Physics, Catalog 2025-26

MAJOR, MINOR

“Look deeply into nature and you will understand everything better,” said Albert Einstein. Students of physics at Hollins understand the truth of this maxim. Through their investigations of laws that underlie reality, they gain a greater appreciation not only of our universe but also their relationship to it.

In physics courses at Hollins, you will engage the ideas of Newton and Hamilton, Maxwell and Einstein, among many others. You will find that wrestling with tough questions and exploring the limits of what is known about the world is the physicist’s stock-in-trade and that there is a joy in understanding nature that comes from truly seeing it for the first time.

Classes are intimate: upper-division classes typically have 3-4 students, and lower-division courses have 10-15. We place great value on nurturing each student’s development as a physical thinker. In physics courses at Hollins, you’ll find yourself challenged and closely supported and nurtured as you mature in your physical reasoning.

REQUIREMENTS FOR A MAJOR IN PHYSICS:

10 courses and their corresponding laboratories (48 credits)

- PHYS 201, 201L: Analytical Physics I, Lab (4, 2)
- PHYS 202, 202L: Analytical Physics II, Lab (4, 2)
- PHYS 301: Classical Mechanics (4)
- PHYS 302: Electromagnetism (4)
- PHYS 310: Modern Physics (4)
- PHYS 331: Physical Chemistry I (4)
- PHYS 335: Quantum Mechanics (4)
- PHYS 470: Physics Research Seminar (4)
- One additional 300-level PHYS course other than PHYS 399: Internship (4)
- PHYS 290: Independent Study or any 300-level PHYS course or PHYS 480: Senior Thesis (4)

REQUIRED ALLIED COURSES:

- MATH 241: Calculus I (6)
- MATH 242: Calculus II (4)
- MATH 316: Several-Variable Calculus (4)

- CHEM 101 and CHEM 102: General Chemistry (including laboratories) (4, 2) (4, 2) or CHEM 105: Principles of Chemistry (including laboratory) (4, 2)

REQUIREMENTS FOR A MINOR IN PHYSICS:

5 courses and the corresponding laboratories (24–28 credits) from:

- PHYS 201, 201L: Analytical Physics I, Lab (4, 2)
- PHYS 202, 202L: Analytical Physics II, Lab (4, 2)
- PHYS 310: Modern Physics (4)
- One additional 300-level PHYS course other than PHYS 399: Internship (4)
- PHYS 290: Independent Study or any 300-level PHYS course (4)

For all laboratories offered in the physics department, the corresponding lecture course is a corequisite or prerequisite.

Proficiency in mathematics is required for all physics major courses. Courses in statistics and computer science are highly recommended. Prerequisites for any course may be satisfied by examination.

A student with a score of 4 or 5 on the College Entrance Examination Board (CEEB) AP Physics C: Mechanics exam will receive four credits in physics (equivalent of PHYS 201). A student with a score of 4 or 5 on the AP Physics C: Electricity and Magnetism exam should consult with the department chair about potential course credit. A student with a score of 4 or 5 on the AP Physics I: Algebra-based exam will receive four credits in physics (equivalent of PHYS 151). A student with a score of 4 or 5 on the AP Physics 2: Algebra-based exam should consult with the department chair about potential course credit. Laboratory sections for these courses may need to be completed at Hollins.

COURSES IN PHYSICS:

PHYS 101: INTRODUCTION TO ASTRONOMY (4)

A course in astronomy dealing with the physical principles and scientific investigation of objects in our solar system, galaxy, and universe. The course will emphasize the study of stars, star systems, cosmology, and relativity; and how knowledge is acquired of celestial objects to develop models of our universe. Will include observations of the night sky. Open to first-year students and the nonscientist. No prerequisite. Offered Term 1. (SCI, TLAS)

PHYS 108: BASIC ELECTRONICS (4)

A course that combines a lecture and lab approach. Basic electronic concepts, static electricity to solid-state electronics will be taught in lectures. Analog and digital circuit

fundamentals will be emphasized in the laboratory sections. Open to first-year students. No prerequisite. (SCI)

PHYS 151: PHYSICAL PRINCIPLES I (4)

Noncalculus-based general physics with an emphasis on problem-solving, primarily intended for science and pre-medical students. Covers Newtonian mechanics, thermal physics, fluid physics, and wave motion. Open to first-year students. Prerequisite: Prerequisites: q and MATH 140 or a higher-level MATH course. Offered Term 1. (SCI: must take lab to fulfill SCI)

PHYS 152: PHYSICAL PRINCIPLES II (4)

Noncalculus-based general physics with an emphasis on problem-solving, primarily intended for science and pre-medical students. Topics include electricity, magnetism, DC/AC circuits, light and optics, and quantum physics. Open to first-year students. Prerequisite: PHYS 151. Offered Term 2. (SCI: must take lab to fulfill SCI)

PHYS 151L, 152L: PHYSICAL PRINCIPLES I, II LAB (2, 2)

Open to first-year students. Prerequisite: q. Corequisite: PHYS 151 or 152. PHYS151L offered Term 1. PHYS 152L offered Term 2. (Q, SCI)

PHYS 201: ANALYTICAL PHYSICS I (4)

A rigorous calculus-based introduction to classical mechanics, gravitation, thermal physics, fluid physics, and electricity and magnetism. Open to first-year students with advanced placement. Prerequisites: MATH 241 or test into MATH 242 (can be taken concurrently). Offered Term 1. (SCI: must take lab to fulfill SCI; TLAS: must take lab to fulfill TLAS)

PHYS 202: ANALYTICAL PHYSICS II (4)

