

- 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.
- 850. Ionized Gases**  
Spring. 3(3-0) E E 835 or PHY 448. *Interdepartmental with the Astronomy Department and Electrical Engineering and administered by Electrical Engineering.*  
Elastic collision processes; Boltzmann equation; moment equations; basic plasma phenomena; motion of a charged particle in electrical and magnetic field; individual and collective charged particle behavior.
- 857. Theoretical Mechanics I**  
Winter. 3(3-0)  
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**  
Spring. 3(3-0) *Approval of department.*  
Hamiltonian formalism for particles and fields, variational methods, canonical transformations, small oscillators, classical fields, relativity.
- 860. General Relativity and Cosmology I**  
*Fall of even-numbered years. 3(3-0) 858 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.
- 961. Accelerator Physics**  
Winter. 3(3-0) 849, 858.  
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.
- 989. Waves and Radiations in Plasmas**  
*Fall of even-numbered years. 3(3-0) 850. Interdepartmental with the Astronomy Department and Electrical Engineering and administered by Electrical Engineering.*  
Plasma oscillation; interaction, electromagnetic fields with plasmas, wave propagation in magnetic media; plasma sheath; radiation of electric source in incompressible and compressive plasmas; electroacoustic waves; magnetohydrodynamics; research topics in plasmas.
- 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.

**Descriptions — Physiology  
of  
Courses**

- 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.
- 242. 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**  
Fall. 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.
- 801. Advanced Physiology**  
(501.) Winter. 4(3-2) 331, 332 or 401; courses in anatomy, including histology, biochemistry and calculus recommended.  
Principles of physiological control systems. Physiology of the nervous system including, neuromuscular, reflex, sensory and autonomic nervous function. Physiology of respiration; acid-base, regulation of body fluids.
- 802. Advanced Physiology**  
(502.) Spring. 4(3-2) 331, 332 or 401; courses in anatomy, including histology, biochemistry and calculus recommended.  
Physiology of kidney and micturition, blood and cardiovascular system.
- 803. Advanced Physiology**  
Fall. 4(3-2) 331, 332 or 401; courses in anatomy, including histology, biochemistry and calculus recommended.  
Physiology of the digestive system, regulation of metabolism; endocrinology and reproduction.
- 808. Neuroendocrinology**  
Winter. 3(3-0) Approval of department.  
Anatomical, biochemical and physiological aspects of neuroendocrinology. Control systems and interaction among endocrine glands will be emphasized.
- 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 of even-numbered years. 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) 802, approval of department.  
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 of odd-numbered years. 4(2-4) Approval of department.  
Functions and properties of the peripheral and central nervous systems.
- 836. Physical Principles of Biological Systems**  
Winter. 3(3-0)  
Application of laws and methods of physics to measurement and description of physiological phenomena.
- 837. Radiobiology**  
Fall. 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.
- 865. Advanced Neurobiology**  
Winter of odd-numbered years. 3(3-0) BPY 825. Interdepartmental with the departments of Biophysics, Biomechanics, Psychology and Zoology and administered by the Department of Biomechanics.  
Basic organization, structure and function of neural networks comprising sensory, motor, and autonomic systems including examples from invertebrates and vertebrates.
- 870. Research Problems and Techniques in Pathologic Physiology**  
Summer. 3(3-0) 801, 802, 803.  
Description of mechanisms of human disease states. Stimulation of research where especially needed. Development of animal models to study these disease states. Lecture demonstrations illustrate methods of producing disease models.

**885. Vertebrate Neural Systems I**

Fall of odd-numbered years. 5(3-4)  
Approval of department; ANT 815 and BPY 825 recommended. Interdepartmental with the Zoology, Biophysics and Psychology Departments and administered by the Psychology Department.

Structure and function of major component systems of vertebrate brains, their evolution, ontogeny and comparative analysis in mammals, birds, reptiles, amphibians and fish. Interrelation of behavioral, anatomical and physiological studies.

**886. Vertebrate Neural Systems II**

Winter of even-numbered years. 5(3-4)  
PSY 885. Interdepartmental with the Psychology, Biophysics and Zoology Departments and administered by the Zoology Department.

Continuation of 885. Major component systems of vertebrate brains, their evolution, ontogeny, and comparative analysis in mammals, birds, reptiles, amphibians and fish. Interrelation of behavioral, anatomical, and physiological studies.

