Physics Courses (Physics and Astronomy) (PHYS)

This is a list of all physics courses. For more information, see Physics and Astronomy.

**PHYS:1000 First-Year Seminar** 1 s.h.
Small discussion class taught by a faculty member; topics chosen by instructor; may include outside activities (e.g., films, lectures, performances, readings, visits to research facilities). Requirements: first- or second-semester standing.

**PHYS:1100 From Quarks to Quasars** 3-4 s.h.
Conceptual explanations of the latest discoveries in physics—from the smallest objects, such as quarks and atoms, to the largest, such as galaxies, black holes, and quasars. Requirements: non-science majors. GE: Natural Sciences with Lab; Natural Sciences without Lab.

**PHYS:1200 Physics of Everyday Experience** 3 s.h.
Principles of physics; basic motion, behavior of fluids, waves, temperature and heat, gravity and planetary motion, electricity and magnetism, optics, nuclear energy, radioactivity, and medical imaging technology; examples from everyday experience; for non-science majors. GE: Natural Sciences without Lab.

**PHYS:1300 Nanoscience** 3 s.h.
Properties of very small materials and structures; unique properties emerging at a length scale of one billionth of a meter, or one nanometer. GE: Natural Sciences without Lab.

**PHYS:1400 Basic Physics** 3-4 s.h.
Quantitative treatment of mechanics, electricity, heat, liquids, gases, and atomic, nuclear, and elementary particle physics. Requirements: must have completed high school trigonometry or achieved a minimum ALEKS score of 75%. GE: Natural Sciences with Lab; Natural Sciences without Lab.

**PHYS:1409 Basic Physics Lab** 1 s.h.
Laboratory for PHYS:1400. Corequisites: PHYS:1400 (if not taken as a prerequisite). GE: Natural Sciences Lab only.

**PHYS:1410 Physics of Sound** 3-4 s.h.
Acoustical foundations of music; production of sound by vibrating objects, properties of sound waves, vocal acoustics, hearing, room acoustics, principles of electroacoustics. GE: Natural Sciences with Lab; Natural Sciences without Lab.

**PHYS:1511 College Physics I** 4 s.h.
Algebra-based treatment of mechanics, waves, thermodynamics, and special relativity. Requirements: must have completed high school trigonometry or achieved a minimum ALEKS score of 75%. GE: Natural Sciences with Lab.

**PHYS:1512 College Physics II** 4 s.h.
Continuation of PHYS:1511; algebra-based treatment of electricity, magnetism, light, and modern physics. Prerequisites: PHYS:1511 or PHYS:1511. GE: Natural Sciences with Lab.

**PHYS:1611 Introductory Physics I** 4 s.h.

**PHYS:1612 Introductory Physics II** 3-4 s.h.
Continuation of PHYS:1611; calculus-based treatment of electricity, magnetism, and light. Prerequisites: PHYS:1611. Corequisites: MATH:1560 or MATH:1860. GE: Natural Sciences with Lab; Natural Sciences without Lab.

**PHYS:1619 Introductory Physics II Lab** 1 s.h.
Laboratory for PHYS:1612. Requirements: 3 s.h. in PHYS:1612. GE: Natural Sciences Lab only.

**PHYS:1701 Physics I** 4 s.h.
Introduction to physics; calculus-based treatment of Newtonian mechanics for point particles and rigid bodies; conservation laws. Offered fall semesters. Corequisites: MATH:1850. Requirements: physics or astronomy major. GE: Natural Sciences with Lab.

**PHYS:1702 Physics II** 4 s.h.

**PHYS:1999 Undergraduate Seminar arr.**
Selected topics in physics and astronomy; discussion, presentations.

**PHYS:2703 Physics III** 4 s.h.
Continuation of PHYS:1702; introduction to physics; calculus-based treatment of electromagnetic waves and optics; mechanical and sound waves; thermal physics. Offered fall semesters. Prerequisites: PHYS:1702.

**PHYS:2704 Physics IV** 3-4 s.h.
Introduction to quantum mechanics and other topics in modern physics, including special relativity, atomic and solid state physics. Offered spring semesters. Prerequisites: (PHYS:1612 or PHYS:2703) and (MATH:1860 or MATH:1550). Requirements: for 3 s.h. option—nonmajor.

**PHYS:2990 Reading in Physics arr.**
Selected topics in physics.

**PHYS:3500 Undergraduate Practicum arr.**
Experiences that provide special opportunities for students to gain practical and hands-on training related to topics in physics; practicums typically arranged by individual faculty members. Requirements: application and acceptance into practicum.

**PHYS:3710 Intermediate Mechanics** 3 s.h.
Introduction to Newtonian mechanics; noninertial reference systems; central forces, celestial mechanics; rigid body motion; Lagrangian and Hamiltonian equations of motion; small oscillations. Prerequisites: (PHYS:1611 or PHYS:1511 or PHYS:1701) and (MATH:1860 or MATH:1560).

