860. General Relativity and
Cosmology I
Fall of even-numbered years. 3(3-0)
858 or approval of department. Interdepartmental with the Department of Astronomy and Astrophysics.
Conceptual foundations of general relativity theory; elements of tensor calculus; Riemann-Cartesian 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 Department of Astronomy and Astrophysics.
Relativistic cosmology; the model universes; steady-state theory; observational evidence and possibilities for decision among models; current possibilities for decision among models; observational evidence and

862. Quantized Fields
Fall. 3(3-0) 868.
Transformation theory and invariance principles; the rotation group and theory of angular momentum; Wigner-Eckart theorem and applications.

866. 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 formulas, Feynman rules, quantum electrodynamics; topics from many-body theory.

877. Equilibrium Statistical Mechanics
Fall. 3(3-0) Approval of department.
Ensembles, partition functions, thermodynamic potential 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.

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

891. Elementary Particle Physics
Fall. 3(3-0) 890.
Properties of elementary particles; invariance principles and conservation laws; strong, electromagnetic, and weak interactions; pion physics.

892. Elementary Particle Physics
Fall. 3(3-0) 891.
Quark and meson resonances, unitary symmetry, dispersion relations.

893. Elementary Particle Physics
Spring. 3(3-0) 892.
Selected current topics, partial wave amplitudes and Regge poles; current algebra and weak interactions.

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

895. Molecular Structure and Spectra II
Winter of even-numbered years. 3(3-0) 895.
Structure and spectra of polyatomic molecules.

896. Molecular Structure and Spectra III
Spring of even-numbered years. 3(3-0) 896.
Advanced topics in vibration-rotation theory of polyatomic molecules.

897. Nuclear Physics I
Fall. 3(3-0) 897.
Nucleon-nucleon scattering, nuclear sizes and shapes, multipole moments; shell model; collective states.

898. Nuclear Physics II
Winter. 3(3-0) 898.
Experimental methods and instrumentation; nuclear reactions; inelastic scattering and particle transfer.

899. Nuclear Physics III
Spring. 3(3-0) 899.
Many-body methods in nuclear physics; Bethe-Goldstone equation; effective interaction; nuclear models.

901. Comparative Physiology I
Fall. 4(3-0) 901 or B.S. 312 and CEM 132. Interdepartmental with Department of Zoology.
A comparison of osmoregulation, digestion, respiration, and other physiological processes in a wide range of organisms.

902. 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.
500B. Introductory Physiology for Medicine

Summar. 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 basic 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

(S01.) Winter. 4(3-3) 331, 332 or 401; courses in anatomy, including histology, biochemistry and calculus recommended.

Principles of physiological control systems. Physiology of the nervous system including, neurovascular, reflex, sensory and autonomic nervous function. Physiology of respiration; acid-base, regulation of body fluids.

802. Advanced Physiology

(S02.) Spring. 4(3-3) 331, 332 or 401; courses in anatomy, including histology, biochemistry and calculus recommended.

Physiology of kidney and menstruation, blood and cardiovascular system.

803. Advanced Physiology

Fall. 4(3-3) 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.

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 radiophysical 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)

PST 825. Interdepartmental with the departments of Biophysics, Psychology, and Zoology and administered by the Department of Biomechanics.

Basic organization, structure and function of nervous networks comprising sensory, motor, and autonomic systems including examples from invertebrates and vertebrates.

870. Research Problems and Techniques in Pathologic Physiology

Spring. 3(3-0) 801, 802, 803.


885. Vertebrate Neural Systems I

Fall of odd-numbered years. 3(3-4) Approval of department. ANT 815 and PST 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. 3(3-4)

PST 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.

890. Research

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

900. Seminar

Fall, Winter, Spring. 1(1-0) May re-enroll for a maximum of 8 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(3-2) 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.
Descriptions — Physiology of Courses

945. **Physiology of Mammalian Reproduction**  
Winter, 4(3-0) DBY or FSL 445 or approval of department. Interdepartmental with and administered by the Department of Dairy Science.  
Chemistry and biosynthesis of reproductive hormones. Gonadal, hypothalamic and pituitary development of reproductive potential. Ovulation, fertilization, implantation and placenta tion will be studied. Relationships of conceptus, uterus and corpus luteum. Parturition.

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.

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**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.

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 Iams**  
Fall, Winter, Spring, Summer. 4(3-0)  
Introduction to basic contemporary political ideologies, historical 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)  
Introduces student to following major areas of political science: organizational structure, legislative, political and legal systems, and government; major institutions of political systems, and their role in the political process; political processes and institutions at the national and international level; political behavior and institutions at the state and local level; political action and decision making; political parties and interest organizations; and the role of political elites and mass media in the political process.

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**999. Research**  
Fall, Winter, Spring, Summer. 4(3-0)  
Variable credit. Approval of department.

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**Descriptive Physiology**

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.

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**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.

334. **Campaigns and Elections**  
Fall, Spring. 4(3-0)  
Methods of campaigning. Nomination process and recruitment of candidates. Formation of electoral coalitions and analysis of election results. Examination of trends and changes in electoral support.

335. **Comparative Parties and Pressure Groups**  
Spring. 4(3-0)  
Dynamics of political party and pressure group behavior in selected political systems. Comparative analysis of organization, ideologies, membership, leadership, tactics, power and influence of parties.

336. **Black Political Movements**  
Fall. 4(3-0)  
Examines attempts of blacks to gain political access and identity in America from post civil war through black nationalism. Traced as a case study of the politics of social movements.

337. **Ethnicity, Race and Politics**  
Winter. 4(3-0)  
Juniors. Ethnicity and race as factors in the political process and as issues of public policy.

338. **Politics and Inequality**  
Winter. 4(3-0)  
Nature of democratic politics, distribution of power and the role of political elites, and impact of politics on social inequality and policy-making, in the United States and in comparative perspective.