

PHYSICS

Susan Lehman, Chair

Shila Garg

Cody Leary

Karen Lewis

John Lindner

Why is the sky blue? Why is water wet? In seeking to understand natural phenomena as simply as possible, physicists have made a remarkable discovery: whatever questions they ask the answers ultimately involve the *same* elegant principles of energy and momentum, mass and charge. Physicists seek and study rhythms and patterns among natural phenomena, including those that are readily apparent (like the orbits of planets) and those that are apparent only to deep analysis and careful observation (like the quantum fluctuations of atoms). Abetted by the power of mathematics, they ultimately comprehend and express the fundamental regularities of the physical universe in uniquely human metaphors. In this way, the universe comes to know itself in human terms.

A Physics major provides a rigorous grounding in the scientific process and a firm scientific understanding of the world. It fosters critical thinking and provides broad practical training in science and technology. It can lead to graduate study and basic research (in a variety of disciplines), to stimulating jobs in industry, or to challenging and rewarding careers in teaching. Our faculty is engaged in original research, and our students are drawn early into collaborative research projects with faculty.

Major in Physics

Consists of fifteen courses:

- MATH 11100
- MATH 11200
- MATH 21200
- PHYS 20300
- PHYS 20400
- PHYS 20500
- One of the following courses: PHYS 22000 or 23000
- PHYS 20800
- PHYS 30100
- PHYS 30200
- PHYS 30400
- One of the following courses: PHYS 30300, 30500, 32000, 35000, or 37700
- Junior Independent Study: PHYS 40100
- Senior Independent Study: PHYS 45100
- Senior Independent Study: PHYS 45200

Minor in Physics

Consists of six courses:

- PHYS 20300
- PHYS 20400
- PHYS 20500
- Three elective Physics courses, only one of which can be PHYS 11000, 12100, or 12200

Special Notes

- The Foundations sequence PHYS 20300, 20400 is a prerequisite for the selection of Physics as a major and is best taken the first year, although one can still complete the major if the sequence is taken the second year.
- The Calculus sequence MATH 11100, 11200 must be taken at least concurrently with the Foundations sequence, although MATH 10700, 10800 may substitute for MATH 11100.
- Those students considering graduate study in physics should also take PHYS 35000, MATH 21100, CHEM 11000, 12000, and as many advanced Physics courses as can be scheduled.
- Those students considering astronomy or astrophysics as a career should major in Physics and take PHYS 12100, 12200, and 32000.
- For students interested in engineering, Physics is a natural basis for 3-2 engineering programs, which are described under *Pre-Professional and Dual Degree Programs*. However, such students must complete enough physics in three years to complete the major in the fourth year, if necessary.
- PHYS 10100, 10200, 11000, 12100, and 12200 do not count toward a Physics major (except by special permission of the department).
- **Advanced Placement:** A student may receive credit if a score of 4 or 5 is obtained on any of the following AP examinations:
 - Physics B
 - Physics C: Mechanics
 - Physics C: Electricity and Magnetism.
- Students need to check with the chairperson of the department to determine whether they will receive one or two credits toward graduation and at what level they should begin their college Physics courses. The advanced placement policy of the College is explained in the section on *Admission*. Students who have taken a college level physics course (other than Advanced Level or AP Exam) and would like to place beyond the first Physics course need to take a placement exam that the chairperson administers.
- No student may receive credit for both PHYS 10100 and 20300 or PHYS 10200 and 20400.
- The laboratory and classroom components are closely integrated in Physics courses with a laboratory and must therefore be taken concurrently. The course grade and the laboratory grade will be identical and are based on performance in both components; the relative weight of the two components will be stated in each course syllabus.
- Physics majors cannot use S/NC grading option for the required courses, and the department recommends they not use it for any course in Physics, Mathematics, or Chemistry.
- Physics minors can use the S/NC grading option for no more than two of the required courses.
- Only grades of C- or better are accepted for the major or minor.

PHYSICS COURSES

PHYS 10100. GENERAL PHYSICS (Communication)

Mechanics, heat, wave motion and sound. For students who do not intend to major in physics. Students who have completed one semester of calculus with a grade of C+ or better should take PHYS 20300. Three hours per week plus laboratory. Knowledge of algebra and trigonometry is expected. (1.25 course credits) Annually. Fall. [Q, MNS]

PHYS 10200. GENERAL PHYSICS

Optics, electricity and magnetism, and atomic and nuclear physics. Three hours per week plus laboratory. (1.25 course credits) Prerequisite: PHYS 10100. Annually. Spring. [Q, MNS]

PHYS 11000. PHYSICS REVOLUTIONS

Designed for non-science majors, this course explores how physics has revolutionized our understanding of the natural world. Revolutions include the unification of the terrestrial and the celestial in Newton's Mechanics; of electricity, magnetism and light in Maxwell's Electromagnetism; of space and time in Einstein's Theory of Relativity; of particles and waves in Quantum Mechanics. No mathematics beyond high school algebra is assumed. Three hours per week. Fall 2012. [Q, MNS]

PHYS 12100. ASTRONOMY OF STARS AND GALAXIES

The brilliant and sometimes fuzzy objects in the night sky are dynamic, volatile stars and gigantic galaxies. We will study the general properties of stars as well as how they evolve from birth to death. We will also study the shape and composition of galaxies and the ultimate fate of our universe. Knowledge of high school algebra and trigonometry is expected. Three hours per week. Spring 2013. [Q, MNS]

PHYS 12200. ASTRONOMY OF THE SOLAR SYSTEM

In just one generation, space exploration has revolutionized our understanding of the solar system. Planets, moons, asteroids and comets have been transformed from obscure and remote objects with mythical names to remarkable and detailed real worlds. In this course, we will study the surprising new solar system that the Space Age continues to reveal. Knowledge of high school algebra and trigonometry is expected. Three hours per week. Fall 2012. [MNS]

