PHYSICS (PHYS)

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PHYS Courses

PHYS 1100 Introduction to the Physics Major (1 unit)
Term Typically Offered: F
CR/NC

Introduction to the skills, tools, and habits-of-mind physicists use to investigate physical phenomena. Exploration of possible careers and issues of diversity and representation in physics. Introduction to the research programs and opportunities in the department. Credit/No credit grading only. 1 activity. Formerly PHYS 100.

PHYS 1104 Introductory Physics (3 units)
Term Typically Offered: F
2026-28 or later catalog: GE Area 5A
2020-26 catalogs: GE Area B1
Prerequisite: Appropriate Math Placement; or one of the following: MATH 118, MATH 1104, or MATH 1106.

Elementary introduction to mechanics, gases, liquids and solids, heat, vibrations and waves, light, electricity and magnetism. Intended to provide non-science students with an understanding of basic physical concepts. Not open to students who have credit in a college physics course. 3 lectures. Fulfills GE Area 5A (GE Area B1 for students on the 2020-26 catalogs). Formerly PHYS 104.

PHYS 1111 Contemporary Physics for Nonscientists (3 units)
Term Typically Offered: SP
2026-28 or later catalog: GE Area 5A
2020-26 catalogs: GE Area B1

Qualitative exploration of the key concepts of quantum mechanics and Einstein's special and general theories of relativity. Particle-wave duality, Heisenberg's uncertainty principle, Schrodinger's cat, warped spacetime, black holes. Not open to students with credit in PHYS 211 or PHYS 2211. 3 lectures. Fulfills GE Area 5A (GE Area B1 for students on the 2020-26 catalogs). Formerly PHYS 111.

PHYS 1121 College Physics I (4 units)
Term Typically Offered: F, SP, SU
2026-28 or later catalog: GE Area 5A
2026-28 or later catalog: GE Area 5C
2020-26 catalogs: GE Area B1
2020-26 catalogs: GE Area B3
Prerequisite: Appropriate Math Placement; or one of the following: MATH 118, MATH 119, MATH 1006, or MATH 1007.

Introduction to mechanics emphasizing motion, force, energy, and fluids. Waves and vibrations, sound, thermodynamics, and heat. Not open to students with a grade of C- or better in PHYS 141 or PHYS 1141. 3 lectures, 1 laboratory. Fulfills GE Area 5A and 5C (GE Areas B1 and B3 for students on the 2020-26 catalogs). Formerly offered as part of the PHYS 121, 122, 123 series, students may not earn credit for both PHYS 121 and PHYS 1121.

PHYS 1123 College Physics II (4 units)
Term Typically Offered: F, SP, SU
Prerequisite: One of the following: PHYS 121, PHYS 141, PHYS 1121, or PHYS 1141.

Continuation of two course college physics series. Electrostatics, electric current, magnetic fields and induction. Light and optics. Elements of modern physics. Not open to students with a grade of C- or better in PHYS 143 or PHYS 1143. 3 lectures, 1 laboratory. Formerly offered as part of the PHYS 121, 122, 123 series, students may not earn credit for both PHYS 123 and PHYS 1123.

PHYS 1141 General Physics I (4 units)
Term Typically Offered: F, SP, SU
2026-28 or later catalog: GE Area 5A
2026-28 or later catalog: GE Area 5C
2020-26 catalogs: GE Area B1
2020-26 catalogs: GE Area B3
Corequisite: MATH 141 or MATH 1261.

Fundamental principles of mechanics. 1D and 2D particle kinematics and vectors. Newton's laws. Work and energy, and momentum. Equilibrium of a rigid body, rotational kinematics and dynamics. Simple harmonic motion. Gravitation. Kinetic theory and laws of thermodynamics. Primarily for engineering and science students. 3 lectures, 1 laboratory. Crosslisted as HNRS/PHYS 1141. Fulfills GE Areas 5A and 5C (GE Areas B1 and B3 for students on the 2020-26 catalogs). Formerly offered as part of the PHYS 141, 142, 143 series, students may not earn credit for both PHYS 141 and PHYS 1141.

