480. Philosophy of Science, Part I

Winter. 4(3-0) 337 or approval of department.

Topics such as: the logical structure of scientific theories, empirical meaningfulness and testability, deductive and probabilistic explanation, prediction.

481. Philosophy of Science, Part II

Spring. 4(3-0) 337 or approval of department.

Topics such as: discovery vs. validation of theories, probability, induction and confirmation theory.

483. Philosophy of Physical Science

Fall, Spring. 4(4-0) Nine credits in physical science or approval of department. Interdepartmental with and administered by Lyman Briggs College.

Philosophical problems of the physical sciences. The topics will be taken from such areas as: quantum mechanics, space-time, classical mechanics, relativity.

484. Philosophy of Biological Sciences

Winter, Spring. 4(4-0) Nine credits in science or approval of department. Interdepartmental with and administered by Lyman Briggs College.

Methodological notions and problems of the biological sciences such as: observation and measurement, classification, teleological and functional explanation, teleological systems, emergentism, vitalism, value neutrality.

485. Philosophy of the Social Sciences

Spring. 4(3-0) Three credits in philosophy at 300 level or higher or 9 credits in philosophy or 9 credits, other than basics, in social science or approval of department.

Selected problems in the methodology of the behavior sciences, including such topics as: concept formation and theory construction, explanation and insight, subjectivity and value judgments, emergence and teleology, historicism, reductionism, measurement, and statistical inference.

494. Special Topics

Fall, Winter, Spring, Summer. 2 to 6 credits. May re-enroll for credit. Approval of department.

Intensive study of some particular problem or author in philosophy.

825. Seminar in the History of Philosophy

Fall, Winter, Spring. 4 credits. Approval of department.

830. Seminar in Ethics

Winter, Spring, Summer. 4 credits. May re-enroll for credit. Approval of department.

837. Seminar in Logic

Fall, Winter, Spring. 4(3-0) May re-enroll for credit. Approval of department.

841. Seminar in Epistemology

Fall, Winter, Spring. 4 credits. May re-enroll for credit. Approval of department.

845. Seminar in Metaphysics

Fall, Winter, Spring. 4 credits. May re-enroll for credit. Approval of department.

850. Seminar in Aesthetics

Fall. 4(3-0) Approval of department.

The nature of aesthetic values, grounds of criticism, function of the arts, etc.

860. Seminar in Social Philosophy

Spring. 4(3-0) Approval of department.

Philosophy of law and of the state.

870. Seminar in the Philosophy of Language

Fall. 4(3-0) Approval of department.

Concrete bases of language and nature of meaning.

880. Seminar in the Philosophy of Science

Fall, Winter. 4 credits. Approval of department.

890. Graduate Reading Course

Fall, Winter, Spring, Summer. 1 to 10 credits. May re-enroll for credit. Approval of department.

Supervised reading course for advanced graduate students for more thorough investigation of special fields.

899. Research

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

999. Research

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

PHYSICAL SCIENCE PHS

College of Natural Science

203. Foundations of Physical Sciences

Fall, Winter, Spring, Summer. 4(3-3) Primarily for elementary school teachers.

Integrated descriptive course in the elements of physical science including the interrelations among chemistry, geology, meteorology, astronomy, and physics.

401. Mathematics for Teachers

Fall. 4(4-0) Teaching experience and approval of department.

Provides mathematical background for science teachers. It will emphasize the basic concepts of mathematics, including number systems. Topics will be selected from algebra, analytic geometry and trigonometry to illustrate the principles of number, operation, relation, proof and other basic mathematical ideas.

402. Mathematics for Teachers

Fall, Winter. 4(4-0) 401 or approval of department.

Continuation of 401.

403. Mathematics for Teachers

Winter, Spring. 4(4-0) 402 or approval of department.

Continuation of 402.

404. Physical Science for Teachers

Fall, Winter, Spring. 4(3-3) Bachelor's degree.

An integrated course in the physical sciences on the nature of the matter and energy gained by interrelating the facts, principles and laws about light, electricity, magnetism and sound as well as the structure and properties of substances, rates of reaction, equilibria. The concepts of measurement will be stressed. The course is for general science teachers and is not applicable for chemistry or physics majors.

