

# PHYSICS (PHYS)

# Course numbers with the # symbol included (e.g. #400) have not been taught in the last 3 years.

## PHYS 805 - Experimental Physics

**Credits:** 4

Experiments in nuclear, solid-state, and surface physics. Includes discussion of laboratory techniques, data analysis, and data presentation. Special projects assigned to individual students.

## PHYS 806 - Introduction to Physics Research and Teaching

**Credits:** 1

This course introduces new graduate students to both research and teaching. The teaching portion focuses on facilitating group work, problem solving, and deeper student thinking. The research portion focuses on research currently conducted at UNH, library resources, responsible conduct in research, how research differs from coursework, and how research results are presented in the research community. Cr/F.

## PHYS 808 - Optics

**Credits:** 4

Geometrical optics, electromagnetic theory of light, interference, diffraction, polarization, related phenomena and nonlinear optics. (Alternate years only.)

## PHYS 810 - Introduction to Astrophysics

**Credits:** 4

Review of the sun, stars, Milky Way, external galaxies, and expansion of the universe. Recent discoveries of radio galaxies, quasi-stellar objects, cosmic black-body radiation, x rays, and gamma rays precede a discussion of Newtonian and general relativistic cosmological models, steady-state/big-bang theories, and matter-antimatter models. (Also offered as EOS 810.) (Alternate years only.)

## PHYS 811 - Topics in Modern Physics

**Credits:** 1-4

Discussions, lectures, and laboratory work on topics of current interest in physics. An introductory course for secondary school teachers and others with some science background.

## PHYS 812 - Introduction to Space Plasma Physics

**Credits:** 4

Introduction to the subject of space plasma physics including solar physics, heliospheric physics, magnetospheric physics, and ionospheric physics. The course provides an overview of the basic phenomena and processes (e.g. particle acceleration and transport, shock formation, magnetic structures and reconnection, wave propagation, wave-particle interactions, instabilities), theoretical techniques (e.g. single-particle orbits, kinetic and fluid descriptions), and experimental techniques. (Also offered as EOS 812.) (Alternate years only.)

## PHYS 818 - Introduction to Solid-State Physics

**Credits:** 4

Crystal structure, diffraction, lattice vibrations, electronic and optical properties of metals and semiconductors; selected topics in modern condensed matter physics. Prereq: introduction to quantum mechanics I, electricity and magnetism I or equivalent. (Normally offered every other year.)

## PHYS 820 - Nuclear Physics

**Credits:** 4

Nuclear phenomenology, reactions, models, radiation, interaction of radiation with matter; accelerators; properties and interactions of elementary particles; symmetries and symmetry breaking standard model. Prereq: introduction to quantum mechanics I and II; electricity and magnetism I and II; or permission of instructor.

## PHYS 864 - General Relativity and Cosmology

**Credits:** 4

Review of special relativity, and the motivation for considering gravity in terms of curvature of space time. Introduction to Riemannian geometry, general relativity and Einstein's equations. Application of general relativity in the study of black holes, gravitational waves, cosmology, as well as recent results on inflation and quantum gravity. (Alternate years only.)

## PHYS 895 - Independent Study

**Credits:** 1-8

Individual project under direction of a faculty adviser.

## PHYS 899 - Master's Thesis

**Credits:** 1-6

May be repeated up to a maximum of 6 credits. Cr/F.

## PHYS 900 - Introduction to Physics Research and Teaching I

**Credits:** 1

Introduction to teaching/research in physics including responsibilities and methods for teaching assistants, research currently conducted at UNH, library sources, responsible conduct in research, how research differs from coursework, how research results are presented in the research community, and readings from physics education research literature. Cr/F.

## PHYS 901 - Introduction to Physics Research and Teaching II

**Credits:** 1

Introduction to teaching/research in physics including responsibilities and methods for teaching assistants, research currently conducted at UNH, library sources, responsible conduct in research, how research differs from coursework, how research results are presented in the research community, and readings from physics education research literature. Cr/F.

## PHYS 902 - Issues in Teaching and Learning Physics

**Credits:** 1-3

Issues in teaching and learning physics including cognitive models of learning; assessment tools; meta-cognitive issues; role of mathematics; effectiveness of labs; issues in problem solving; misconceptions studies. Extensive reading, writing, discussion and reflection is required. May be repeated for a maximum of 3 credits.

## PHYS 931 - Mathematical Physics

**Credits:** 3

Complex variables, differential equations, asymptotic methods, integral transforms, special functions, linear vector spaces and matrices, Green's functions, and additional topics selected from integral equations, variational methods, numerical methods, tensor analysis, and group theory. (Also offered as MATH 931.)

