PHYSICS (PHYS)

Explanation of Course Numbers

- Courses in the 1000s are primarily introductory undergraduate courses
- Those in the 2000–4000s are upper-division undergraduate courses that can also be taken for graduate credit with permission and additional work
- Those in the 6000s and 8000s are for master’s, doctoral, and professional-level students
- The 6000s are open to advanced undergraduate students with approval of the instructor and the dean or advising office

PHYS 0801W. Dean’s Seminar. 3 Credits.

PHYS 1000. Dean’s Seminar. 3 Credits.
The Dean's Seminars provide Columbian College first-year students focused scholarship on specific intellectual challenges. Topics vary by semester. Consult the Schedule of Classes for more details. Restricted to First-year students in CCAS.

PHYS 1003. Physics for Future Presidents. 0-4 Credits.
A serious but accessible presentation of topics important for leaders to know—energy, global climate, high-tech devices, space travel, nuclear weapons, etc. Students possessing any level of scientific background are equipped with the concepts and analytical tools needed to make informed decisions and to argue their view persuasively. Laboratory fee.

PHYS 1003W. Physics for Future Presidents. 0-4 Credits.

PHYS 1005. How Things Work. 4 Credits.
Primarily for non-science majors. Physical principles are introduced through a study of everyday objects to see what makes them tick. This unconventional approach is primarily conceptual in nature and intended for students seeking a connection between science and the world in which they live. Prerequisite: high school algebra and trigonometry. Laboratory fee.

PHYS 1007. Music and Physics. 4 Credits.
Primarily for non-science majors. A comparative study of music and physics, showing parallels in the history of the two fields and emphasizing those topics in physics related to the theory of music and the production of sound by musical instruments, particularly classical mechanics and wave motion. Prerequisite: high school algebra and geometry. Laboratory fee.

PHYS 1008. Origin and Evolution of Ideas in Physics. 4 Credits.
Primarily for non-science majors. The evolution of ideas and their historical continuity in the search for basic physical theories. By presenting the world-views of great physicists of the past, the division of physics into many sub-disciplines is avoided and a humanistic approach is achieved. Prerequisite: high school algebra. Laboratory fee.

PHYS 1008W. Origin and Evolution of Ideas in Physics. 4 Credits.
Primarily for non-science majors. The evolution of ideas and their historical continuity in the search for basic physical theories. By presenting the world-views of great physicists of the past, the division of physics into many sub-disciplines is avoided and a humanistic approach is achieved. Prerequisite: high school algebra. Laboratory fee.

PHYS 1011. General Physics I. 4 Credits.
Classical physics. Mechanics, including Newton’s laws of motion, force, gravitation, equilibrium, work and energy, momentum, and rotational motion; periodic motion, waves, and sound; heat and thermodynamics. Prerequisite: high school trigonometry. Laboratory fee.

PHYS 1012. General Physics II. 4 Credits.
Classical and modern physics. Electrostatics, electromagnetism, direct and alternating current circuits, and electromagnetic radiation; geometrical and physical optics; special relativity; quantum theory; atomic physics; nuclear physics; particle physics; astrophysics and cosmology. Prerequisite: PHYS 1011. Laboratory fee.

PHYS 1021. University Physics I. 4 Credits.

PHYS 1022. University Physics II. 4 Credits.

PHYS 1022W. University Physics 2. 4 Credits.
PHYS 1023W. Modern Physics. 3 Credits.

PHYS 1025. University Physics I with Biological Applications. 4 Credits.
Classical mechanics and thermodynamics using calculus. Newtonian mechanics: force, momentum, work and energy, mechanical equilibrium, linear and rotational motion, fluids. Energy transfer, statistical models, and entropy. Physics principles and problem solving will be taught with examples and problems from the life sciences. Prerequisite: Math 1232; corequisite: Math 1232. Laboratory fee. Credit cannot be earned for both PHYS 1021 and 1025.