405. Physical Science for Teachers

Fall, Winter, Spring. 4(3-3) 404.

Continuation of 404.

406. Physical Science for Teachers

Fall, Winter, Spring. 4(3-3) 405.

Continuation of 405.

410. Seminar on Recent Advances in Physical Science

Fall, Winter, Spring, Summer. 3(3-0) May re-enroll for a maximum of 6 credits if different topic is taken. Approval of department.

A series of lectures by senior faculty of topics on the history, development, the most recent advances and the possible future and limits of the Physical Sciences.

411. Seminar on Man, His Universe

Fall, Winter, Spring, Summer. 3(3-0) Approval of department.

A creative review by senior faculty from Astronomy, Biochemistry, Biophysics, Geology, Physics and Philosophy on the impact of recent space probes in developing modern concepts of the universe.

412. Seminar on Man, His Earth

Fall, Winter, Spring, Summer. 3(3-0) Approval of department.

A summary by senior faculty from Astronomy, Anthropology, Botany, Geology, Meteorology, and Zoology of new ideas, methods, and theories employed by current researchers to unravel the mysteries of the origin of the earth, its interior, the forces developing the scenic surface features, and the evolution of life in its historical setting.

PHYSICS PHY

College of Natural Science

Introductory courses are divided into three groups:

(1) 237, 238, 239 (theory) and 257, 258, 259 (laboratory) open to students who are taking at the same time, or who have taken, first year mathematics through college algebra and trigonometry.

(2) 287, 288, 289 (theory) and 297, 298, 299 (laboratory) for students of engineering, physical sciences, mathematics, and others. Those electing this sequence should have completed courses in mathematics through two terms of analytic geometry and calculus.

(3) 291, 292, 293, 294, 392, 393, 394, 395 for physics majors and others who have a special interest in physics. Students electing this sequence should have completed or should be taking the second term of analytic geometry and calculus.

A student may change from one group of introductory courses to another but may not receive credit for the equivalent of more than one complete three-term introductory sequence.

Credit may not be earned for more than one of the courses PHY 294, 357 or 364.

PHY 357 and 360 cannot be used to meet the requirements for a major in physics.

All 400 level physics courses require PHY 289 or 293 as prerequisites.

237. Introductory Physics

Fall, Winter. 3(4-0) MTH 102 or 109 or 111 or concurrently.

Mechanics and heat.

238. Introductory Physics

Winter, Spring. 3(4-0) 237.

Heat, electricity and magnetism.

239. Introductory Physics

Fall, Spring. 3(4-0) 238.

Wave motion, sound, light, and modern developments.

256. *Energy Consumption and Environmental Quality*
Spring. 3(3-0) Sophomores. Interdepartmental with and administered by Lyman Briggs College.
The role of energy as a fundamental pollutant will be discussed along with the availability of fossil energy sources. Limitations on the safe utilization of both fossil and nuclear energy will also be considered.

257. *Introductory Physics Laboratory*
Fall, Winter. 1(0-2) 237 or concurrently.
Mechanics and heat.

258. *Introductory Physics Laboratory*
Winter, Spring. 1(0-2) 238 or concurrently.
Heat, electricity and magnetism.

259. *Introductory Physics Laboratory*
Fall, Spring. 1(0-2) 239 or concurrently.
Wave motion, sound, light and modern developments.

287. *Principles of Physics*
Fall, Winter. 4(5-0) MTH 113.
Mechanics.

288. *Principles of Physics*
Winter, Spring. 4(5-0) 287; MTH 214 or approval of department.
Heat and thermodynamics, electricity and magnetism.

289. *Principles of Physics*
Fall, Spring, Summer. 4(5-0) 288; MTH 214 or approval of department.
Wave motion, sound, light, and modern developments.

291. *Physics I*
Spring. 4(5-0) MTH 214 or concurrently.
First of a five-term course sequence in elementary physics consisting of 291, 292, 293, 294 and 395. In this sequence the principles of physics are presented in a unified manner that emphasizes modern concepts. Mechanics, including special relativity.

