APPLIED PHYSICS

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

PREREQUISITES AND INTRODUCTORY COURSES

During their first year, students interested in Applied Physics should start by taking courses in mathematics, and physics if possible, appropriate to their level of preparation. The choice between different starting points is generally made on the basis of performance on Advanced Placement tests; see the First-year Student Website for more information.

The recommended sequence in mathematics for students interested in Applied Physics or Electrical or Mechanical Engineering is APHY 151, MATH 222, and APHY 194. MATH 120 is an acceptable alternative to APHY 151 and MATH 225 is an acceptable alternative to MATH 222. Similarly, PHYS 301 may be substituted for APHY 194 or MATH 222.

The recommended starting courses in physics are PHYS 200 and 201. 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 260 and 261 instead. Students who are less well prepared in physics and mathematics may choose to take PHYS 180 and 181 during their first year, or PHYS 200 and 201 during their sophomore year after they have taken more mathematics courses. Two laboratory courses, such as PHYS 205L and 206L, should be taken at some time during the first or second year.

Because computers are ubiquitous in the practical applications of physics, students interested in Applied Physics should also take a course on the use of computers early in their studies. ENAS 130 is recommended; a comparable course in computer science may be substituted with the approval of the director of undergraduate studies.

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 directors of undergraduate studies and individual faculty members in their departments of interest to optimize choices and to ensure maximum flexibility at the time a major is selected.

REQUIREMENTS OF THE MAJOR

The major in Applied Physics requires eight courses beyond the introductory sequence. Two of these must be APHY 471, 472. All majors are also required to take APHY 322, 439, and PHYS 420, or equivalents. The three remaining advanced courses should focus on a particular area of concentration. For example, a student interested in solid-state and/or quantum electronics might choose from APHY 321, 448, 449, EENG 320, and 325. A student interested in the physics of materials and/or nanoscience might choose from APHY 448, 449, CHEM 230, 450, and MENG 285. Many other concentrations are possible.

SENIOR REQUIREMENT

Seniors must complete an independent research project, taken as APHY 471 and 472. 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 director of undergraduate studies as early as possible to discuss available options and general requirements.

ADVISING

The Applied Physics major provides for 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 director of undergraduate studies as early as possible, and in any case by the end of the 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:

<table>
<thead>
<tr>
<th>First-Year</th>
<th>Sophomore</th>
<th>Junior</th>
<th>Senior</th>
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<tbody>
<tr>
<td>APHY 151</td>
<td>APHY 194</td>
<td>APHY 439</td>
<td>APHY 448</td>
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<tr>
<td>MATH 222</td>
<td>APHY 322</td>
<td>APHY 472</td>
<td>APHY 449</td>
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<tr>
<td>PHYS 200</td>
<td>ENAS 130</td>
<td>EENG 320</td>
<td>APHY 471</td>
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<td>PHYS 201</td>
<td>PHYS 206L</td>
<td>PHYS 420</td>
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<td>PHYS 205L</td>
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A student interested in alternative energy who starts physics in the sophomore year and conducts research in the senior year might elect:

<table>
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<th>Senior</th>
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<tbody>
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<td>APHY 322</td>
<td>APHY 448</td>
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<td>MATH 120</td>
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<td>PHYS 205L</td>
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<td>ENAS 130</td>
<td>EENG 406</td>
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REQUIREMENTS OF THE MAJOR

**Prerequisites**  
PHY 180, 181, or 200, 201, with appropriate math coreqs and 2 lab courses as specified; APHY 151 or MATH 120; MATH 222 or MATH 225 or PHYS 301; and APHY 194, or PHYS 301; ENAS 130

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

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

**Specific courses required**  APHY 322, 439, PHYS 420

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

**Senior requirement**  APHY 471 and 472 or equivalent

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FACULTY OF THE DEPARTMENT OF APPLIED PHYSICS

**Professors**  Charles Ahn, †Sean Barrett, Hui Cao, Richard Chang (Emeritus), Michel Devoret, Paul Fleury (Emeritus), †Steven Girvin, †Leonid Glazman, Victor Henrich, Sohrab Ismail-Beigi, †Marshall Long, †Tso-Ping Ma, Simon Mochrie, Vidvuds Ozolins, Daniel Prober, Nicholas Read, †Mark Reed, Robert Schoelkopf, †Ramamurti Shankar, †Mitchell Smooke, A. Douglas Stone, †Hongxing Tang, Robert Wheeler (Emeritus), Werner Wolf (Emeritus)

**Associate Professors**  †Jack Harris, †Corey O’Hern

**Assistant Professors**  †Michael Choma, Liang Jiang, Owen Miller, Peter Rakich

†A joint appointment with primary affiliation in another department.