PHYS 1143 General Physics II (4 units)
Term Typically Offered: F, SP, SU
2026-28 or later catalog: GE Area 5A
2026-28 or later catalog: GE Area 5C
2020-26 catalogs: GE Area B1
2020-26 catalogs: GE Area B3
Prerequisite: PHYS 141 or PHYS 1141. Corequisite: MATH 143 or MATH 1262.

Wave optics, geometrical optics, lenses, mirrors, and optical instruments. Charge and matter, electric force, field and potential, capacitance. Current and resistance, circuits, magnetic field and force, induced emf, Maxwell's equations, and AC circuits. 3 lectures, 1 laboratory. Crosslisted as HNRS/PHYS 1143. Fulfills GE Areas 5A and 5C (GE Areas B1 and B3 for students on the 2020-26 catalogs). Formerly offered as part of the PHYS 141, 142, 143 series, students may not earn credit for both PHYS 143 and PHYS 1143.

PHYS 2200 Special Problems for Undergraduates (1-2 units)
Term Typically Offered: F, SP
Prerequisite: Consent of instructor.

Individual investigation, research, studies, or surveys of selected problems. Repeatable up to 4 units. Formerly PHYS 200.

PHYS 2211 General Physics III: Modern Physics (4 units)
Term Typically Offered: F, SP
Prerequisite: PHYS 143 or PHYS 1143; and MATH 241 or MATH 2263. Recommended: One of the following: MATH 242, MATH 244, MATH 2341, or MATH 2343.

Introduction to modern physics. Special relativity, quantum mechanics, and statistical mechanics. Application to atoms, molecules, crystalline solids, nuclei, and elementary particles. 4 lectures. Formerly PHYS 211.

PHYS 2270 Special Topics (1-3 units)
Term Typically Offered: TBD
Prerequisite: Consent of instructor.

Directed group study of special topics. The Class Schedule will list topic selected. Repeatable up to 6 units. 1 to 3 lectures. Formerly PHYS 270.

PHYS 3301 Statistical Mechanics (3 units)
Term Typically Offered: SP
Prerequisite: PHYS 211 or PHYS 2211; and MATH 143 or MATH 1262. Recommended: CSC 101, CSC 1001, or other programming experience.

Introduction to statistical mechanics and thermodynamics. Entropy, temperature, ensembles, partition functions, chemical potential, free energy. Applications include paramagnetism, ideal gas, Fermi-Dirac and Bose-Einstein distributions. 3 lectures. Formerly PHYS 301.

PHYS 3305 Classical Mechanics I (3 units)
Term Typically Offered: F
2026-28 or later: Upper-Div GE Area 2/5
2020-26 catalogs: Upper-Div GE Area B
Prerequisite: Junior standing; completion of GE Area 1 with grades of C- or better (GE Area A for the 2020-26 catalogs); completion of GE Area 2 with a grade of C- or better (GE Area B4 for the 2020-26 catalogs); MATH 242 or MATH 2343; and PHYS 141 or PHYS 1141.

Laws of motion, kinematics and dynamics of a particle. Oscillations. Work and energy. Linear and angular momentum. Lagrange's and Hamilton's equations. Kepler's laws of orbital motion and central force problems. Use of numerical methods for solving problems. 3 lectures. Fulfills GE Areas Upper-Division 2 or Upper-Division 5 (GE Area Upper-Division B for students on the 2020-26 catalogs). Formerly PHYS 305.

PHYS 3306 Classical Mechanics II (3 units)
Term Typically Offered: SP
Prerequisite: PHYS 305 or PHYS 3305.

Mechanics in non-inertial reference frames. Dynamics of rigid bodies. Coupled oscillators and normal modes. Nonlinear Mechanics and Chaos. Collision Theory and Continuum Mechanics. Use of numerical methods for solving problems. 3 lectures. Formerly PHYS 306.

PHYS 3310 Physics of Energy (2 units)
Term Typically Offered: F
Prerequisite: PHYS 143 or PHYS 1143.