## PHYS 935 - Statistical Physics

**Credits:** 3

Review of thermodynamics and kinetic theory, followed by an introduction to classical and quantum statistical mechanics. Microcanonical, canonical, and grand canonical ensembles; ideal Fermi and Bose gases and applications of statistical mechanics to selected physical problems. Prereq: PHYS 931; 939; 943.

**PHYS 939 - Classical Mechanics****Credits:** 3

Newtonian, Lagrangian, and Hamiltonian formulation of the classical mechanics of particles and rigid bodies. Topics that serve as background for the study of modern physical theories are emphasized.

**PHYS 941 - Electromagnetic Theory I****Credits:** 3

The formulation and detailed application of electromagnetic theory to physical problems. The material covered is at the level of the text by J.D. Jackson, "Classical Electrodynamics".

**PHYS 942 - Electromagnetic Theory II****Credits:** 3

The formulation and detailed application of electromagnetic theory to physical problems. The material covered is at the level of the text by J.D. Jackson, "Classical Electrodynamics".

**PHYS 943 - Quantum Mechanics I****Credits:** 3

Introduces non-relativistic quantum theory, covering wave mechanics, Dirac notation, angular momentum, the use of perturbation theory to calculate atomic energy levels, the interaction of atoms with radiation, and various approaches to calculating the differential scattering cross-section.

**PHYS 944 - Quantum Mechanics II****Credits:** 3

See description for PHYS 943.

**PHYS 951 - Plasma Physics****Credits:** 3

Kinetic theory of plasmas; plasma waves, instabilities, turbulence, diffusion, adiabatic motion of charged particles, nonlinear plasma phenomena. Prereq: PHYS 935; PHYS 941; PHYS 941. (Normally offered every other year.)

**PHYS 953 - Magnetohydrodynamics of the Heliosphere****Credits:** 3

Introduction to solar physics, with emphasis on gas dynamics and magnetic fields. Interior structure, the theory of convection, wave motions in the presence of magnetism and gravity, coronal heating theories, steady and nonsteady flows, dynamo theory, and the theory of solar flares and other transient phenomena. Salient observational data are reviewed. (Normally offered every other year.)

**PHYS 954 - Heliospheric Physics****Credits:** 3

The solar wind and its effects on cosmic rays. The basic equations of the solar wind: mass, momentum, angular momentum, and energy balance. Transport processes. Waves, shocks, and instabilities in the solar wind. The basic equations of energetic particle transport. Solar modulation of solar and galactic cosmic rays. Interaction of energetic particles with shock waves. Salient data are reviewed. (Normally offered every other year.) Also offered as EOS #954.

**PHYS 961 - Advanced Quantum Mechanics I****Credits:** 3

Relativistic wave equations, propagator theory and Feynman diagrams, quantum theory of radiation, second quantization, introduction to quantum field theory and related topics. Prereq: PHYS 939; PHYS 944. (Normally offered every other year.)

**PHYS 962 - Advanced Quantum Mechanics II****Credits:** 3

Relativistic wave equations, propagator theory and Feynman diagrams, quantum theory of Radiation, second quantization, introduction to quantum field theory and related topics.

**PHYS 965 - Advanced Solid-State Physics****Credits:** 3

Theory of crystalline metals, semiconductors, and insulators. Selected topics from the following: surfaces, films, quantum dots, clusters, solid-state devices. Prereq: PHYS 935; PHYS 941; PHYS 943. (Normally offered every other year.)

**PHYS 987 - Magnetospheres****Credits:** 3

Introduces plasma physics of the interaction of solar and stellar winds with planets having internal magnetic fields, most predominately, the Earth. Both MHD and kinetic descriptions of internal and boundary processes of magnetospheres as well as treatment of the interaction with collisional ionospheres. Flow of mass, momentum, and energy, through such systems. Prereq: PHYS 951; PHYS 952;/or permission. (Also offered as EOS 987.) (Normally offered every other year.)

**PHYS 995 - Special Topics****Credits:** 1-3

Any special fields of study not covered by the above courses may be included. Topic choices in previous years: astrophysics; elementary particles; lasers/masers; many-body theory; general relativity and cosmology; group theory; atomic physics; quantum theory of light; nonlinear equations, and chaos. May be taken more than once. (Not offered every year.)

**PHYS 999 - Doctoral Research****Credits:** 0

Cr/F.