292. *Physics II*
Fall. 4(5-0) 291; MTH 215 or concurrently.
Continuation of 291. Electricity and magnetism with some special relativity.

293. *Physics III*
Winter. 4(5-0) 292.
Continuation of 292. Wave physics including optics.

294. *Physics IV*
Spring. 4(5-0) 293 or 289.
Continuation of 293. Introduction to quantum physics.

297. *Principles of Physics Laboratory*
Fall, Winter. 1(0-2) 287 or 292 or concurrently.
Mechanics.

298. *Principles of Physics Laboratory*
Winter, Spring. 1(0-2) 288 or 293 or concurrently.
Heat and thermodynamics, electricity and magnetism.

299. *Principles of Physics Laboratory*
Fall, Spring, Summer. 1(0-2) 289 or 294 or concurrently.
Wave motion, sound, light and modern developments.

310. *Calculus Concepts in Physics*
Fall, Summer. 5(5-0) 237, 238, 239; MTH 214.
A transition course to prepare students who had non-calculus introductory physics for upperdivision courses. Discussions and problems in mechanics, electricity and magnetism, wave motion and modern physics. Familiarity with non-calculus introductory physics is assumed.

357. *Topics in Contemporary Physics*
Spring. 4(4-0) One year of general college physics.
Atomic and nuclear physics, cosmic rays and elementary particles, nuclear energy, new theoretical concepts. Recommended for prospective high school teachers.

364. *Introduction to Modern Physics I*
Fall, Winter, Spring. 3(3-0) 289 or 293 or approval of department.
Atomic structure; wave and particle aspects of radiant energy; optical and X-ray spectra.

365. *Introduction to Modern Physics II*
Winter, Spring. 3(3-0) 364 or 294.
Nuclear, molecular, solid state and elementary particle physics. Special emphasis is given to applications such as reactors, super conductors, semi-conductors, fusion reactions, particle accelerations, etc.

368. *Elementary Solid State Physics I*
Winter. 3(3-0) 364 or 294.
Crystal structure and binding; lattice dynamics, specific heat, thermal conductivity; free electron theory of metals, conductivity, optical properties; elementary band theory; Hall effect, effective masses in metals and semi-conductors.

369. *Elementary Solid State Physics II*
Spring. 3(3-0) 368.
Ferroelectricity, paramagnetism, ferromagnetism, antiferromagnetism, domain walls; point defects, and dislocations in metals, formation and motion energies, internal friction, radiation damage.

392. *Physics II Laboratory*
Fall. 1(0-3) 287 or 292 or concurrently.
Experiments in classical mechanics and electricity and magnetism.

393. *Physics III Laboratory*
Winter. 1(0-3) 288 or 293 or concurrently.
Experiments in wave motion and optics.

394. *Physics IV Laboratory*
Spring. 1(0-3) 289 or 294 or concurrently.
Experiments in general and modern physics.

395. *Physics V*
Fall. 3(3-0) 294 or approval of department.
Continuation of 294. Thermodynamics and statistical physics.

400H. *Honors Work*
Fall, Winter, Spring. Variable credit.

404. *Special Problems*
Fall, Winter, Spring, Summer. 1 to 5 credits. 289 or 293; approval of department.

419. *Electronics*
Spring. 3(2-3) E E 345.
Electron tube and electric circuits designed for control and physical measurement. Laboratory work provides direct study of characteristics of tubes and circuits.

427. *Intermediate Mechanics*
Fall. 3(3-0) 289 or 293; MTH 215.
Statics and dynamics of a particle and of rigid bodies; linear and non-linear oscillations; gravitation from a field point of view; transformation properties of physical quantities; introduction to mathematical techniques of theoretical physics.

428. *Intermediate Mechanics*
Winter. 3(3-0) 427.
Continuation of 427.

429. *Advanced Mechanics*
Spring. 3(3-0) 428.
Advanced methods of theoretical mechanics; generalized coordinates; Lagrange's and Hamilton's equations; the wave equation, theory of vibrations.