Physics and mathematics applied to broad energy concepts and interplay of these technologies with society and government policy. Efficient usage, transportation, transmission, storage, planning and public policy. Concepts may include fossil fuels, solar, nuclear fission and fusion, fuel cells, wind, wave, tidal, and geothermal energy. 2 lectures. Formerly PHYS 310.

PHYS 3314 Ocean Dynamics (3 units)
Term Typically Offered: SP
Prerequisite: One of the following: PHYS 123, PHYS 143, PHYS 1123, or PHYS 1143; and MATH 241 or MATH 2263. Recommended: One of the following: MATH 242, MATH 244, MATH 2341, or MATH 2343.

Physics governing ocean circulation and transport processes. Physical environment, dynamics of fluid motion in the presence of rotation and stratification, balanced flows, heat budgets, ocean waves, mixing and turbulence, and applications to climate processes and the biological environment. 3 lectures. Formerly PHYS 314.

PHYS 3315 Lasers (2 units)
Term Typically Offered: F
Prerequisite: PHYS 211 or PHYS 2211.

Interaction of light with matter, theory of laser action, laser beam characteristics, continuous and pulsed output, types of lasers. Laser applications that may include interferometry, fiber optics, pulsed laser applications, atom trapping, nonlinear optics. 2 lectures. Formerly PHYS 315.

PHYS 3316 Instrumentation and Techniques of Experimental Physics (4 units)
Term Typically Offered: F
Prerequisite: CSC 101 or CSC 1001; and PHYS 143 or PHYS 1143.

Statistical data analysis. Introduction to laboratory test and measurement equipment. Basic analog and digital electronic circuits emphasizing applications in experimental physics. Computer based data acquisition, data analysis and control. 3 lectures, 1 laboratory. Replaced PHYS 206.

PHYS 3320 Methods of Theoretical Physics (4 units)
Term Typically Offered: F
Prerequisite: Physics majors; PHYS 211 or PHYS 2211; and one of the following: MATH 244, MATH 2341, MATH 242, or MATH 2343.

Mathematical techniques of theoretical physics with applications from classical mechanics, optics, electromagnetism, and quantum mechanics. Maxwell's equations and vector calculus. Fourier analysis. Series solutions. Partial differential equations with problems involving the heat equation, the wave equation, and the Schroedinger equation. 4 lectures. Formerly PHYS 320.

PHYS 3323 Optics (4 units)
Term Typically Offered: SP
Prerequisite: MATH 241 or MATH 2263; PHYS 143 or PHYS 1143; and one of the following: PHYS 320, PHYS 3320, EE 2328, EE 201, EE 2201, ME 318, or ME 3318.

Ray optics, lens systems, optical instruments, wave optics, interference, diffraction, polarization of light, wave propagation in media and at interfaces, waveguides, optical fiber. 3 lectures, 1 laboratory. Formerly PHYS 323.

PHYS 3330 Teaching Physics (2 units)
Term Typically Offered: SP
Prerequisite: One of the following: PHYS 123, PHYS 1123, PHYS 143, PHYS 1143, PSC 103, or PSC 1102.

Inquiry approaches to teaching physics incorporating insights from physics education research and computer technology. Pedagogical approaches and assessment that engages learners in scientific discourse and development of basic models of physics phenomena such as motion, forces, energy, and momentum through experimentation. 1 lectures, 1 activities. Formerly PHYS 330.

PHYS 3339 Communicating Physics (1 unit)
Term Typically Offered: SP
GWR
Prerequisite: Junior standing and completion of GE Area 1 with grades of C- or better (GE Area A for the 2020-26 catalogs). Concurrent: PHYS 3340.

Communication techniques for physics. Critical study of scientific literature, creation of lab reports, oral presentations, posters, outreach, with peer-review. 1 activity. Fulfills GWR.

PHYS 3340 Quantum Physics Laboratory I (1 unit)
Term Typically Offered: SP
Prerequisite: PHYS 206 or PHYS 3316; and PHYS 211 or PHYS 2211. Concurrent: PHYS 3339.

