Courses of Instruction

An examination of the beginnings of analytic philosophy. Examines the major works from the period 1879–1921 of the three progenitors of this philosophical movement: Gottlob Frege, Bertrand Russell, and Ludwig Wittgenstein. Topics include objectivity and truth, logic and inference, and the foundations of mathematics.
Prerequisite: Philosophy 223 or permission of the instructor.

334c. Free Will. Fall 2009. SCOTT R. SEHON.
Do we have free will and moral responsibility? Can we have free will and moral responsibility if determinism is true? More broadly, can we have free will if all human behaviors can be explained scientifically? Readings from contemporary sources.
Prerequisite: One course in philosophy.

337c. Hume. Fall 2010. MATTHEW STUART.
An examination of Hume’s metaphysics and epistemology, focusing on his masterpiece, A Treatise of Human Nature. This work — completed when the author was only twenty-six — was largely ignored during his lifetime, but is now recognized as the high-water mark of British Empiricism. Topics to include Hume’s theories about cognition, imagination, causality, inductive reasoning, free will, personal identity, miracles, and moral evaluation.
Prerequisite: Philosophy 112 or permission of the instructor.

Examines debates in recent ethical theory and normative ethics. Possible topics include realism and moral skepticism, explanation and justification in ethics, consequentialism and its critics, relativism, whether morality is overly demanding, the sources of normativity, and the relation of ethics to science.
Prerequisite: Philosophy 112, 221, or 258, or permission of the instructor.

[346c. Philosophy of Gender: Sex and Love. (Same as Gay and Lesbian Studies 346 and Gender and Women’s Studies 346.)]

[375c. Metaphysics of the Self.]

392c. Advanced Topics in Environmental Philosophy. Spring 2010. LAWRENCE H. SIMON.
Examines philosophical, moral, political, and policy questions regarding various environmental issues. Possible topics include the ethics of climate change policy, our obligations to future generations, benefit-cost analysis vs. the precautionary principle as a decision-making instrument, and the relationship between justice and sustainability. (Same as Environmental Studies 392.)

401c–404c. Advanced Independent Study and Honors in Philosophy. THE DEPARTMENT.

Physics and Astronomy

Thomas Baumgarte, Department Chair
Dominica Lord-Wood, Department Coordinator

Professors: Thomas Baumgarte, Stephen G. Naculich, Dale A. Syphers
Associate Professors: Mark O. Battle, Madeleine E. Msall
Lecturer: Karen Topp
Laboratory Instructors: Kenneth Dennison, Gary L. Miers
Physics and Astronomy

The major program depends to some extent on the student’s goals, which should be discussed with the department. Those who intend to do graduate work in physics or an allied field should plan to do an honors project. For those considering a program in engineering, consult pages 46–47. A major with an interest in an interdisciplinary area such as geophysics, biophysics, or oceanography will choose appropriate courses in related departments. Secondary school teaching requires a broad base in science courses, as well as the necessary courses for teacher certification. For a career in industrial management, some courses in economics and government should be included.

**Requirements for the Major in Physics**

A student majoring in physics is expected to complete Mathematics 161, 171, Physics 103, 104, 223, 229, one 300-level methods course (Physics 300, 301, or 302), and three additional approved courses higher than 104 (one of which may be Mathematics 181 or higher). At least five physics courses must be taken at Bowdoin. For honors work, a student is expected to complete Mathematics 181, and Physics 103, 104, 223, 229, 300, 310, 451, and four additional courses, two of which must be at the 300 level, and one of which may be in mathematics numbered higher than Mathematics 181.

**Requirements for the Minor in Physics**

The minor consists of at least four Bowdoin physics courses numbered 103 or higher, at least one of which must be Physics 104.

**Interdisciplinary Majors**

The department participates in interdisciplinary programs in chemical physics and geology and physics. See pages 209 and 212.

