

PHYSICS (PHY)

PHY 601. Physics Seminar. (0.5 h)

Discussion of contemporary research, usually with visiting scientists.

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PHY 607. Biophysics. (3 h)

Introduction to the structure, dynamic behavior, and function of DNA and proteins, and a survey of membrane biophysics. The physical principles of several biophysical methods, such as X-ray diffraction, sedimentation, light scattering, light absorption, fluorescence and single molecule tools are studied. Designed to be accessible to students with biochemistry, chemistry, or physics backgrounds. Recommended C-PHY 625.

PHY 610. Extragalactic Astronomy and Cosmology. (3 h)

Topics covered include galactic structure, models for galaxies and galaxy formation, the large-scale structure of the universe, the Big Bang model of the universe, physical processes such as nucleosynthesis in the early universe, and observational cosmology.

PHY 620. Physics of Macromolecules. (3 h)

Physics of biologically important molecules, especially proteins and nucleic acids. Topics covered include the physical basis of biomolecular structure, the energetics and statistical mechanics of biomolecular dynamics, and the electrostatics and solvation of biomolecules. Course requirements may include a field trip to a relevant conference, such as the Carolina Biophysics Symposium, and a discussion section with an appropriate physics colloquium speaker. Designed to be accessible to students with biochemistry, chemistry, or physics backgrounds provided they have some exposure to thermodynamics and macromolecular structure. C-PHY 623.

PHY 623. Comput Biophys Lab. (1 h)

Application of techniques in molecular modeling, including energy minimization, molecular dynamics simulation, and conformational analysis, to biological macromolecules. P-PHY 630 or POI.

PHY 625. Biophysical Methods Lab. (1 h)

Lab involves experiments using various biophysical techniques such as DNA and protein gel electrophoresis, protein crystallography and X-ray diffraction, electron paramagnetic resonance, atomic force microscopy, fluorescence microscopy, light scattering, stopped-flow absorption spectroscopy and ultracentrifugation. Recommended C-PHY 607.

PHY 635. Computational Physics. (3 h)

An introduction to finding numerical solutions to scientific problems. Topics include understanding computational errors, differentiation, integration interpolation, root finding, random numbers, linear systems, Fourier methods, and the solution of ODEs and PDEs. There is no computer programming prerequisite. Credit will not be given for both PHY 635 and CSC/MST 655.

PHY 637. Analytical Mechanics. (1.5 h)

The Lagrangian and Hamiltonian formulations of mechanics with applications. Taught in the first half of the fall semester.

PHY 639. Electricity and Magnetism. (1.5 h)

Electrostatics, magnetostatics, dielectric and magnetic materials, Maxwell's equations and applications to radiation, relativistic formulation. The first half course is taught in the second half of the fall semester, following PHY 637. The other course is taught in the spring semester. These should be taken in sequence. P-PHY 601.

PHY 640. Electricity and Magnetism. (1.5-3 h)

Electrostatics, magnetostatics, dielectric and magnetic materials, Maxwell's equations and applications to radiation, relativistic formulation. The first half course is taught in the second half of the fall semester, following PHY 637. The other course is taught in the spring semester. These should be taken in sequence. P-PHY 601.

PHY 641. Thermodynamics and Statistical Mechanics. (3 h)

Introduction to classical and statistical thermodynamics and distribution functions.

PHY 642. Electricity and Magnetism. (1.5 h)

PHY 643. Quantum Physics. (3 h)

Application of the elementary principles of quantum mechanics to atomic, molecular, solid state, and nuclear physics.

PHY 644. Quantum Physics. (3 h)

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PHY 645. Advanced Physics Laboratory. (1 h)

The lab associated with PHY 643, 644.

PHY 652. Physical Optics and Optical Design. (1-4 h)

Interaction of light with materials; diffraction and coherent optics; ray trace methods of optical design. Lab-three hours.

PHY 652L. Physical Optics Lab. (0 h)

PHY 654. Introduction to Solid State Physics. (3 h)

Survey of the structure, composition, physical properties, and technological applications of condensed matter. P-PHY 643.

PHY 655. Exotic Materials. (1.5 h)

This course is a study of materials that express exotic properties that are derived from some aspect of the system's dimensionality. It introduces the thermal, electrical, optical and magnetic properties of exotic materials systems. It discusses simple models for the structure-property relationships for a wide range of nanoscale and low-dimensional systems.

