

# Applied Physics

**Director of undergraduate studies:** Daniel Prober (daniel.prober@yale.edu), 417 BCT, 432-4280; appliedphysics.yale.edu

Physics is the study of the fundamental laws of nature. Applied physics uses these laws to understand phenomena that have practical applications. Engineering in turn makes use of these phenomena for human purposes. Applied physics thus forms a link between the fundamental laws of nature and their applications. Students majoring in Applied Physics take courses in both physics and engineering, as well as courses specifically in applied physics. Students completing the program in Applied Physics are prepared for graduate study in applied physics, in physics, in nanoscience, or in engineering, and, with appropriate prerequisites, in medicine; or they may choose careers in a wide range of technical and commercial fields, or in fields such as technical writing or patent law that draw on interdisciplinary subjects.

Contemporary physical science and engineering are becoming increasingly interdisciplinary. Traditional boundaries between fields have blurred, and new areas are constantly emerging, e.g., nanotechnology. The Applied Physics major provides a flexible framework on which students can build a curriculum tailored to their own interests, in consultation with the director of undergraduate studies (DUS).

## PREREQUISITES

During their first year, students interested in Applied Physics should start by taking courses in mathematics, and in physics if possible, appropriate to their level of preparation. The choice between different starting points is generally made based on performance on Advanced Placement tests. The multiplicity of choices facing students interested in this general area indicates the importance of informed advice for first-year students. Students should consult freely with DUSs and individual faculty members in their departments of interest to optimize choices and to ensure maximum flexibility at the time a major is selected.

The required prerequisites for students interested in Applied Physics include two physics courses and one physics lab; APHY 1510 or MATH 1200; and PHYS 4000 (or APHY 1940 with either MATH 2220 or MATH 2250 or MATH 2260).

The recommended starting courses in physics are PHYS 2000 and 2010. These courses should be taken in the first year by students who have a strong preparation in mathematics and physics. Students with a particularly strong background in physics and mathematics may take PHYS 2600 and 2610 instead. Students who are less well prepared in physics and mathematics may choose to take PHYS 1800 and 1810 during their first year, or PHYS 2000 and 2010 during their sophomore year after they have taken additional mathematics courses. One laboratory course, PHYS 1660L or 2060L, should be taken at some time during the first or second year.

## REQUIREMENTS OF THE MAJOR

The major in Applied Physics requires eight courses beyond the introductory sequence. Two of these must be APHY 4710 and 4720. All majors are also required to take APHY 3220, APHY 4390 or PHYS 4400, and APHY 4200, or equivalents. The three remaining advanced courses should comprise an area of focus. For example, a student interested in solid-state and/or quantum electronics might choose from APHY 3210,

4480, 4490, ECE 3200, and 3250. A student interested in the physics of materials and/or nanoscience might choose from APHY 4480, 4490, CHEM 2200, and MENG 2615. Many other focus areas are possible.

**Credit/D/Fail** No more than one course taken Credit/D/Fail may be applied toward the requirements of the major with permission of the DUS. The senior special projects, APHY 4710 and 4720, may only be taken for a letter grade.

**Outside credit** Courses taken at another institution or during an approved summer or term-time study abroad program may count toward the major requirements with DUS approval.

#### SENIOR REQUIREMENT

Seniors must complete an independent research project, taken as APHY 4710 and 4720. The independent research project is under the supervision of a faculty member in Applied Physics, Physics, Engineering, or related departments. The project may be started in the junior year and continued into the senior year. Students planning to do a research project should contact the DUS as early as possible to discuss available options and general requirements.

#### ADVISING

The Applied Physics major provides various programs corresponding to a range of student interests. Substitutions of equivalent courses may be permitted. Students interested in an Applied Physics major should contact the DUS as early as possible, and in any case by the end of their sophomore year.

A well-prepared student interested in materials physics or quantum electronics who starts the senior research in the junior year might elect the following course sequence:

First-Year	Sophomore	Junior	Senior
APHY 1510	APHY 3220	APHY 4720	APHY 4480
PHYS 2000	APHY 4390	ECE 3200	APHY 4490
PHYS 2010	PHYS 4000	APHY 4200	APHY 4710
PHYS 2060L			

A student interested in alternative energy who starts physics in the sophomore year and conducts research in the senior year might elect:

First-Year	Sophomore	Junior	Senior
MATH 1200	PHYS 2000	APHY 3220	APHY 4480
	PHYS 2010	APHY 4390	APHY 4710
	PHYS 2060L	ECE 3200	APHY 4720
	PHYS 4000	APHY 4200	ECE 4061

#### REQUIREMENTS OF THE MAJOR

**Prerequisites** PHYS 1800, 1810, or PHYS 2000, 2100, with appropriate math coreqs and PHYS 1660L or 2060L; APHY 1510 or MATH 1200; PHYS 4000 (or APHY 1940 with either MATH 2220 or MATH 2250 or MATH 2260)

**Number of courses** 8 term courses beyond prereqs (incl senior req)

**Distribution of courses** 3 adv courses in physical or mathematical sciences or engineering in area of focus, with DUS approval

**Specific courses required** APHY 3220, 4390 or PHYS 4400, and APHY 4200, or equivalents

**Substitution permitted** Any relevant course approved by DUS

**Senior requirement** APHY 4710 and 4720

#### FACULTY OF THE DEPARTMENT OF APPLIED PHYSICS

**Professors** Charles Ahn, †Sean Barrett, Hui Cao, Michel Devoret, Paul Fleury (*Emeritus*), †Steven Girvin, †Leonid Glazman, †Jack Harris, Victor Henrich (*Emeritus*), Sohrab Ismail-Beigi, Simon Mochrie, †Corey O'Hern, Vidvuds Ozolins, Daniel Prober, Nicholas Read, Peter Schiffer, Robert Schoelkopf, †Ramamurti Shankar, †Mitchell Smooke, A. Douglas Stone, †Hongxing Tang, Robert Wheeler (*Emeritus*), Werner Wolf (*Emeritus*)

**Associate Professors** †Michael Choma, Peter Rakich

**Assistant Professors** Yu He, Owen Miller, Shruti Puri

†A joint appointment with primary affiliation in another department.