Cell  
Summer, 3(2-3) Approval of department. 
Physiologic mechanisms common to all living cells with emphasis on those of the vertebrates. The functions of the cell membrane and cytoplasm are studied as the basis for the physiologic behavior of vertebrate organs and systems.

440. Avian Physiology  
Spring of odd-numbered years. 4(3-3) Approval of department. Interdepartmental and administered jointly with the Poultry Science Department. 
A survey of the systemic physiology of birds emphasizing digestion, metabolism, the endocrine, and reproductive processes.

455. Endocrinology and Reproduction of Farm Animals  
Fall, 4(3-2) 940. Interdepartmental and administered jointly with the Dairy Department. 
Endocrine and reproductive systems are presented with emphasis upon characteristics which can be altered for economic benefit and upon causes, prevention, and treatment of endocrine abnormalities.

480. Special Problems  
Fall, Winter, Spring, Summer. 1 to 5 credits. Approval of department.

501. Advanced Mammalian Physiology  
Winter, Summer. 6(4-6) Approval of department. 
Basic aspects of cellular physiology including the study of nerve and muscle cell function and the fluid and electrolyte environment of body tissues. Blood, heart and circulation, kidney function and respiration physiology.

502. Advanced Mammalian Physiology  
Fall, Spring. 6(4-6) 501. 
A continuation of 501; with consideration of the digestive, central nervous and endocrine systems.

503. Advanced Endocrinology  
Winter. 3(3-0) Approval of department. 
Current developments in anatomy, physiology, chemistry, and regulation of the major endocrine glands; nervous and hormonal control of reproduction and lactation.

812. Advanced Comparative Physiology  
Fall. 4(3-4) B S 212 or approval of department. 
A study of organ function in a wide range of groups of animals with emphasis on evolutionary relationships and physiological basis of ecology.

815. Sensory Physiology  
Winter, 3(3-2) Not open to students with credit in 233. Approval of department. 
Physiology of sense organs for students in physiology, psychology and others.

819. Kidney Physiology and Electrolyte Metabolism  
Spring. 3(3-0) 502. 
Critical study of the literature on classical and contemporary principles of renal physiology and related aspects of body fluid and electrolyte metabolism.

835. Neurophysiology  
Winter. 4(3-4) Approval of department. 
Functions and properties of the peripheral and central nervous systems.

836. Physical Principles of Biological Systems  
Spring. 3(3-0) 
Application of laws and methods of physics to measurement and description of physiological phenomena.

837. Radiobiology  
Winter. 3(3-0) Approval of department. 
Application of radioactive tracer techniques to study of biological functions. Determination of turnover rates and tissue constituents by isotope dilution. Control of radiation hazards.

859. Analysis of Hormone Action  
Spring. 4(4-0) ZOL 317, or approval of department. Interdepartmental with the Zoology Department. 
Discussion of recent work on the molecular and developmental aspects of hormone action in vertebrates and invertebrates. Selected topics to vary from year to year.

890. Research  
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

910. Seminar  
Fall, Winter, Spring, Summer. 1(1-0) 
May re-enroll for a maximum of 2 credits for the Master's program and a maximum of 4 additional credits for either the Ph.D. or the diploma program.

915. Respiratory Physiology  
Spring. 4(3-2) 502, approval of department. 
Development of ideas leading to our present state of knowledge in respiration.

919. Cardiovascular System  
Fall. 4(3-3) 502. 
Outstanding literature on physiology of heart, blood vessel and lymphatics, hemodynamics, cardiac output and circulation in special regions. Appropriate methodology discussed. Laboratory work illustrates principles of special procedures.

950. Topics in Physiology  
Fall, Winter, Spring. 1 to 3 credits. May re-enroll for a maximum of 9 credits. Approval of department. 
Classical and modern concepts in selected areas of physiology.

950. Problems  
Fall, Winter, Spring, Summer. 1 to 3 credits. May re-enroll for a maximum of 9 credits. Approval of department. 
Limited amounts of individual work on selected research problems.

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

POLICE ADMINISTRATION AND PUBLIC SAFETY  
PLA

College of Social Science

110. Introduction to Criminal Justice  
Fall, Winter, Spring. 5(4-0) 
Agencies and processes involved in the administration of criminal justice—the legislature, the police, the prosecutor, the courts and corrections. Problems of law enforcement in a democratic society.

130. Administrative Concepts in Law Enforcement and Public Safety  
Winter, Spring, Summer. 
Exposition of those basic principles and practices of administration which apply to law enforcement and public safety. Theoretical and practical aspects of management factors such as organization, decision making, human relations and power.

225. Police Science Laboratory I  
Fall, Winter, Spring. 4(0-5) 
General course in laboratory techniques. Photography, recording of a crime scene, collection and preservation of evidence, and fingerprinting.

235. Police Administration I  
Fall. 5(4-1) 
Principles of police administration and organization; administration of staff units; function and activities of police agencies.

236. Police Administration II  
Winter. 5(4-1) 
Administration of police line operations; including patrol as the basic police function, investigation, juvenile, traffic and special operational units. Liaisons between units, enforcement policy, manpower distribution, and analysis of operations.

245. Highway Traffic Administration I  
Fall. 5(5-0) 
Examination of United States transportation system, emphasizing efficient, safe operation. Activities and agencies concerned with increasing efficiency. System's development, components; social, economic and political impacts. Survey of present and future needs.

246. Highway Traffic Administration II  
Winter. 5(4-0) 
Organization for traffic control, accident investigation, traffic flow regulation, and accident analysis and interpretation. Survey of traffic law, as related to administration. Violation bureau and traffic court administration.

247. Highway Traffic Administration III  
Spring. 5(4-0) 
Highway traffic education at the elementary, secondary and adult levels of instruction. Communication aspects of highway traffic administration. Public support organizations. Motor vehicle fleet safety programs. Traffic safety research.