**Prerequisites**

Students must earn a grade of C- or above in any prerequisite physics course.

**Introductory, Intermediate, and Advanced Courses**

50a - MCSR, INS. Physics of Musical Sound. Fall 2009. KAREN TOPP.

An introduction to the physics of sound, specifically relating to the production and perception of music. Topics include simple vibrating systems; waves and wave propagation; resonance; understanding intervals, scales, and tuning; sound intensity and measurement; sound spectra; how various musical instruments and the human voice work. Students are expected to have some familiarity with basic musical concepts such as scales and intervals. Not open to students who have credit for or are concurrently taking any physics course numbered 100 or higher.

[62a - MCSR, INS. Contemporary Astronomy.]

[80a - INS. Light and Color.]

[81a - INS. Physics of the Environment. (Same as Environmental Studies 81.)]

93a - MCSR. Introduction to Physical Reasoning. Fall 2009. MADELEINE MSALL.

Climate science. Quantum Physics. Bioengineering. Rocket science. Who can understand it? Anyone with high school mathematics (geometry and algebra) can start. Getting started in physics requires an ability to mathematically describe real world objects and experiences.
Prepares students for additional work in physical science and engineering by focused practice in quantitative description, interpretation, and calculation. Includes hands-on measurements, some introductory computer programming, and many questions about the physics all around us. To ensure proper placement, students are expected to have taken the physics placement examination prior to registering for Physics 93.


An introduction to the conservation laws, forces, and interactions that govern the dynamics of particles and systems. Shows how a small set of fundamental principles and interactions allow us to model a wide variety of physical situations, using both classical and modern concepts. A prime goal of the course is to have the participants learn to actively connect the concepts with the modeling process. Three hours of laboratory work per week. To ensure proper placement, students are expected to have taken the physics placement examination prior to registering for Physics 103.

Prerequisite: Previous credit or concurrent registration in Mathematics 161 or higher, or permission of the instructor.


An introduction to the interactions of matter and radiation. Topics include the classical and quantum physics of electromagnetic radiation and its interaction with matter, quantum properties of atoms, and atomic and nuclear spectra. Three hours of laboratory work per week will include an introduction to the use of electronic instrumentation.

Prerequisite: Physics 103 and previous credit or concurrent registration in Mathematics 171 or 181, or permission of the instructor.


A quantitative introduction to astronomy, with emphasis on stars, stellar dynamics, and the structures they form, from binary stars to galaxies. Topics include the night sky, stellar structure and evolution, white dwarfs, neutron stars, black holes, quasars, and the expansion of the universe. Several nighttime observing sessions are required. Intended for both science majors and non-majors who are secure in their mathematical skills. A working familiarity with algebra, trigonometry, geometry, and calculus is expected. Does not satisfy pre-med or other science departments' requirements for a second course in physics.

Prerequisite: Mathematics 161 or higher, or permission of the instructor.


The basic phenomena of the electromagnetic interaction are introduced. The basic relations are then specialized for a more detailed study of linear circuit theory. Laboratory work stresses the fundamentals of electronic instrumentation and measurement with basic circuit components such as resistors, capacitors, inductors, diodes, and transistors. Three hours of laboratory work per week.

Prerequisite: Physics 104 or permission of the instructor.


An introduction to two cornerstones of twentieth-century physics, quantum mechanics, and special relativity. The introduction to wave mechanics includes solutions to the time-independent Schrödinger equation in one and three dimensions with applications. Topics in relativity include the Galilean and Einsteinian principles of relativity, the “paradoxes” of special relativity, Lorentz transformations, space-time invariants, and the relativistic dynamics of particles. Not open to students who have credit for or are concurrently taking Physics 275, 310, or 375.

Prerequisite: Physics 104 or permission of the instructor.
229a. **Statistical Physics.** Every spring. Spring 2010. MADELEINE MSALL.

