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 the thesis has begun. May be repeated for credit.

5960. Seminar in Problems of Philosophy. 3 hours. Intensive analysis of major philosophical issues against the background of classical and contemporary investigations. May be repeated for credit.

6100. Aesthetics. 3 hours. Examination of principles of value and aesthetics proposed by representative artists and philosophers.

6120. Social and Political Philosophy. 3 hours. Examination of the relation among philosophical ideas and community, natural rights, justice, freedom and authority.

6350. Metaphysics. 3 hours. Examination of problems that arise from attempts to give an account of reality and its manifestations: possibility and necessity, causality, the nature of events, mind-body and universals.

6620. Existentialism. 3 hours. Examination of the place of man in the world and his relation to problems of authenticity, anxiety and forlornness. Kierkegaard, Nietzsche, Heidegger and Sartre.

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

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.

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

5450. Survey of Solid State Physics. 3 hours. A course designed to acquaint the student 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.

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.

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.

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.

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. Monet Carlo methods. Random walk simulations. Classical trajectory simulations.

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.

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 6000 (concurrent), or consent of department.

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.

5900-5910. 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.

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

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.

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

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.

5960-5970. 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.

5980-5990. 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.

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.

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.

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.

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.

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 5510.

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.

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.

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.

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.

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.

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.

6450-6460. 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 5510 and 5450, or consent of department.

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

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

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

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.

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.

6900-6910. 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.

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

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.

Political Science

International Studies – see *Undergraduate Catalog*

Political Science, PSCI

5020. Proseminar in American Government and Politics. 3 hours. Concepts, research, analytical methods and literature drawn from the leading scholars in the various areas of the field.

5050. Seminar in American Government and Politics. 3 hours. Analysis of pertinent government and political problems confronting the American people on the national, state and local levels. May be repeated for credit as topics vary.

5220. Proseminar in Public Law. 3 hours. Concepts, research, analytical methods and literature drawn from leading scholars in various areas of the field.

5230. Seminar in American Public Law. 3 hours. The legal framework within which American governmental processes operate; analysis of substantive legal rules and basic processes by which law is made and applied. May be repeated for credit as topics vary.