PHYSICS: CHEMICAL PRINCIPLES, BA

Physics and astronomy are fundamental sciences aimed at discovering the basic principles that govern our universe. Physicists study the interplay between space, time, matter, and energy. Complex behavior in nature is explained in terms of elementary relations between constituent elements and the forces that bind them, over distances ranging from subatomic to cosmic scale. Astronomy encompasses the entire physical universe beyond the earth: the solar system, stars, galaxies, galaxy clusters and superclusters, quasars, and the large-scale structure of the universe. The basic tools in physics and astronomy are mathematics and experimental investigation and observation of the world around us.

At Penn, the curriculum for undergraduate Physics majors, which includes extensive laboratory experience, is based on faculty strengths in Condensed Matter Physics, Elementary Particle Physics, and Astrophysics. Undergraduate teaching is linked to faculty research efforts in these areas, and participation by undergraduates in research is strongly encouraged.

This concentration is particularly appropriate for students planning to enter the health professions. Such students should be aware that, although not part of the concentration requirements, laboratories in general and organic chemistry and lecture and laboratory work in biology are generally required by professional schools in the health area. The concentration may also be appropriate for other students pursuing double majors in Physics and Chemistry or Biochemistry.

The minimum total course units (https://www.college.upenn.edu/credits-needed-major) for graduation in this major is 36. Double majors may entail more course units.

Note: For Biology concentration, see Biophysics track outlined below.

For more information: http://www.physics.upenn.edu/

For information about the General Education requirements, please visit the College of Arts & Sciences Curriculum (https://www.college.upenn.edu/curriculum) page.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Course Units</th>
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</thead>
<tbody>
<tr>
<td>PHYS 411</td>
<td>Introduction to Quantum Mechanics I</td>
<td>1</td>
</tr>
<tr>
<td>PHYS 150</td>
<td>Principles of Physics I: Mechanics and Wave Motion</td>
<td>1.5</td>
</tr>
<tr>
<td>or PHYS 170</td>
<td>Honors Physics I: Mechanics and Wave Motion</td>
<td></td>
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<tr>
<td>PHYS 151</td>
<td>Principles of Physics II: Electromagnetism and Radiation</td>
<td>1.5</td>
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<tr>
<td>or PHYS 171</td>
<td>Honors Physics II: Electromagnetism and Radiation</td>
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Concentration Requirements

Select one of the following Concentrations: 5

Chemical Principles Concentration:

- CHEM 101 General Chemistry I
- CHEM 102 General Chemistry II
- CHEM 221 Physical Chemistry I & CHEM 222 physical Chemistry II
- PHYS 401 Thermodynamics and the Introduction to Statistical Mechanics and Kinetic Theory

Biology Concentration: Biophysics Track Requirements:

- BIOL 121 Introduction to Biology - The Molecular Biology of Life
- BIOL 221 Molecular Biology and Genetics
- BIOL 251 Molecular and Cellular Neurobiology
- BIOL 404 Immunobiology
- PHYS 280 Physical Models of Biological Systems

Total Course Units 36

You may count no more than one course toward both a Major and a Sector requirement. For Exceptions, check the Policy Statement (http://www.college.upenn.edu/sectors-policy).

Honors

Applicants must have a minimum GPA of 3.3 in major-related courses.

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>PHYS 499</td>
<td>Senior Honor Thesis (Semester 1)</td>
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<tr>
<td>PHYS 499</td>
<td>Senior Honor Thesis (Semester 2)</td>
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</table>

Thesis Accepted

The degree and major requirements displayed are intended as a guide for students entering in the Fall of 2019 and later. Students should consult with their academic program regarding final certifications and requirements for graduation.