Develops a framework capable of predicting the properties of systems with many particles. This framework, combined with simple atomic and molecular models, leads to an understanding of such concepts as entropy, temperature, and chemical potential. Some probability theory is developed as a mathematical tool.

Prerequisite: **Physics 104** or permission of the instructor.

235a. **Engineering Physics.** Every other spring. Spring 2010. DALE SYPHERS.

Examines the physics of materials from an engineering viewpoint, with attention to the concepts of stress, strain, shear, torsion, bending moments, deformation of materials, and other applications of physics to real materials, with an emphasis on their structural properties. Also covers recent advances, such as applying these physics concepts to ultra-small materials in nano-machines. Intended for physics majors and architecture students with an interest in civil or mechanical engineering or applied materials science.

Prerequisite: **Physics 104** or permission of the instructor.

240a. **Modern Electronics.** Every other spring. Spring 2011. THE DEPARTMENT.

A brief introduction to the physics of semiconductors and semiconductor devices, culminating in an understanding of the structure of integrated circuits. Topics include a description of currently available integrated circuits for analog and digital applications and their use in modern electronic instrumentation. Weekly laboratory exercises with integrated circuits.

Prerequisite: **Physics 103 or 104**, or permission of the instructor.

250a - MCSR. **Acoustics.** Every other fall. Fall 2009. MADELEINE MSALL.

An introduction to the motion and propagation of sound waves. Covers selected topics related to normal modes of sound waves in enclosed spaces, noise, acoustical measurements, the ear and hearing, phase relationships between sound waves, and many others, providing a technical understanding of our aural experiences.

Prerequisite: **Physics 104** or permission of the instructor.

251a. **Physics of Solids.** Every other spring. Spring 2010. DALE SYPHERS.

Solid state physics describes the microscopic origin of the thermal, mechanical, electrical and magnetic properties of solids. Examines trends in the behavior of materials and evaluates the success of classical and semi-classical solid state models in explaining these trends and in predicting material properties. Applications include solid state lasers, semiconductor devices and superconductivity. Intended for physics, geology, or chemistry majors with an interest in materials physics or electrical engineering.

Prerequisite: **Physics 104** or permission of the instructor.

[257a. **Atmosphere and Ocean Dynamics.** (Same as Environmental Studies 253 and Geology 257.)]

262a. **Astrophysics.** Every other fall. Fall 2010. THE DEPARTMENT.

A quantitative discussion that introduces the principal topics of astrophysics, including stellar structure and evolution, planetary physics, and cosmology.

Prerequisite: **Physics 104** or permission of the instructor.

280a. **Nuclear and Particle Physics.** Every other spring. Spring 2011. THE DEPARTMENT.

An introduction to the physics of subatomic systems, with a particular emphasis on the standard model of elementary particles and their interactions. Basic concepts in quantum mechanics and special relativity are introduced as needed.

Prerequisite: **Physics 104** or permission of the instructor.

Topics to be arranged by the student and the faculty. If the investigations concern the teaching of physics, this course may satisfy certain of the requirements for the Maine State Teacher’s Certificate. Students doing independent study normally have completed a 200-level physics course.


Mathematics is the language of physics. Similar mathematical techniques occur in different areas of physics. A physical situation may first be expressed in mathematical terms, usually in the form of a differential or integral equation. After the formal mathematical solution is obtained, the physical conditions determine the physically viable result. Examples are drawn from heat flow, gravitational fields, and electrostatic fields.

Prerequisite: Physics 104 and Mathematics 181, or permission of the instructor.


Intended to provide advanced students with experience in the design, execution, and analysis of laboratory experiments. Projects in optical holography, nuclear physics, cryogenics, and materials physics are developed by the students.

Prerequisite: Physics 223 or permission of the instructor.


An introduction to the use of computers to solve problems in physics. Problems are drawn from several different branches of physics, including mechanics, hydrodynamics, electromagnetism, and astrophysics. Numerical methods discussed include the solving of linear algebra and eigenvalue problems, ordinary and partial differential equations, and Monte Carlo techniques. Basic knowledge of a programming language is expected.

