### 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.*

Multipoles and multipole expansions; electrostatics of macroscopic materials, dielectrics, magnetostatics, vector potential, magnetic moments, 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.*

Wave guides and resonant cavities, boundary-value problems. Simple radiating systems, antennas. Special relativity, covariance of electrodynamics, transformation of electromagnetic fields. Radiation by moving charges, Lienard-Wiechert potentials.

### 857. *Theoretical Mechanics I*
*Fall. 2(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 Lorentz transformation properties; interaction with electromagnetic fields; quantization of scalar, electromagnetic and Dirac fields.

### 869. *Quantized Fields*
*Spring. 3(3-0) 868.*

Heisenberg 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 thermodynamics; 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) 878.*

Green's function techniques with application to transport theory, superconductivity, magnetism.

### 899. *Research*
*Fall, Winter, Spring, Summer. Variable credit. Approval of department.*

### 907. *Sound and Ultrasonics*
*Fall, Winter, Spring. 4(4-0) May re-enroll for a maximum of 12 credits. MTH 215.*

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 colloidal chemistry, biology, medicine, metallurgy, nondestructive testing communications, and other fields.

### 927. *Elementary Particle Physics*
*Fall. 3(3-0) 869.*

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.

### 929. *Elementary Particle Physics*
*Spring. 3(3-0) 928.*

Selected current topics, partial wave amplitudes and Regge poles; current algebra and weak interactions.

### 937. *Molecular Structure and Spectra I*
*Fall of odd-numbered years. 3(3-0) 837 or concurrently.*

Structure and spectra of diatomic molecules.

### 938. *Molecular Structure and Spectra II*
*Winter of even-numbered years. 3(3-0) 937.*

Structure and spectra of polyatomic molecules.

### 939. *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; Hartee-Fock equation, Brillouin zones.

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

Effective mass approximation. Exchange and correlation corrections. Theory of conductivity and related effect, metals and semiconductors.

### 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, multipole moments; 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(3-0) 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.

### 961. *Accelerator Physics*
*Winter. 3(3-0) 849, 859.*

Cyclotrons, betatrons, synchrotrons, and linear accelerators. Theory of magnetic focussing: constant gradient, alternating gradient, edge focussing. Acceleration processes, longitudinal motion. Non-linear resonances, stability limits. Beam injection, extraction, and transport.

### 984. *Advanced Readings in Physics*
*Fall, Winter, Spring, Summer. Variable credit.*

### 987. *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. Variable credit. Approval of department.*

## PHYSIOLOGY PSL

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

### 240. *Introductory Physiology*
*Fall, Spring, Summer. 4(3-2) Sophomores or approval of department.*

Survey of the physiology of circulatory system, excretion, 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 relationships; exercise; 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 316; CEM 132, or approval of department.*

### 332. *Human Physiology*
*Spring. 4(3-2) 331.*

### 412. *Introductory Comparative Physiology*

*(310.) Fall. 4(3-4) 240 or B S 212 and CEM 132.*

A comparison 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 endocrines, and reproduction.

### 444. *Milk Secretion*

*Winter. 4(3-2) Interdepartmental and administered jointly with the Dairy Department.*

Anatomy of mammary gland. Hormonal and nervous control of mammary growth, initiation and maintenance of lactation. Biochemistry of milk secretion. Physiology of milking; physiological, pathological and management factors affecting lactation.

### 445. *Endocrinology and Reproduction of Farm Animals*

*Fall. 4(3-2) 240. 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.

### 808. *Advanced Endocrinology*

*Winter. 3(3-0) Approval of department.*

Current developments on 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(2-2) Not open to students with credit in 323. 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 prinicples of renal physiology and related aspects of body fluid and electrolyte metabolism.

### 835. *Neurophysiology*

*Winter. 5(4-3) 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*

*(430). 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 and administered by 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.

### 899. *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 vessels 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, Summer. 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.

### 980. *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. 5(3-4)*

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(0-8)*

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. Liaison 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.