

PHIL 6710. Ecofeminism: Women's Studies and Environmental Ethics. 3 hours. Examines the merger of feminism with environmental ethics and its subsequent evolution. Subject matter includes the analysis of patriarchy, gender issues and multicultural perspectives within the larger framework of ethical and philosophical responses to ecocrises.

PHIL 6720. Comparative Environmental Ethics. 3 hours. An exploration of resources for environmental philosophy in non-Western traditions, focusing on South and East Asian traditions.

PHIL 6730. Western Religion and the Environment. 3 hours. A historic and contemporary overview of Euro-American religious thought concerning the environment, including investigation of the ancient Western religions, Judaism, Christianity and Native American religions.

PHIL 6740. Environmental Ethics and Public Policy. 3 hours. Investigates the policy turn in environmental philosophy, exploring ways to make environmental ethics and environmental philosophy more relevant to decision-makers, public agencies and stakeholders groups.

PHIL 6750. Environmental Justice. 3 hours. Examination of the histories, concepts, philosophical implications, and the struggles of people in shaping the environmental justice movement. Examines the underlying notions of environmental goods and harms, the perspectives of environmental law and policy, and the politics of environmental identities.

PHIL 6760. Topics in Environmental Philosophy. 3 hours. Focused examination of the perennial or emerging topics in environmental philosophy, such as the intrinsic value of nature, monism versus pluralism, ecophenomenology, holism versus individualism, and non-Western explorations of environmental ethics and philosophy. May be repeated for credit as topics vary.

PHIL 6900-PHIL 6910. Special Problems. 1–3 hours. Research by doctoral students in fields of special interest. Prerequisite(s): consent of department.

PHIL 6950. Doctoral Dissertation. 3, 6, 9 hours. To be scheduled only with consent of department. 12 hours required. No credit assigned until dissertation has been completed and filed with the graduate dean. Doctoral students must maintain continuous enrollment in this course subsequent to passing qualifying examination for administration for admission to candidacy. May be repeated for credit.

PHIL 6960. Seminar in Problems in Philosophy. 3 hours. Intensive analysis of major philosophical issues against the background of classical and contemporary investigations. May be repeated for credit as topics vary.

Physical Education

see *Undergraduate Catalog*

Physics

Astronomy – see *Undergraduate Catalog*

Physics, PHYS

PHYS 5450. Survey of Solid State Physics. 3 hours. Acquaints students with the major areas of solid state physics. Simple models and physical insight to solid state phenomena are stressed. Intended for physics students of all specializations. Topics include crystal structure, crystal symmetry, reciprocal lattice, X-ray diffraction, crystal binding, phonons and lattice vibrations, thermal properties, free electron theory, semiconductors, superconductivity and magnetic properties. Prerequisite(s): PHYS 4110.

PHYS 5500. Quantum Mechanics I. 3 hours. Fundamentals of quantum theory. Foundations of wave mechanics, wavepackets and the uncertainty principles. Schroedinger equation, one-dimensional problems, operators and eigenfunctions, three-dimensional problems, angular momentum and spin.

PHYS 5510. Quantum Mechanics II. 3 hours. Scattering theory; spin, angular momentum; WKB and variation method; time-independent and time-dependent perturbation theory; identical particles; applications; relativistic waves equations. Prerequisite(s): PHYS 5500.

PHYS 5610. Selected Topics in Modern Physics. 3 hours. Selected topics of contemporary interest in physics. Prerequisite(s): consent of department. May be repeated for credit as topics vary with consent of department chair.

PHYS 5700. Computational Physics. 3 hours. Symbolic and numerical solutions to single and multiple, single-variable and multi-variable, linear and nonlinear, integral and differential equations. Finite-differences method for solving a partial differential equation. Solution visualization techniques, including multidimensional plots. Matrix manipulation. Data analysis. Monte Carlo methods. Random walk simulations. Classical trajectory simulations.

PHYS 5710. Advanced Classical Mechanics I. 3 hours. Variational principles and Lagrange's equations. Central force problem. Rigid body motion. Hamilton's equations; canonical variables and transformations; action-angle variables; Hamilton-Jacobi theory. Prerequisite(s): PHYS 3220 or consent of department.

PHYS 5720. Electromagnetic Theory I. 3 hours. Maxwell's equations, vector, scalar potentials; gauge transformations; wave equation; conservation theorems; boundary conditions; statics. Non-dissipative media and dispersion; dissipative media; reflection and refraction; guided waves. Prerequisite(s): PHYS 4210 and PHYS 6000 (concurrent), or consent of department.

PHYS 5750. Selected Topics in Materials Physics. 3 hours. Topics from specialized areas of materials science, physics, chemistry. Integrated circuit fabrication and materials. Transmission electron microscopy. May be repeated for credit as topics vary.

PHYS 5900-PHYS 5910. Special Problems. 1–6 hours each. Special problems in advanced physics for graduate students. Problem chosen by the student with the approval of the supervising professor and the department chair.

PHYS 5920-PHYS 5930. Research Problems in Lieu of Thesis. 3 hours. An introduction to research; may consist of an experimental, theoretical or review topic.

PHYS 5940. Seminar in Current Literature of Physics. 1–3 hours. Reports and discussion one hour a week. Required each term/semester of all graduate students in physics.

PHYS 5941. Colloquium. 1 hour. Weekly lectures by faculty and invited guests on topics of current interest in contemporary physics.

PHYS 5950. Master's Thesis. 3 or 6 hours. To be scheduled only with consent of department. 6 hours credit required. No credit assigned until thesis has been completed and filed with the graduate dean. Continuous enrollment required once work on thesis has begun. May be repeated for credit.