Prerequisite: Physics 104 or permission of the instructor.


A mathematically rigorous development of quantum mechanics, emphasizing the vector space structure of the theory through the use of Dirac bracket notation. Linear algebra will be developed as needed.

Prerequisite: Physics 224 and 300, or permission of the instructor.


First the Maxwell relations are presented as a natural extension of basic experimental laws; then emphasis is given to the radiation and transmission of electromagnetic waves.

Prerequisite: Physics 223 and 300, or permission of the instructor.


A rigorous treatment of the earth’s climate, based on physical principles. Topics include climate feedbacks, sensitivity to perturbations, and the connections between climate and radiative transfer, atmospheric composition, and large-scale circulation of the oceans and atmospheres. Anthropogenic climate change will also be studied. (Same as Environmental Studies 357 and Geology 357.)

Prerequisite: Physics 229, 255, 256, or 300, or permission of the instructor.


A thorough review of particle dynamics, followed by the development of Lagrange’s and Hamilton’s equations and their applications to rigid body motion and the oscillations of coupled systems.

Prerequisite: Physics 300 or permission of the instructor.
First discusses special relativity, introducing the concept of four-dimensional spacetime. Then develops the mathematical tools to describe spacetime curvature, leading to the formulation of Einstein’s equations of general relativity. Finishes by studying some of the most important astrophysical consequences of general relativity, including black holes, neutron stars, and gravitational radiation.  
Prerequisite: Physics 300 or permission of the instructor.

401a–404a. Advanced Independent Study in Physics. The Department.  
Topics to be arranged by the student and the faculty. Students doing advanced independent study normally have completed a 300-level physics course.

451a–452a. Honors in Physics. The Department.  
Programs of study are available in semiconductor physics, microfabrication, superconductivity and superfluidity, astrophysics, relativity, ultrasound, and atmospheric physics. Work done in these topics normally serves as the basis for an honors paper.  
Prerequisite: Permission of the instructor.

Psychology

Samuel P. Putnam, Department Chair  
Donna M. Trout, Senior Department Coordinator

Professors: Barbara S. Held, Louisa M. Słowiackz
Associate Professors: Suzanne Lovett, Samuel P. Putnam, Paul E. Schaffner,  
Richmond R. Thompson (Neuroscience)  
Assistant Professor: Seth J. Ramus (Neuroscience)  
Visiting Faculty: Julie Quimby  
Lecturer: Diane W. Lee

Students in the Department of Psychology may elect a major within the psychology program, or they may elect an interdisciplinary major in neuroscience, sponsored jointly by the Departments of Psychology and Biology (see Neuroscience, pages 233–34). The program in psychology examines contemporary perspectives on principles of human behavior, in areas ranging from cognition, language, development, and behavioral neuroscience to interpersonal relations and psychopathology. Its approach emphasizes scientific methods of inquiry and analysis.

Requirements for the Major in Psychology
The psychology major comprises ten courses. These courses are selected by students with their advisors and are subject to departmental review. Each student must take three core courses: an introductory course, Psychology 101, which will serve as a prerequisite to further study in the major; and Psychology 251 and 252. These core courses should be completed before the junior year. Students must take three electives numbered 200 or higher. Finally, students must take laboratory and advanced courses. Students have the option of taking either (a) two laboratory courses numbered 260–279 and two advanced (300-level) courses, or (b) three laboratory courses numbered 260–279 and one advanced (300-level) course. Note that either Psychology 275 or 276, but not both, may count toward the two- or three-course laboratory-requirement options. Similarly, either Psychology 320 or 321, but not both, may count toward the two-advanced-course-requirement option; and no more than one course from among Psychology 315, 316, 318, and 319 may count toward the two-advanced-course-