Experimental studies of quantum properties of atoms and nuclei. Measurements of fundamental constants. Use of modern laboratory instruments in physical measurements. Overview of skills needed in a working physics laboratory. Rigorous computer-based statistical and error analysis of data. 1 laboratory. Formerly PHYS 340.

PHYS 3341 Quantum Physics Laboratory II (1 unit)
Term Typically Offered: F
Prerequisite: PHYS 340; or PHYS 3339 and PHYS 3340.

Second semester of the advanced lab experience. Advanced experimental physics techniques, instrumentation, data acquisition and analysis. Quantum experimental studies of atoms, molecules and nuclei, and their interactions with light, other forms of radiation, and static electric and magnetic fields. 1 laboratory. Formerly PHYS 341.

PHYS 3345 Quantum Computing (3 units)
Term Typically Offered: SP
Prerequisite: One of the following: MATH 206, MATH 244, MATH 1151, or MATH 2341; and one of the following: CHEM 353, CHEM 3392, PHYS 211, or PHYS 2211.

Quantum mechanical wave functions. Principle of superposition and entanglement. States of one or more quantum bits. Quantum gates and circuits. Application of quantum gates on simulators and quantum computers. Quantum computer architectures. Quantum algorithms. Ethics of quantum computing. 2 lectures, 1 activity. Crosslisted as CPE/PHYS 3345. Formerly CPE/PHYS 345.

PHYS 4202 Computational Physics (4 units)
Term Typically Offered: F
Prerequisite: CSC 101 or CSC 1001; and one of the following: MATH 242, MATH 244, MATH 2341, or MATH 2343.

Applications of computational methods in physics. Concepts may include data selection and feature extraction with machine learning, finite difference methods in calculus, Monte-Carlo simulations, and spectral methods. 2 lectures, 2 activities.

PHYS 4400 Special Problems for Advanced Undergraduates (1-2 units)
Term Typically Offered: F, SP
Prerequisite: Consent of instructor.

Individual investigations, research, studies, or surveys of selected problems. Repeatable up to 4 units. Formerly PHYS 400.

PHYS 4403 Particle and Nuclear Physics (3 units)
Term Typically Offered: F
Prerequisite: PHYS 211 or PHYS 2211; and one of the following: MATH 242, MATH 244, MATH 2341, or MATH 2343. Recommended: CSC 101, CSC 1001, or other programming experience.

Comprehensive exploration of particle and nuclear physics, including the Standard Model, neutrinos, heavy ion collisions, and nuclear structure and reactions. Instructors may choose to emphasize theoretical and/or experimental treatments of contemporary research concepts. 2 lectures, 1 activity. Formerly PHYS 403.

PHYS 4404 Research Experience for Advanced Undergraduates (1-2 units)
Term Typically Offered: F, SP
CR/NC
Prerequisite: Consent of instructor.

Individual investigations, research, studies, or surveys of selected problems. Repeatable up to 4 units. Credit/No Credit grading only. Formerly PHYS 404.

PHYS 4405 Quantum Mechanics I (3 units)
Term Typically Offered: F
Prerequisite: PHYS 305 or PHYS 3305; and PHYS 320 or PHYS 3320.

The postulates and interpretation of quantum mechanics. Wave functions. The Schroedinger equation and its solutions in one and more dimensions. The hydrogen atom. Discrete problems, including spin. 3 lectures. Formerly PHYS 405.

PHYS 4406 Quantum Mechanics II (3 units)
Term Typically Offered: SP
Prerequisite: PHYS 405 or PHYS 4405.

Symmetries and conservation laws. Time-independent and time-dependent perturbation theory. Variational principle and WKB approximation. Scattering and the Born approximation. Quantum dynamics. 3 lectures. Formerly PHYS 406.

PHYS 4408 Electromagnetic Fields and Waves I (3 units)
Term Typically Offered: SP
Prerequisite: PHYS 320 or PHYS 3320.

Electric and magnetic field theory using vector analysis. Electric fields, dielectric materials, magnetic fields, magnetic materials. Induced emf, Maxwell's equations, wave equation, plane electromagnetic waves. 3 lectures. Formerly PHYS 408.