PHYS 5960-PHYS 5970. Science Institute. 1–6 hours each. For students accepted by the university as participants in special institute programs. May be repeated for credit, not to exceed a total of 6 hours in each course. Laboratory fee required.

PHYS 5980-PHYS 5990. Special Problems. 1–3 hours each. Special problems in advanced physics for graduate students. Problem chosen by the student with the approval of the supervising professor.

PHYS 6000. Mathematical Methods of Physics I. 3 hours. Complex variables, Laurent series, contour integration, integral transformations, dispersion relations, approximations methods, ordinary differential equations. Legendre, Bessel functions. Sturm-Liouville theory, eigenvalue problem. Green's functions. Prerequisite(s): PHYS 3310.

PHYS 6001. Mathematical Methods of Physics II. 3 hours. Floquet theory, Mathieu and Hill equations, elliptic functions, vector spaces and Hilbert spaces, linear operators and elements of spectral theory. Green's functions, integral equations, non-linear wave equations and approximation techniques. Prerequisite(s): PHYS 6000.

PHYS 6010. Advanced Classical Mechanics II. 3 hours. Non-linear dynamics; chaos; fractals; classical field theory; hydro-dynamics and non-linear waves. Prerequisite(s): PHYS 5710.

PHYS 6030. Electromagnetic Theory II. 3 hours. Waves in plasma; waves in inhomogeneous, anisotropic and non-linear media. Radiation and diffraction; particle radiation and energy loss in matter. Scattering. Multipole fields. Covariant formulation and classical field theory. Prerequisite(s): PHYS 5720.

PHYS 6110. Statistical Mechanics I. 3 hours. Equilibrium classical and quantum statistical mechanics and thermodynamics with applications to real gases, liquids, solids, spin systems and phase transitions. Prerequisite(s): PHYS 4110 and PHYS 5510.

PHYS 6120. Statistical Physics. 3 hours. Non-equilibrium classical and quantum statistical mechanics, including Boltzmann equations, BBGKY hierarchy, transport theory and dielectric properties of systems; fluctuations and irreversible processes. Prerequisite(s): PHYS 6110 or consent of department.

PHYS 6155. Communication in Scientific Teaching and Research. 3 hours. Basics of technical writing; techniques for seeking and obtaining research funding; research proposal writing; research presentations; research publications; job applications and interviewing; the workings and organization of academic institutions, government agencies and private industry.

PHYS 6160. Introduction to Scattering Theory I. 3 hours. Partial waves; effective range theory; integral equation approach; resonances; bound states; variational and R-Matrix methods. Emphasis on applications. Prerequisite(s): PHYS 5510.

PHYS 6161. Introduction to Scattering Theory II. 3 hours. Time-dependent potential scattering, the general theory of collisions, electron-ion collisions, resonances, ion-ion collisions, ion-atom collisions, density matrix formulation and atoms in intense fields. Emphasis on applications.

PHYS 6330. Atomic and Molecular Physics I. 3 hours. Atomic, molecular structure; construction of periodic table. Experimental basis. One-, few- and many-electron systems; Hartree-Fock, Thomas Fermi methods; inner and outer shell phenomena. Prerequisite(s): PHYS 5510.

PHYS 6340. Atomic and Molecular Physics II. 3 hours. Applications of scattering theory. Born approximation, phase shifts, effective range theory; density operator; scattering and transition matrices. Interaction of large and weak EM fields with matter. Laser spectroscopy. Prerequisite(s): PHYS 6330.

PHYS 6450-PHYS 6460. Advanced Solid State Physics. 3 hours each. A two-course sequence designed to prepare graduate students for research in several areas of current interest in solid state physics. Topics include lattice vibration and phonon spectra; band theory, including calculational schemes, symmetry considerations and application to metals and semiconductors; optical and magnetic properties of solids. Prerequisite(s): PHYS 5450 and 5510, or consent of department.

PHYS 6500-PHYS 6510. Advanced Quantum Theory. 3 hours each.

PHYS 6500. Dirac and Heisenberg formalisms, second quantization and quantum theory of radiation. Dirac equation and its applications. Prerequisite(s): consent of department.

PHYS 6510. Quantization of Dirac, Klein-Gordon fields, interactions, S-matrix theory, perturbation theory and applications. Prerequisite(s): PHYS 6500 or consent of department.

PHYS 6750. Selected Topics in Theoretical Physics. 3 hours. Advanced topics selected from areas of theoretical and mathematical physics, including relativity, field theory, elementary particles and the many-body problem. Prerequisite(s): consent of department. May be repeated for credit as topics vary.

PHYS 6800. Selected Topics in Solid State Physics. 3 hours. Advanced topics selected from specialized areas of solid state physics. Prerequisite(s): consent of department. May be repeated for credit as topics vary.

PHYS 6900-PHYS 6910. Special Problems. 1–3 hours each. Special problems in experimental or theoretical physics for advanced graduate students. Problem chosen by the student with the approval of the supervising professor.

PHYS 6940. Individual Research. 1–12 hours. To be scheduled by the doctoral candidate engaged in research. May be repeated for credit.

PHYS 6950. Doctoral Dissertation. 3, 6 or 9 hours. To be scheduled only with consent of department. 12 hours credit required. No credit assigned until dissertation has been completed and filed with the graduate dean. Doctoral students must maintain continuous enrollment in this course subsequent to passing qualifying examination for admission to candidacy. May be repeated for credit.