430. *Introduction to Radioactivity and Radioisotope Techniques*
Fall, Summer. 3(2-3) One year each of general college chemistry and physics and CEM 161. CEM 162 recommended. Physics majors cannot apply course towards graduation requirements. Interdepartmental with the Chemistry Department.
Elementary nuclear properties and processes with emphasis on radioactivity, its measurement, and its interaction with matter. Special attention is given to experimental techniques and applications of radioisotopes to problems in chemistry, the life sciences and industry.

438. *Optics*
Fall. 4(3-3) 289 or 293; MTH 215.
Geometrical optics including Fermat's Principle, reflection, refraction, mirrors, thin lenses, thick lenses, aberrations, and the effects of apertures and stops, interference.

439. *Optics*
Winter. 4(3-3) 438.
Physical optics including Huygens-Fresnel Principles, diffraction; Fourier transforms of wave forms, convolution, diffraction and image formation; holography; polarization.

447. *Electricity and Magnetism I*
Winter. 4(4-0) Eighteen credits in physics, including 289 or 293; MTH 215.
Advanced study of electromagnetic phenomena; electrostatic potentials from Laplace's and Poisson's equations; effects of dielectric and magnetic materials; magnetic fields and potentials; induced e.m.f.; Maxwell's equations; electromagnetic radiation and waves.

448. *Electricity and Magnetism II*
Spring. 4(4-0) 447.
Continuation of 447.

457G. *Advanced Physics Laboratory (General)*
(457.) Fall. 3(1-6) 15 credits in physics including 289 or 293.
Experiments in modern physics of historical interest and in general physics research techniques. Emphasizes experimental methods and proper treatment of data. Independent work encouraged.

457N. *Advanced Physics Laboratory*

(457.) Winter of even-numbered years, Spring of odd-numbered years. 3(1-6) 15 credits in physics including 289 or 293.

Experiments in nuclear physics. Detection of nuclear radiation and determination of nuclear properties. Emphasizes research methods and proper treatment and interpretation of data. Independent work encouraged.

457S. *Advanced Physics Laboratory (Solid State)*

(457.) Spring of even-numbered years, Winter of odd-numbered years. 3(1-6) 15 credits in physics including 289 or 293.

Experiments in low temperature and solid state physics. Emphasizes research methods and proper treatment and interpretation of data. Independent work encouraged.

491. *Introduction to Quantum Mechanics*

(467.) Fall. 3(3-0) 294 or 364; MTH 215.

Schroedinger wave equation and its applications; angular momentum; one electron atoms; moments and spin; perturbation methods; absorption and emission of radiation; atomic and molecular structure.

492. *Introduction to Quantum Mechanics II*

(468.) Winter. 3(3-0) 491.

Continuation of 491.

493. *Introduction to Quantum Mechanics III*

(469.) Spring. 3(3-0) 492.

Continuation of 492.

498. *Introduction to Nuclear Physics*

Spring. 3(3-0) 294 or 364 or 491.

Interactions of nuclear radiations with matter; properties of nuclei; alpha, beta, gamma decay; nuclear models; nuclear reactions and elementary applications of scattering theory; reactors, accelerators; introduction to high-energy physics.

817. *Techniques of Theoretical Physics I*

Fall. 2(2-0) Graduate students; or approval of department.

Formulation of physical problems and practical methods of solving frequently encountered differential and integral equations including numerical methods; approximations appropriate to physical situations are stressed.

818. *Techniques of Theoretical Physics II*

Winter. 2(2-0) 817.

Special functions of importance to theoretical physics are described. Solution of physical problems using Green's Functions, the delta function, expansions in series, integral transforms.

819. *Techniques of Theoretical Physics III*

Spring. 2(2-0) 818, MTH 423.

Application of methods of contour integration to solution of physical problems; introduction to basic concepts involved in theoretical formulation of quantum mechanical states, observables, and development of dynamical systems.

827. *Theoretical Physics I*

Summer of odd-numbered years. 3(3-0) 428 or approval of department.

Vector analysis, mechanics of a particle and of systems of particles. Lagrange's equations, Hamiltonian methods, rotational motion.