PHYS 1026. University Physics II with Biological Applications. 4 Credits.
Periodic motion waves, and classical electromagnetism using calculus. Waves and sound. Electrostatics, Gauss’s law, capacitance. Electric resistance, electric current. Magnetism. Electrostatics in ionic solutions and cells, circuit models for nerves and ion channels. Geometric and physical optics. Physics principles and problem solving will be taught with examples and problems from the life sciences. Prerequisite: PHYS 1021 or 1025, MATH 1232. Laboratory fee. Credit cannot be earned for both PHYS 1022 and 1026.

PHYS 2151. Intermediate Laboratory I: Techniques and Methods. 3 Credits.
Experiments in electromagnetism, classical and quantum mechanics, atomic and nuclear physics with emphasis on experimental methods. Corequisite: PHYS 1023. Laboratory fee.

PHYS 2151W. Intermediate Laboratory I: Techniques and Methods. 3 Credits.
Experiments in electromagnetism, classical and quantum mechanics, atomic and nuclear physics with emphasis on experimental methods. Corequisite: PHYS 1023. Laboratory fee.

PHYS 2152. Intermediate Laboratory II: Instrumentation. 3 Credits.
Elementary electric and electronic analog and digital circuits. Topics include passive and active components in DC and AC circuits and operational amplifiers, with emphasis on measurement techniques. Laboratory fee.

PHYS 2161. Mechanics I. 3 Credits.
Mechanics of mass points and rigid bodies. Newton’s laws, conservation laws, Euler’s equations, inertia tensor, small vibrations, and elements of Lagrange’s and Hamilton’s equations. Prerequisite: PHYS 1023; MATH 2233.

PHYS 2163. Physical and Quantum Optics. 3 Credits.
Wave motion, electromagnetic aspects of light, dispersion of light in media, geometrical optics, polarization and optical properties of crystals, interference, diffraction, lasers, holography. Mathematical tools, including Fourier methods, developed as needed. The quantum description of light complements the classical description. Prerequisite: PHYS 1023; MATH 2233. Laboratory fee.

PHYS 2165. Electromagnetic Theory. 3 Credits.
Electrostatics and magnetostatics, electric and magnetic fields in matter, scalar and vector potentials, electromagnetic induction. Maxwell’s equations. The methods of vector and tensor calculus are developed as needed, as are the methods of images, Fourier series, and some computational methods. Prerequisite: PHYS 1023; MATH 2233.

PHYS 2166. Electromagnetic Theory. 3 Credits.
Conservation laws, electromagnetic waves, radiation, relativistic formulation of electrodynamics and potential fields. Prerequisite: PHYS 2165.

PHYS 2182. Computational Electricity/Magn. 3 Credits.

PHYS 2183. Computational Modern Physics. 3 Credits.

PHYS 4195. Undergraduate Research. 3 Credits.
Research on problems in physics approved by the faculty. May be repeated once for credit.

PHYS 4196. Undergraduate Research in Biophysics. 3 Credits.
Research on problems in biophysics approved by the faculty. May be repeated once for credit.

PHYS 4197. Undergraduate Research in Nuclear Physics. 3 Credits.
Research on problems in nuclear physics approved by the faculty. May be repeated once for credit.

PHYS 5701. Selected Topics. 0-4 Credits.

PHYS 6110. Mathematical Methods of Theoretical Physics. 4 Credits.

PHYS 6120. Advanced Mechanics. 4 Credits.

PHYS 6130. Computational Physics I. 1 Credit.
Taken in conjunction with PHYS 6110 and PHYS 6120.
PHYS 6210. Electrodynamics and Classical Field Theory. 4 Credits.

PHYS 6220. Quantum Mechanics I. 4 Credits.
General aspects of quantum mechanics with emphasis upon the developmental principles involved. Operators, representations, transformation theory. Schroedinger and Heisenberg pictures, angular momentum, perturbation and scattering theory. Introduction to relativistic quantum field theory, first-order electromagnetic processes. Many-body theory. Prerequisite: Consent of a departmental graduate advisor. Corequisite: PHYS 6230.

PHYS 6230. Computational Physics II. 1 Credit.