**PHYS:3730 Statistical Physics** 3 s.h.
Integrated introduction to subjects of thermodynamics, statistical mechanics, classical and quantum statistics of interacting particles; kinetic theory; emphasis on applications. Prerequisites: PHYS:2704.

**PHYS:3741 Introduction to Quantum Mechanics I** 3 s.h.
Superposition principle, Stern-Gerlach experiment, linear operators, measurement theory, time evolution, angular momentum, wave mechanics in one dimension, one-dimensional harmonic oscillator, two-body problems with central forces, and the hydrogen atom. Prerequisites: MATH:2850 and PHYS:2704 and PHYS:2700.
PHYS:3742 Introduction to Quantum Mechanics II 3 s.h.
Continuation of PHYS:3741; Perturbation theory, variational
methods, WKB approximation, scattering, Helium atom,
periodic table, atomic spectroscopy, transition rates, and
other selected applications. Prerequisites: PHYS:3741.

PHYS:3750 Fundamentals of Micro and
Nanofabrication 3 s.h.
Fundamentals of micro and nanofabrication processes;
physical principles of photo and electron beam lithography,
alternative nanolithography techniques, thin film deposition,
molecular beam epitaxy, atomic layer deposition, self-
assembly; metrology methods; physical and chemical
processes of wet and plasma etching; clean room science,
operations, safety protocols; sequential micro and
nanofabrication processes involved in manufacture of
semiconductor, photonic, nanoscale devices; imaging and
characterization of micro and nanostructures; scientific and
technological applications of emerging micro and nanodevices
and systems. Prerequisites: BIOL:1141 or CHEM:1120 or
PHYS:1612 or CHEM:1110 or CHEM:1060 or PHYS:1702 or
PHYS:1611. Requirements: undergraduate lab course in
chemistry, biology, physics, or engineering.

PHYS:3756 Intermediate Laboratory 3 s.h.
Introduction to instruments and techniques of experimental
physics and basic skills needed for carrying out experimental
physics research; hands-on use of a variety of instruments

PHYS:3811 Electricity and Magnetism I 3 s.h.
Introduction to electricity and magnetism; topics include
electrostatics, magnetostatics, potential theory, and electric
and magnetic fields in matter. Prerequisites: (MATH:3550 or
MATH:2850) and (PHYS:1612 or PHYS:1702 or PHYS:1512).

PHYS:3812 Electricity and Magnetism II 3 s.h.
Continuation of PHYS:3811; introduction to electricity
and magnetism; topics include Maxwell's equations,
electrodynamics, electromagnetic waves, radiation, and
special relativity. Prerequisites: PHYS:3811.

PHYS:3850 Electronics 4 s.h.
Design and construction of small circuits; use of measurement
instruments—oscilloscope, multimeter, function generator;
circuits, including transistors, operational amplifiers, digital,
analog-to-digital conversion. Prerequisites: PHYS:1512
or PHYS:1612 or PHYS:1702. Requirements: physics or
astronomy major.

PHYS:4720 Introductory Optics 3 s.h.
Wave motion and superposition, electromagnetic theory,
photons, propagation of light, geometrical and physical optics,
interference, diffraction, polarization, and Fourier optics;
optical components, devices, and systems. Prerequisites:
(PHYS:1512 or PHYS:2703 or PHYS:1612) and (MATH:1560 or
MATH:1860). Same as ECE:4720.

PHYS:4726 Electro Optics 3 s.h.
Wave equation solutions; optical birefringence; finite beam
propagation in free space, dielectric waveguides and fibers;
optical resonators; nonlinear phenomena; electro-optic,
acousto-optic modulation; optical detection, noise; application
to communication systems. Requirements: for ECE:5790—
ECE:3700; for PHYS:4726—PHYS:3812. Same as ECE:5790.

PHYS:4728 Introductory Solid State Physics 3 s.h.
Phenomena associated with solid state; classification of solids
and crystal structures, electronic and vibrational properties
in solids; thermal, optical, magnetic, dielectric properties of
solids. Prerequisites: PHYS:3741. Same as ECE:4728.

PHYS:4731 Plasma Physics I 3 s.h.
Physics of ionized gases, including orbit theory, guiding
center motion, adiabatic invariants, ionization balance
description of plasmas by fluid variables and distribution
functions; linearized wave motions, instabilities;
magnetohydrodynamics. Prerequisites: PHYS:3812.

PHYS:4740 Elementary Particles and Nuclear
Physics 3 s.h.
Accelerators, particle detectors, passage of radiation through
matter; nuclear structure, nuclear reactions; quark model
of hadrons; strong, electromagnetic, weak interactions of
elementary particles; gauge theories, intermediate vector
bosons; unification of electromagnetic and weak interactions.
Prerequisites: PHYS:3741.

PHYS:4750 Advanced Laboratory 3 s.h.
Advanced experimental work and development of new
experiments.

PHYS:4761 Mathematical Methods of Physics I 3 s.h.
Functions of complex variables, integration methods, linear
vector spaces, tensors, matrix algebra. Prerequisites:
MATH:2850.