828. *Theoretical Physics II*

Summer of even-numbered years. 3(3-0) 448 or approval of department.

Special relativity, Maxwell's equations, electrodynamics and electromagnetic waves.

829. *Theoretical Physics III*

Spring. Summer of odd-numbered years. 3(3-0) Approval of department.

Principles of thermodynamics; topics in kinetic theory; introduction to statistical mechanics.

837. *Quantum Mechanics I*

Fall. 3(3-0) 428, 491.

The formulation of quantum mechanics, superposition principle, state vector and representations; uncertainty principle; Schroedinger equation and its solution for physical systems.

838. *Quantum Mechanics II*

Winter. 3(3-0) 837.

Approximation methods, perturabation theory, applications to atomic transitions, angular momentum.

839. *Quantum Mechanics III*

Spring. 3(3-0) 838.

Collision processes and scattering theory, applications; many-particle systems.

840. *Symmetry in Solid State Physics*

Spring. 3(3-0) Graduates or approval of department.

Translational symmetry and Bloch's Theorem, reciprocal lattice, Brillouin zones; point groups, representations, character tables, molecular vibrations, group of the wave vectors and band theory of solids, crystal fields.

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.

860. *General Relativity and Cosmology I*

Fall of even-numbered years. 3(3-0) 859 or approval of department. Interdepartmental with the Astronomy Department.

Conceptual foundations of general relativity theory; elements of tensor calculus; Riemann-Christoffel curvature tensor; the field equations; experimental tests; special solutions; the extension to cosmology.

861. *General Relativity and Cosmology II*

Winter of odd-numbered years. 3(3-0) AST 860. Interdepartmental with the Astronomy Department.

Relativistic cosmology: the model universes; steady-state theory; observational evidence and possibilities for decision among models; current problems.

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.

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) 839 and 840.

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 Osteopathic Medicine
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.

401. *Comparative Physiology I*

(412.) Fall. 4(3-4) 240 or B S 212 and CEM 132. Interdepartmental with Department of Zoology.

A comparison of osmoregulation, digestion, respiration, and other physiological processes in a wide range of organisms.

402. *Comparative Physiology II*

Winter. 4(4-0) 401 or approval of department. Interdepartmental with and administered by the Department of Zoology.

A comparison of sensory, motor, endocrine and other integrative mechanisms in animals.

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. 4(3-3) 4(6-6) 5 weeks. This is equivalent to 3 hours of lecture and 3 hours of laboratory on a ten-week basis. 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 Science 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 Science 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.

497. *Principles of Endocrinology*

Winter. 4(4-0) Organic chemistry; ZOL 317. Interdepartmental with and administered by the Zoology Department.

Hormonal principles, illustrated by experimental observations, in vertebrates and invertebrates. Emphasis on cellular endocrinology. Group discussion, background in organic chemistry and cell biology strongly recommended. Term paper required.

500A. *Introductory Physiology for Medicine*

(500.) Fall, Winter. 3(3-0) or 5(5-0) Admission to the professional program in a college of medicine.

Concepts and problems in physiology to be followed by supplemental physiology instruction during subsequent phases of medical training.

500B. *Introductory Physiology for Medicine*

Summer. 3(3-0) or 4(3-1) Admission to the professional program in a college of medicine.

Classical concepts and problems in physiology which form a base for clinical physiology training in subsequent terms.

500C. *Introductory Physiology for Medicine*

Fall. 3(3-0) or 4(3-1) Admission to the professional program in a college of medicine.

Continuation of 500B.

501. *Advanced Mammalian Physiology*

Winter. 5(5-0) Approval of department.

Basic aspects of cellular physiology: membrane permeability, ionic equilibria, bioelectric phenomena, fluid and electrolyte environment of cells. Neuro-muscular physiology; reflexes, central and autonomic nervous systems; sensory physiology. Endocrine gland system; digestion and metabolism.

502. *Advanced Mammalian Physiology*

Spring. 6(5-4) 501.

Continuation of 501; reproduction; blood and cardiovascular system; respiration and kidney.