PHY 656. Electronic Imaging Sciences. (1.5 h)

This course introduces the theory and application of the electron imaging systems: transmission electron microscopy (TEM) and scanning electron microscopy (SEM). It focuses on basic materials science though some biological materials will be covered. It is taught as a series of lectures followed by laboratories.

PHY 657. Scanning Probes. (1.5 h)

This course examines the theory and application of scanning tunneling microscopy and atomic force microscopy (STM/AFM). It introduces how each type of imaging works, how to model spectroscopic data, and how to use each microscope. Students will image using the STM and AFM as well as take and reduce spectroscopy data using models built in Maple or Mathematica.

PHY 658. Kinetics of Materials. (1.5 h)

This course offers a study of driving forces for atomic and ionic motion within solids leading to a range of materials properties from work hardening to phase transformations and formation. Atomic-level models for diffusion will be introduced as well as techniques and examples of the solution to the diffusion equation. It complements the traditional thermodynamics course.

PHY 661. Biophysics Seminar. (1 h)

Seminal and current publications in biophysics are studied. Each week a member of the class makes an oral presentation on a chosen publication and leads the ensuing discussion. Students may also be required to make a second oral presentation relevant to their own research. Does not fulfill course requirements for Master's or PhD degrees. May be repeated for credit.

PHY 663. Condensed Matter Seminar. (1 h)

Seminal and current publications in condensed matter physics are studied. Each week a member of the class makes an oral presentation on a chosen publication and leads the ensuing discussion. Does not fulfill course requirements for Master's or PhD degrees. May be repeated for credit.

PHY 681. Research. (1-3 h)

Library, conference, and lab work performed on an individual basis.

PHY 682. Research. (1-3 h)

Library, conference, and lab work performed on an individual basis.

PHY 685. Bioinformatics. (3 h)

Introduces bioinformatics and computing techniques essential to current biomedical research. Topics include genome and protein sequence and protein structure databases, algorithms for bioinformatics research, and computer architecture and environmental considerations. Also listed as CSC 685 and BIO 685. P-Introductory courses in biology, chemistry, and molecular biology or biochemistry or POI.

PHY 691. Special Topics in Physics. (1-4 h)

Courses in selected topics in physics. May be repeated if course content differs.

PHY 692. Special Topics in Physics. (1-4 h)

Courses in selected topics in physics. May be repeated if course content differs.

PHY 711. Classical Mechanics and Mathematical Methods. (3 h)

A study of variational principles and Lagrange's equations, the rigid body equations of motion, the Hamilton equations of motion and canonical transformations, Hamilton-Jacobi theory, and applications to continuous systems and fields. Kerr, N. Holzwarth.

PHY 712. Electromagnetism. (3 h)

A study of electric and magnetic fields in vacuum and within media and their sources. Analytical and numerical methods for solving Maxwell's equations are also an important part of the course.

PHY 715. Nonlinear Optics and Quantum Electronics. (1-4 h)

Nonlinear phenomena in laser spectroscopy, the quantum nature of optical processes in matter, and topics in laser physics. Lab—three hours. R. Williams.

PHY 731. Elementary Particle Physics. (3 h)

Fundamentals of contemporary elementary particle physics. Carlson.

PHY 741. Quantum Mechanics. (3 h)

Study of the foundations of modern quantum theory, with an emphasis on the meaning of the wave equation, operators, eigen-functions, eigenvalues, commutators, matrix mechanics, spin, and scattering. Anderson, Carlson, N. Holzwarth, Kerr.

PHY 742. Quantum Mechanics. (3 h)

Study of the foundations of modern quantum theory, with an emphasis on the meaning of the wave equation, operators, eigen-functions, eigenvalues, commutators, matrix mechanics, spin, and scattering. Anderson, Carlson, N. Holzwarth, Kerr.

PHY 743. Advanced Quantum Mechanics. (3 h)

Advanced topics in quantum mechanics, including an introduction to relativistic quantum theory, quantum electrodynamics, and many particle treatments. Anderson, Carlson, N. Holzwarth, Kerr.

PHY 744. Introduction to Quantum Field. (3 h)

Introduction to relativistic quantum field theory, including canonical quantization, path integral techniques, perturbation theory, and renormalization. Anderson, Carlson.