PHYS:4762 Mathematical Methods of Physics II 3 s.h.
Continuation of PHYS:4761; Hilbert space, special functions,
Fourier transform and expansions in orthogonal polynomials,
differential equations, Green's functions. Prerequisites:
PHYS:4761.

PHYS:4820 Optical Signal Processing 3 s.h.
Linear systems description of optical propagation; diffraction
and angular plane wave spectrum; lenses as Fourier
transformers, lens configurations as generalized optical
processors; lasers, coherence, spatial frequency analysis;
holography; convolvers, correlators, matched filters; synthetic
aperture radar; optical computing. Requirements: for
ECE:5780—ECE:3700; for PHYS:4820—PHYS:3812. Same as
ECE:5780.

PHYS:4860 Computational Physics 3 s.h.
Introduction to contemporary use of computers by physicists;
topics such as numerical solutions of ordinary differential
equations in classical mechanics, boundary value problems in
electricity and magnetism, eigenvalue problems in quantum
mechanics, Monte Carlo simulations in statistical mechanics,
methods of data analysis. Prerequisites: PHYS:3741 and
PHYS:3811 and PHYS:3710.

PHYS:4905 Special Topics in Physics 3 s.h.
Introduction to scientific programming using the Python
language and linear algebra for applications in physics.

PHYS:4990 Reading in Physics 3 s.h.
Selected topics in physics.

PHYS:4999 Undergraduate Research 3 s.h.
Supervised research leading to written report or oral
presentation.

PHYS:5000 Workshops and Special Training in
Physics 3 s.h.
Workshops and special training opportunities for
postbaccalaureate students; may include collaborations with
other departments, institutions, or externally funded research
organizations.

PHYS:5710 Classical Mechanics 3 s.h.
Dynamics of mass points; Lagrange multipliers, small
oscillations, Hamilton's equations; canonical transformations,
Hamilton-Jacobi theory; chaos. Prerequisites: PHYS:3710.
PHYS:5729 Fluid Mechanics 3 s.h.
Basic equations of fluid mechanics and solutions of these equations for various cases of special interest; compressible and incompressible flows in two- and three-dimensions, rotational and irrotational flows, self-similar solutions, instabilities, turbulence; relate solutions to application of general interest to physicist and engineers; subsonic and supersonic flows around wings and bodies, gravity waves in oceans and atmospheres, transition to supersonic flow in a rocket nozzle, supersonic outflow of gas from the Sun and other stars, and physics of high energy explosions. Prerequisites: PHYS:3710. Requirements: knowledge of vector calculus at level used in PHYS:3811 and PHYS:3812.

PHYS:5730 Statistical Mechanics I 3 s.h.
Probability concepts; kinetic equations; classical and quantum equilibrium statistical mechanics with applications, including ideal and imperfect gases and phase transitions, irreversible processes, fluctuation-dissipation theorems. Prerequisites: PHYS:3730 and PHYS:3741.

PHYS:5741 Quantum Mechanics I 3 s.h.
Nonrelativistic quantum mechanics, Schrödinger wave mechanics, Hilbert space methods, perturbation theory, scattering, spin and angular momentum, identical particles, selected applications, introduction to relativistic theory. Prerequisites: PHYS:3741 and PHYS:3742.

PHYS:5742 Quantum Mechanics II 3 s.h.
Continuation of PHYS:5741. Prerequisites: PHYS:5741.

PHYS:5811 Classical Electrodynamics 3 s.h.
Advanced electromagnetostatics, boundary value problems, Green's functions, Maxwell's equations, radiation theory, physical optics, multipole expansion of radiation field.

PHYS:5812 Classical Electrodynamics II 3 s.h.
Special relativity, motion of charges in fields, theories of radiation reaction, special topics. Prerequisites: PHYS:5811.

PHYS:5905 Special Topics in Physics 3 s.h.
Selected topics in physics.

PHYS:6723 Advanced Optics 3 s.h.
Classical theory of absorption and emission; laser theory, threshold, rate equations, saturation, spectral and spatial hole burning; resonators and Gaussian beam optics; dispersion and light scattering; nonlinear optics, three- and four-wave mixing, harmonic generation, parametric amplification, and stimulated scattering. Prerequisites: PHYS:3812.

PHYS:7270 Ethics in Physics for Graduate Students arr.
Responsible conduct and ethics training.

PHYS:7604 Ethics in Physics for Postdocs 0 s.h.
Responsible conduct and ethics training.

PHYS:7720 Semiconductor Physics 3 s.h.
Electronic, optical, and materials properties of semiconductors. Prerequisites: PHYS:4728 and PHYS:5742. Same as ECE:7720.

PHYS:7722 Advanced Condensed Matter 3 s.h.
Elementary excitations, plasmonics, exchange/magnetism, hyperfine interactions, resonance, superconductivity, topological materials. Prerequisites: PHYS:7720.

PHYS:7729 Plasma Physics II 3 s.h.
Continuation of PHYS:4731; cold plasma waves, MHD stability, kinetic theory of plasmas, including Landau damping and velocity space instabilities; nonlinear evolution. Prerequisites: PHYS:4731.