PHYS 6310. Statistical Mechanics. 4 Credits.
Classical and quantum statistics. Gibbs paradox, microscopic origins of entropy and other thermodynamic variables, fluctuations, ensemble theory, partition functions, distribution functions, density matrices. Applications include the harmonic oscillator, magnetic systems, ideal Fermi-Dirac and Bose-Einstein systems, blackbody radiation, phonons. Renormalization group, phase transitions and critical phenomena. Prerequisite: Consent of a departmental graduate advisor. Corequisite: PHYS 6330.

PHYS 6320. Quantum Mechanics II. 4 Credits.

PHYS 6330. Computational Physics III. 1 Credit.

PHYS 6510. Communications in Physics. 0-3 Credits.
Student presentations on advanced topics in physics. Prerequisite: Consent of a departmental graduate advisor.

PHYS 6590. Seminar. 0-1 Credits.
Lectures on current topics in physics. May be repeated for credit. Prerequisite: Consent of a departmental graduate advisor.

PHYS 6599. Advanced Study. 3 Credits.
For students who have completed three semesters of course work in the core graduate physics curriculum. Problem sets aimed at development of a deeper and more advanced understanding of physics.

PHYS 6610. Nuclear and Particle Physics I-II. 3 Credits.
Theory and experiment of the standard model of elementary particle physics of strong and electro-weak interactions. Emergence of nuclear interactions and pion physics. Effective field theory, non-perturbative methods, lattice simulations, nuclear models, nuclear reactions. Path integral, gauge fields, S-matrix theory, dispersion relations, renormalization program. Prerequisite: PHYS 6320 and consent of a departmental graduate advisor.

PHYS 6620. Biophysics I. 3 Credits.
Topics include molecular biophysics, modern simulation methodologies and experimental methodologies for probing biological systems.

PHYS 6630. Astrophysics I. 3 Credits.
Astrophysical examination of stellar evolution, including properties of stellar matter, equations of state, nucleosynthesis, red giants, supernovae, white dwarfs, close binary stellar systems, gamma-ray bursts. Overview of observational techniques, including photometry; IR, UV, X-ray observation, gamma-ray frequencies; astrophysical data analysis; evidence for stellar and cosmological models. Prerequisite: Consent of a departmental graduate advisor.

PHYS 6710. Nuclear and Particle Physics II. 3 Credits.

PHYS 6720. Biophysics II. 3 Credits.
Phys 6720: Topics include theoretical and computational methods for genes, proteins, and bionetworks; models of biological complexity; applications of non-equilibrium statistical mechanics and combinatorial optimization. Prerequisite: Phys 6310. This course may be taken repeatedly for credit to a maximum of 15 credits.

PHYS 6730. Astrophysics II. 3 Credits.

PHYS 6998. Thesis Research. 3 Credits.

PHYS 6999. Thesis Research. 3 Credits.

PHYS 8110. Selected Topics in Theoretical Nuclear Physics. 3 Credits.
Prerequisite: Consent of a departmental graduate advisor. May be repeated once for credit with permission of graduate advisor.

PHYS 8120. Selected Topics in Experimental Nuclear Physics. 3 Credits.
Prerequisite: Consent of a departmental graduate advisor. May be repeated once for credit with permission of graduate advisor.
PHYS 8130. Selected Topics in Theoretical Biophysics. 3 Credits.
Prerequisite: Consent of a departmental graduate advisor.  
May be repeated once for credit with permission of graduate advisor.

PHYS 8140. Selected Topics in Experimental Biophysics. 3 Credits.
Prerequisite: Consent of a departmental graduate advisor.  
May be repeated once for credit with permission of graduate advisor.

PHYS 8150. Selected Topics in Astrophysics. 3 Credits.  
Prerequisite: Consent of a departmental graduate advisor.  
May be repeated once for credit with permission of graduate advisor.

PHYS 8998. Advanced Reading and Research. 1-4 Credits.  
Limited to students preparing for the Doctor of Philosophy general examination. May be repeated once for credit.

PHYS 8999. Dissertation Research. 1-12 Credits.  
Limited to Doctor of Philosophy candidates. May be repeated for credit.