PHYS 4409 Electromagnetic Fields and Waves II (3 units)
Term Typically Offered: F
Prerequisite: PHYS 408 or PHYS 4408.

Wave equation, plane electromagnetic waves, guided waves. Dipole radiation, radiation from an accelerated charge. Special relativity. 3 lectures. Formerly PHYS 409.

PHYS 4410 Physics of Solid Earth (3 units)
Term Typically Offered: SP
Prerequisite: PHYS 143 or PHYS 1143; MATH 241 or MATH 2263; and one of the following: MATH 242, MATH 244, MATH 2341, or MATH 2343.

Methods of body wave seismology applied to determination of interior structure and composition of the Earth. Planetary seismology. The geomagnetic field and its source. Application of earthquake seismology, paleomagnetism, heat flow, and gravity to plate tectonics and geodynamics. 3 lectures. Formerly PHYS 410.

PHYS 4418 Introduction to Special and General Relativity (3 units)
Term Typically Offered: SP
Prerequisite: PHYS 211 or PHYS 2211; and PHYS 305 or PHYS 3305.

Introduction to the theory of special and general relativity. Simultaneity, length and time measurements. Space-time diagrams. Lorentz transformations. Four-Vectors and Relativistic mechanics. Gravity as curved spacetime. Solar system tests of relativity. Black holes, gravitational waves, and cosmology. 3 lectures. Formerly PHYS 418.

PHYS 4425 Solid State Physics (4 units)
Term Typically Offered: SP
Prerequisite: One of the following: PHYS 211, PHYS 2211, CHEM 353, or CHEM 3392; and one of the following: MATH 242, MATH 244, MATH 2343, or MATH 2341.

Physics of solids including structural, mechanical, thermal, electronic, and magnetic properties, and additional selected concepts. Introduction to the description of electrons and phonons in crystalline solids, including the properties of metals, semiconductors, and superconductors. 3 lectures, 1 laboratory. Formerly PHYS 425.

PHYS 4428 Nonlinear Dynamics and Chaos (4 units)
Term Typically Offered: F
Prerequisite: PHYS 143 or PHYS 1143; MATH 241 or MATH 2263; and one of the following: MATH 242, MATH 244, MATH 2341, or MATH 2343.
Recommended: Junior standing.

Analysis of linear and nonlinear dynamical systems with emphasis on geometrical methods and visualization techniques. Fixed points, phase plane analysis, bifurcations, limit cycles, chaos, and fractals. Laboratory component includes data acquisition and analysis, numerical simulations of dynamical systems, and analysis of discrete systems. Not open to students with credit in MATH 416 or MATH 4342. 3 lectures, 1 laboratory. Formerly PHYS 428.

PHYS 4461 Senior Project I (1-2 units)
Term Typically Offered: F, SP, SU
Prerequisite: Senior standing and consent of instructor.

Selection and completion of a project under faculty supervision. Projects typical of the type of topics graduates may encounter in graduate study or field of employment. Project results culminate in appropriate deliverable. Formerly PHYS 461.

PHYS 4462 Senior Project II (1-2 units)
Term Typically Offered: F, SP, SU
Prerequisite: PHYS 461 or PHYS 4461; and consent of instructor.

Continuation of project under faculty supervision. Projects typical of the type of topics graduates may encounter in graduate study or field of employment. Project results culminate in appropriate deliverable. Formerly PHYS 462.

PHYS 4470 Special Advanced Topics (1-3 units)
Term Typically Offered: TBD
Prerequisite: Consent of instructor.

Directed group study of special topics for advanced students. The Class Schedule will list topic selected. Repeatable up to 6 units. 1 to 3 lectures. Formerly PHYS 470.

PHYS 4471 Special Advanced Laboratory (1-3 units)
Term Typically Offered: TBD
Prerequisite: Consent of instructor.

Directed group laboratory study of special topics for advanced students. The Class Schedule will list topic selected. Repeatable up to 6 units. 1 to 3 laboratories. Formerly PHYS 471.