PHY 745. Group Theory. (3 h)

Group theory and its applications to the quantum mechanics of atoms, molecules, and solids. Carlson.

PHY 752. Solid State Physics. (3 h)

Introductory course including the structure of perfect crystalline solids, their thermal electronic properties, the free electron and band theory of metals, imperfect crystals, transport properties, and semiconductors. Carroll, N. Holzwarth, Kerr Matthews, R. Williams.

PHY 754. Surface Science. (3 h)

Experimental and theoretical methods for the study of surfaces and interfaces. Lab-1.5 hours. N. Holzwarth, R. Williams.

PHY 756. Seminar on Defects in the Solid State. (2 h)

The generation and interactions of point and line defects such as color centers, vacancies, and dislocations treated. Matthews, R. Williams.

PHY 765. Gravitational and Particle Theory Seminar. (1 h)

Topics in general relativity, particle physics, and astrophysics are studied. Each week a faculty member or member of the class makes an oral presentation on a chosen topic and leads the ensuing discussion. Does not fulfill minimum course requirements for Master's and PhD degrees.

PHY 770. Statistical Mechanics. (3 h)

Introduction to probability theory and to the physics of systems containing large numbers of particles from the classical as well as the quantum point of view. Kerr.

PHY 771. Radiological Physics. (3 h)

The nature and fundamental concepts of ionizing radiation including: ionizing radiation, radiation quantities, attenuation and stopping power, charged particle and radiation equilibrium radioactive decay, photon interactions, charged and uncharged particle interactions, x-ray production and quality, dosimetry concepts, ionization cavity theory, and calibration of ionizing radiation beams.

PHY 773. Radiation Therapy Physics. (3 h)

The physics of radiation treatment including: radiation producing equipment, character of photon and electron radiation beams, radiation dose functions, computerized radiation treatment planning, brachytherapy, special radiation treatment procedures, quality assurance, and radiation shielding for high energy facilities.

PHY 774. Physics of Medical Imaging. (3 h)

The physical principles, mathematical algorithms and devices used in diagnostic medical imaging, covering the following imaging modalities: x-ray digital imaging, digital image receptors, computerized tomography and reconstruction algorithms, ultrasound imaging, magnetic resonance imaging and nuclear medicine imaging.

PHY 776. Medical Health Physics. (3 h)

Physical and biological aspects for the use of ionizing radiation in medical environments, biological consequences of human radiation exposure, principles of ionizing radiation protection, operational dosimetry, radiation exposure recommendations and regulations, physical principles of radiation shielding design, personnel monitoring, medical health physics instrumentation, and waste disposal.

PHY 780. Theory of General Relativity. (3 h)

Study of the covariant formulation of physical laws in mechanics and electromagnetism. Anderson, Cook.

PHY 785. Topics in Theoretical Physics. (1-3 h)

Selected topics of current interest in theoretical physics not included in other courses. Anderson, Carlson, Cook, Fetrow, N. Holzwarth, Kerr, Salisbury.

PHY 787. Advanced Topics in Physics. (1-3 h)

Lectures on advanced topics in physics that depend on the subspecialty of the instructor. Topics range from medical physics to special topics in biophysics, condensed matter physics, or quantum optics. May be repeated for credit.

PHY 789. Survival Skills for Scientists. (1 h)

Students will learn skills that are essential to a successful career in the sciences. The following topics will be covered: Mentoring; How to Read, Write, and Review a Research Paper; Grant & Fellowship Basics; Choosing a Career Path & Creating a Winning Job Application; and Networking & Giving Effective Talks.

PHY 791. Thesis Research I. (1-9 h)

May be repeated for credit. Satisfactory/Unsatisfactory.

PHY 792. Thesis Research II. (1-9 h)

May be repeated for credit. Satisfactory/Unsatisfactory.

PHY 795. Physics for Education Research. (3 h)

Fulfills the requirement for a graduate course in physics for students in the Masters in Education program seeking certification to teach physics.

PHY 891. Dissertation Research I. (1-9 h)

May be repeated for credit. Satisfactory/Unsatisfactory.

PHY 892. Dissertation Research II. (1-9 h)

May be repeated for credit. Satisfactory/Unsatisfactory.