A rigorous calculus-based introduction to classical mechanics, gravitation, thermal physics, fluid physics, and electricity and magnetism. Open to first-year students with advanced placement. Prerequisites: PHYS 201 and MATH 242 (may be taken concurrently) or test into MATH 255. Offered Term 2. (SCI: must take lab to fulfill SCI)

PHYS 201L, 202L: ANALYTICAL PHYSICS I, II LAB (2, 2)

Open to first-year students with advanced placement. Prerequisite: q. Corequisite: PHYS 201 or 202. PHYS201L Offered Term 1. PHYS 202L offered Term 2. (Q, SCI)

PHYS 225: ENERGY AND THE ENVIRONMENT (4)

This course will examine the physics of energy, with a focus on human energy use and production and their effect on the environment. It will utilize the physical concepts of work, energy, and power, with applications from electricity and magnetism and thermodynamics, to provide an understanding of the challenges faced in implementing ecologically and economically sustainable energy. Not open to first years. Prerequisite: ES 117 or PHYS 151 or PHYS 201. Also listed and described as ES 225.

PHYS 236: WIND, WATER, AND WEATHER (4)

This course examines the physical principles of earth's dynamic weather systems, utilizing important concepts from physics, geology, hydrology, and meteorology. Students will gain a broad understanding of interactions between the atmosphere and fresh and ocean water, including global circulation systems, storms, weather forecasting, the carbon cycle, and the greenhouse effect. Special emphasis will be placed on human-induced climate change. Also listed and described as ES 236. Open to first-year students. Prerequisite: ES 117, PHYS 151, or PHYS 201, or permission of instructor.

PHYS 241: GEOLOGY AND EARTH HISTORY (4)

Planet Earth's development as an integrated physical, chemical, and biological system over the past 4.6 billion years. Topics include: the origins of the solar system, Earth, and Moon; forces driving Earth's chemical and geological differentiation; plate tectonics; origins of life and humans; Earth's system dynamics; humans as geological agents; and Earth's climate system. Also listed and described as ES 241. Open to first-year students. (SCI). Offered Term 2

PHYS 290: INDEPENDENT STUDY (2 OR 4)

Individual study, reading, and either experimental or theoretical investigation of a physics-related topic below the advanced level. Each course occupies one term and may be offered during the summer. Up to three courses in the sequence may be taken for credit.

PHYS 301: CLASSICAL MECHANICS (4)

An extension of PHYS 201/202. Topics include Newton's Laws, the simple harmonic oscillator, the central force problem, multi-particle system (coupled oscillators), rotation of rigid bodies, mechanics of continuous media, and the mechanics of Lagrange and Hamilton. Prerequisite: PHYS 201.

PHYS 302: ELECTROMAGNETISM (4)

Intermediate-level electricity, magnetism, and the Maxwell equations of the electromagnetic field. Topics include charged-particle trajectories, the theorems of Gauss and Stokes, vector calculus, Poynting vector, wave and polarization phenomena, and electromagnetic interactions with matter. Prerequisite: PHYS 202.

PHYS 310: MODERN PHYSICS (4)

Twentieth-century developments in physics: relativity theory, the nature of space and time, the equivalence of mass and energy, introductory quantum theory, the particle nature of light, the wave nature of electrons, atomic and molecular structure, and the structure of the nucleus. Prerequisites: PHYS 201 and PHYS 202. .. Offereed Term 1.

PHYS 325: BIOLOGICAL PHYSICS (4)

This course explores the physics of living matter with a focus on the physical biology of cells. Utilizing concepts from thermodynamics and hydrodynamics, it develops an understanding of statistical mechanics through an examination of Brownian motion, diffusion, free energy transductions, and nonequilibrium steady-states. Applications include cell membrane permeability, bacteria locomotion, vascular networks, and mechanochemical motors. Prerequisite: PHYS 201 and 202. Offered Term 2.

PHYS 331, 332: PHYSICAL CHEMISTRY I, II (4, 4)

Also listed and described as CHEM 331, 332. PHYS 331 offered Term 1. PHYS 332 offered Term 2.

PHYS 331L, 332L: PHYSICAL CHEMISTRY I, II LAB (2, 2)

Also listed and described as CHEM 331L and 332L. PHYS 331L offered Term 2. PHYS 332L offered Term 2.

PHYS 335: QUANTUM MECHANICS (4)

A rigorous introduction to the principles of quantum mechanics. Solutions of the Schrödinger equation, harmonic oscillator, and hydrogen atom. Operator methods are introduced and used to compose both orbital angular momentum and spin. Various approximation schemes will be studied. Also listed and described as CHEM 335. Prerequisites: PHYS 310, MATH 255, and MATH 316 or the equivalents are advised as preparation.

PHYS 390: INDEPENDENT STUDY (2 OR 4)

Individual study, reading, and either experimental or theoretical investigation of a physics-related topic at the advanced level. Each course occupies one term and may be offered during the summer. Up to three courses in the sequence may be taken for credit.

PHYS 399: INTERNSHIP (4)

May be proposed in any term.

PHYS 470: PHYSICS RESEARCH SEMINAR (4)

A participatory seminar course examining current research areas in physics. Required of senior physics majors; other junior and senior science majors may enroll with permission. All course members will present and defend their physics-related research. A critical term paper is required. Prerequisite: junior or senior standing.

PHYS 480: SENIOR THESIS (4)

A research paper of publication quality based upon research in physics, or a physics-related field, undertaken for one term plus Short Term during the senior year. Required of all senior physics majors.

PHYS 490: SENIOR HONORS THESIS (4, 4)

By invitation of the department. Application must be made with faculty prior to registration. Required both regular terms and Short Term.