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 major. GE: 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, and gravity. Requirement: must have completed high school trigonometry or achieved a minimum ALEKS score of 75%. 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 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 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 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:1611 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.

**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:2003 Physics III** 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:2905 Programming for Physics** 2 s.h.
Introduction to scientific programming for applications in physics.

**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:3971 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) 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 MATH: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 and equipment. Corequisites: PHYS:3811.

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: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 I 3 s.h.
Advanced electromagnetostatics, boundary value problems, Green's functions, Maxwell's equations, radiation theory, physical optics, multiple 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; resonantors 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.

PHYS:7730 Advanced Plasma Physics I 3 s.h.
Microscopic plasma behavior: statistical mechanics of plasmas; Liouville equation; BBGKY hierarchy; Fokker-Planck equation and relaxation processes; Vlasov equation and linearized wave motion; shocks, nonlinear plasma motions, and instabilities; fluctuations and radiation processes; topics from recent literature.

PHYS:7731 Physics of Strongly Coupled Plasmas 3 s.h.
Conservation laws, equation of state, transport properties, structure factors. Integral equation theories, BBGKY hierarchy, linear response theory, kinetic theories, Chapman-Enskog method, one-component plasma model, and selected topics from recent literature.

PHYS:7740 Introduction to Quantum Field Theory 3 s.h.
Quantization of relativistic and nonrelativistic field theories, covariant perturbation theory, theory of renormalization, dimensional regularization, renormalization group theory, introduction to gauge theories and anomalies. Prerequisites: PHYS:5742.

PHYS:7746 Particle Physics 3 s.h.
Elementary particle properties and phenomenology, quark-parton models, quantum chromodynamics, unified theory of weak and electromagnetic interactions.

PHYS:7760 General Relativity 2-3 s.h.
Einstein's theory of gravitation; principles of general relativity.

PHYS:7761 Cosmology 3 s.h.
Einstein's theory of general relativity radically changed the way we understand the cosmos by providing a mathematical description of space-time itself—this is cosmology; the last three decades have shown remarkable evidence that cosmology is an experimentally testable theory; students explore mathematical underpinnings of cosmology by studying the early universe, the cosmic microwave background, inflation, big bang nucleosynthesis, neutrino physics, quantum field theory effects on space-time, and other issues. Prerequisites: PHYS:7760.

PHYS:7840 Quantum Gauge Theories 3 s.h.

PHYS:7905 Special Topics in Physics arr.

Current research.

Current research. Same as ECE:7930.

PHYS:7936 Seminar: Space Physics arr.
Current research.

PHYS:7945 Seminar: Math/Physics arr.
Current research.

PHYS:7946 Seminar: Nuclear and Particle Physics arr.
Current research.

PHYS:7990 Research: Physics arr.

PHYS:7992 Individual Critical Study arr.
Essay on topic chosen in consultation with faculty member. Requirements: candidacy for M.S. with critical essay.