Physics (PHYS)

Courses

PHYS 5000V. Laboratory and Classroom Practices in Physics. 1-3 Hour.
The pedagogy of curricular materials. Laboratory and demonstration techniques illustrating fundamental concepts acquired through participation in the classroom as an apprentice teacher. (Typically offered: Fall) May be repeated for up to 3 hours of degree credit.

PHYS 50101. Introduction to Current Physics Research Seminar. 1 Hour.
This seminar course introduces new Physics graduate students to the faculty of the Physics department and their current research efforts. In addition, the students will be introduced to scientific ethics, and learn communication skills. (Typically offered: Fall)

PHYS 5020V. Individual Study in Advanced Physics. 1-4 Hour.
Guided study in current literature. (Typically offered: Fall and Spring) May be repeated for up to 4 hours of degree credit.

PHYS 50401. Journal Club Seminar. 1 Hour.
In this seminar, the students will present talks based on published research articles. The goal of the course is to develop oral communication skills in the students. Effective literature search techniques will also be covered. (Typically offered: Spring)

PHYS 50703. Mathematical Methods for Physics. 3 Hours.
This course merges the mathematics required in classical mechanics, electrostatics, magnetostatics, and quantum mechanics into a single course. The goal is to develop physics problem-solving skills, a strong mathematical foundation, and a more unified picture of physics. (Typically offered: Fall)

PHYS 50903. Applications of Group Theory to Physics. 3 Hours.
Application of group theory to topics in physics, especially to atomic/molecular and solid-state physics. Prerequisite: PHYS 50703. (Typically offered: Irregular)

PHYS 51003. Advanced Mechanics. 3 Hours.
Dynamics of particles and rigid bodies. Hamilton's equations and canonical variables. Canonical transformations. Small oscillations. Prerequisite: PHYS 50703. (Typically offered: Fall)

PHYS 51101. Research Techniques Through Laboratory Rotations. 1 Hour.
Graduate students will be introduced to detailed operational aspects of two Physics research laboratories through extensive observation of those laboratory's operations during a six week rotation through each lab. Planning for starting a research project in the summer will take place in the final three week rotation period. (Typically offered: Spring)

PHYS 52103. Statistical Mechanics. 3 Hours.
Classical and quantum mechanical statistical theories of matter and radiation. Prerequisite: PHYS 54103. (Typically offered: Spring)

PHYS 52603. Experiment and Data Analysis. 3 Hours.
This course is devoted to learning some of the frequently used experimental techniques and methods by which experimental data are analyzed to extract quantitative information on physical parameters. Students will perform experiments, analyze data, and write lab reports. Prerequisite: PHYS 54103. (Typically offered: Fall)

PHYS 53103. Advanced Electromagnetic Theory I. 3 Hours.
Electrostatics, boundary-value problems in electrostatics, electrostatics in a medium, magnetostatics, and Faraday's Law. (Typically offered: Spring)

PHYS 53203. Advanced Electromagnetic Theory II. 3 Hours.
Maxwell equations, conservation laws, wave propagation, waveguides, radiating systems, scattering, special relativity, and radiation by moving charges. (Typically offered: Fall)

PHYS 53603. Scientific Computation and Numerical Methods. 3 Hours.
An introduction to numerical methods used in solving various problems in engineering and the sciences. May not earn credit for this course and MATH 43503 or MATH 43603. (Typically offered: Fall Even Years)
This course is cross-listed with MATH 53603.

PHYS 54103. Quantum Mechanics I. 3 Hours.
Non-relativistic quantum mechanics; the Schrodinger equation; the Heisenberg matrix representation; operator formalism; transformation theory; spinors and Pauli theory; the Dirac equation; applications to atoms and molecules; collision theory; and semiclassical theory of radiation. (Typically offered: Fall)

PHYS 54203. Quantum Mechanics II. 3 Hours.
Continuation of PHYS 54103 Prerequisite: PHYS 54103. (Typically offered: Spring)

PHYS 56103. Introduction to Biophysics and Biophysical Techniques. 3 Hours.
Origins of biophysics, biological polymers and polymer physics, properties of DNA and proteins, techniques to study DNA and proteins, biological membrane and ion channels, biological energy, experimental techniques to study single DNA and proteins. Two experiments are included: (1) DNA Gel electrophoresis; (2) Measurement of double-stranded DNA melting point. (Typically offered: Spring)

PHYS 56503. Subatomic Physics. 3 Hours.
Nuclear structure and nuclear reactions. Nature and properties of elementary particles and resonances, their interactions and decays. Phenomenological theory and discussion of experimental evidence. (Typically offered: Fall Odd Years)

PHYS 57103. Condensed Matter Physics I. 3 Hours.
The course covers the Drude theory and the Sommerfeld theory of metals, crystal lattices, reciprocal lattices, X-ray diffraction, Bloch's theory of electrons in periodic potential, formation of band gap, lattice vibration, and cohesive energy in solids. Prerequisite: PHYS 54103. (Typically offered: Fall)

PHYS 57304. Laser Physics. 4 Hours.
A combined lecture/laboratory course covering the theory of laser operation, laser resonators, propagation of laser beams, specific lasers such as gas, solid state, semiconductor and chemical lasers, and laser applications. (Typically offered: Spring Odd Years)

PHYS 57503. Applied Nonlinear Optics. 3 Hours.
Topics include: practical optical processes, such as electro-optic effects, acousto-optic effects, narrow-band optical filters, second harmonic generation, parametric amplification and oscillation, and other types of nonlinear optical spectroscopy techniques which are finding current practical applications in industry. (Typically offered: Irregular)

PHYS 57703. Introduction to Optical Properties of Materials. 3 Hours.
This course covers crystal symmetry optical transmission and absorption, light scattering (Raman and Brillouin) optical constants, carrier mobility, and polarization effects in semi-conductors, quantum wells, insulators, and other optically important materials. (Typically offered: Spring Even Years)

PHYS 57803. Physics of 2D Materials. 3 Hours.
Introduction to the structures of all known layered materials, followed by mechanical, electronic, spin, optical, and topological properties of two-dimensional materials. Discussion of theoretical concepts and examination of experimental manifestations of those concepts are interwoven throughout the semester. Knowledge of solid state physics is required. Pre- or Corequisite: PHYS 54103. (Typically offered: Irregular)

PHYS 5880V. Selected Topics in Physics. 1-3 Hour.
Selected topics in experimental or theoretical physics at the advanced level. (Typically offered: Irregular) May be repeated for up to 6 hours of degree credit.

PHYS 6000V. Master of Science Thesis. 1-6 Hour.
Master of Science Thesis. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.

PHYS 65103. Theoretical Biophysics. 3 Hours.
Introduction to biology as a complex system, networks and information theory, negative and positive feedback systems, gene regulation, noise, and noise propagation, cell signaling pathways, intercellular interactions, and emergence of cooperativity in biological systems. Prerequisite: PHYS 56103. (Typically offered: Fall Even Years)

PHYS 67103. Condensed Matter Physics II. 3 Hours.
The course covers surface physics, physics of homogeneous and inhomogeneous semiconductors, dielectric and ferroelectric physics, defects in crystals, spin interaction and magnetic properties, superconductivity, and band structure calculation. Prerequisite: PHYS 57103 and PHYS 54103. (Typically offered: Spring Even Years)

PHYS 7000V. Doctoral Dissertation. 1-18 Hour.
Doctoral Dissertation. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.