PHYS 20300. FOUNDATIONS OF PHYSICS

Quantitative development of classical mechanics and thermodynamics. For students who intend to major in physics or chemistry or attend a professional school. Three hours per week plus laboratory. (1.25 course credits.) Prerequisite: MATH 11100 (may be taken concurrently; MATH 10700-10800 may substitute for MATH 11100, but taking MATH 10700 concurrently with PHYS 20300 will defer PHYS 20400 to the next academic year). Annually. Fall. [Q, MNS]

PHYS 20400. FOUNDATIONS OF PHYSICS

Quantitative development of classical electromagnetism and optics. Three hours per week plus laboratory. (1.25 course credits) Prerequisite: PHYS 20300, and MATH 11200 must be taken at least concurrently. Annually. Spring. [Q, MNS]

PHYS 20500. MODERN PHYSICS

Space-time physics (relativity, gravitation) and quantum physics (the microworld). Three hours per week plus laboratory. (1.25 course credits) Prerequisite: PHYS 20400 or PHYS 10200 with permission of the instructor. Annually. Fall. [W, Q, MNS]

PHYS 20800. MATHEMATICAL METHODS FOR THE PHYSICAL SCIENCES

Introduces skills of differential equations, linear algebra, and Fourier analysis essential to the physical sciences and engineering. Three hours per week. Prerequisite: MATH 11200 and PHYS 20400 or permission of the instructor. Annually. Spring.

PHYS 22000. ELECTRONICS FOR SCIENTISTS

An introduction to the principles and applications of circuit components, operational amplifiers, oscillators, digital logic, analog-to-digital and digital-to-analog, and an introduction to LabVIEW. Three hours per week plus laboratory. (1.25 course credits) Prerequisite: PHYS 10200 or 20400 or permission of the instructor. Not offered 2012-2013. [Q, MNS]

PHYS 23000. COMPUTATIONAL PHYSICS

A project-based introduction to computer simulation that develops increasingly sophisticated numerical models of physical systems in parallel with proficiency in either a modern computer language like C++ or in computational software like Mathematica. Three hours per week plus laboratory. (1.25 course credits) Prerequisite: PHYS 20500 (may be taken concurrently) or permission of the instructor. Alternate years. Spring 2013.

PHYS 30100. MECHANICS

Viscous forces, harmonic motion, rigid bodies, gravitation and small oscillations in Newtonian mechanics, Lagrange and Hamilton formulations, computer simulation and numerical methods. Three hours per week. Prerequisite: PHYS 20300 and MATH 21200, PHYS 20800 or permission of the instructor. Fall 2012.

PHYS 30200. THERMAL PHYSICS

Classical and quantum treatment of problems in thermodynamics and statistical mechanics. Three hours per week. *Prerequisite: PHYS 20500. Alternate years. Fall 2012.*

PHYS 30300. MODERN OPTICS

An introductory course in the basic concepts, principles, and theories of modern optics, including lasers. Topics include wave optics, light and matter interactions, basic laser principles, holography, and specific optical systems. Three hours per week. *Prerequisite: PHYS 20500. Not offered 2012-2013.*

PHYS 30400. ELECTRICITY AND MAGNETISM

Introduction to classical field theory and Maxwell's equations of electromagnetism. Three hours per week. *Prerequisite: PHYS 20400, 20800, MATH 21200, or permission of the instructor. Alternate years. Spring 2013.*

PHYS 30500. PARTICLE PHYSICS

An introduction to the concepts and techniques of nuclear and elementary particle physics. Three hours per week. *Prerequisite: PHYS 20500. Every three years. Spring 2013.*

PHYS 32000. ASTROPHYSICS

A quantitative introduction to astronomy and astrophysics. Topics include classical astronomy; stellar structure, stellar atmospheres, and stellar evolution; galactic structure, cosmology, and cosmogony. Emphasis will be on quantitative application of physical theory to astronomical phenomena. Three hours per week. *Prerequisite: PHYS 20500. Every three years. Not offered 2012-2013.*

PHYS 35000. QUANTUM MECHANICS

A rigorous introduction to the formalism and interpretation of microworld physics. Probability amplitudes, interference and superposition, identical particles and spin, 2-state systems, Schrodinger evolution, applications. Three hours per week. *Prerequisite: PHYS 20500 and 20800, MATH 21200, or permission of the instructor. Alternate years. Not offered 2012-2013.*

PHYS 37700-37705. SELECTED TOPICS

Condensed Matter, Nonlinear Dynamics, General Relativity, Introduction to Quantum Field Theory, and others offered when sufficient student interest is shown. *For Fall 2012 the topic is Nonlinear Dynamics.*

PHYS 40000. TUTORIAL

Prerequisite: The approval of both the supervising faculty member and the chairperson is required prior to registration.

PHYS 40100. INDEPENDENT STUDY

Laboratory investigations in Mechanics, Thermal Physics, Optics, Quantum, Electricity and Magnetism. Techniques of statistics and data analysis, library utilization, computer interfacing and simulation are explored. One hour per week plus two laboratories. *Prerequisite: PHYS 20800 and one of the following: PHYS 30100, 30200, or 30400. Annually. Spring.*

PHYS 45100. INDEPENDENT STUDY THESIS – SEMESTER ONE

The first semester of the Senior Independent Study project, in which each student engages in creative and independent research guided by a faculty mentor and which culminates in a thesis and an oral examination in the second semester. *Prerequisite: PHYS 40100.*

PHYS 45200. INDEPENDENT STUDY THESIS – SEMESTER TWO

The second semester of the Senior Independent Study project, which culminates in the thesis and an oral examination. *Prerequisite: PHYS 45100.*