**899. Research**

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

**910. Seminar**

Fall, Winter, Spring. 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**

Fall. 4(3-2) 801, approval of department.

Development of ideas leading to our present state of knowledge in respiration.

**919. Cardiovascular System**

Fall. 4(3-3) 802.

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.

**140. Comparative Politics**

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

Comparison of political systems in western and non-western nations.

**160. International Relations**

Fall, Winter, Spring, Summer. 4(3-0)

Contemporary world affairs surveyed. The struggle for power, the nation-state system; factors creating harmony and hostility among nations. War and peace in our time.

**170. The Isms**

Fall, Winter, Spring, Summer. 4(3-0)

Introduction to basic contemporary political ideologies; theoretical foundations of democracy, socialism, communism, political elitism, and nationalism. Special attention to ideology underlying contemporary political problems.

**200. Introduction to Political Science**

Fall, Winter, Spring, Summer. 4(3-0)

Acquaints the student with the theories, methods and concepts of political science. Emphasis is on ideology and interests in the political process.

**IDC. The Politics of Ecology**

For course description, see Interdisciplinary Courses.

**290. Methods of Political Research**

Fall, Winter. 4(3-0) 200.

Design and execution of research in political behavior and institutions. Major emphasis on logic underlying various types of political research, on identification of appropriate data sources and field methods.

**291. Methods of Political Research**

Winter, Spring. 4(3-0) 290.

Analysis of political data, with major emphasis on quantitative techniques.

**301. American State Government**

Fall, Winter, Spring, Summer. 4(3-0)

Major aspects of policy-making process at the state government level. Comparison of state political systems.

**302. American Urban Government**

Fall, Winter, Spring, Summer. 4(3-0)

Urban political process in America. Politics of policy-making for urban functions; politics of intergovernmental relations.

**303. Michigan Government**

Spring. 4(3-0)

How Michigan government is organized and conducted and how policies are made; sources of executive-legislative conflict; politics of taxation; role of the state in local affairs; balance of political forces in the state.

**310. Public Bureaucracy in the Policy Process**

Fall, Spring. 4(3-0)

Introduces student to following major areas of public administration: development of administration in the U.S.; theories of administrative organization; principles and methods of administrative management; executive leadership; interpersonal and intergroup relationships; levels of decision making, ethics and responsibility.

**313. Public Policy Analysis**

Winter. 4(3-0)

Problems and methods in perception of public problems, determination of goals, generation and evaluation of alternatives, policy choice. Planning and program budgeting, political and analytical methods of policy making compared.

**320. The American Judicial Process**

Fall, Winter, Spring, Summer. 4(3-0)

Analysis of the structure and functions of judicial systems. Organization, administration, and politics of judicial bureaucracies. Roles of judges, juries, counsel, litigants, and interest groups in adjudication processes.

**321. Judicial Policy Making**

Fall, Spring. 4(3-0)

Consideration of political behavior of judges (especially Justices of Supreme Court) and their policy making. Focus on policy questions currently important, including civil liberties, national economic policy and interrelationships among governmental units.

**324. The American Legislative Process**

Winter. 4(3-0)

Nature of legislative process in the United States; organization and procedure of legislative bodies; direct legislation; relationship of legislative branch to other branches of government.

**325. The American Executive Process**

Spring. 4(3-0)

Role of the president, state governors, and municipal executives in the American system of government. Analysis and discussion of constitutional status and powers, selection, administrative responsibilities, legislative and political leadership, accountability and responsibility of chief executives.

**329. Socialist Politics in the U.S.**

Spring. 4(3-0)

The politics of Marxist and non-Marxist socialism from the post-Civil War to the present. Political parties, social movements, ideas, and individuals.

**331. American Political Parties**

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

Origins, structure, and functions of political parties. Dynamics of the two-party system. Role of third parties.

**332. Interest Groups and Political Movements**

Winter. 4(3-0)

Group theory and politics. Growth of organizations and associations to represent the interests of business, labor, agricultural, professional, veterans, and other groups. Internal politics of private associations and their impact on public policy.

**333. Political Opinion and Voting Behavior**

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

Development of political attitudes, ideology, and partisanship and their relation to voting behavior; political participation; comparisons of mass and elite attitudes and behavior; representation of public opinion in the political system.

POLITICAL SCIENCE PLS

College of Social Science

**100. American National Government**

Fall, Winter, Spring, Summer. 4(3-0)

Major aspects of national government with emphasis on the policy-making process.