The goal of physics and astronomy is a unified description of the properties of matter and energy. The study of matter and energy encompasses a range of phenomena, from the subnuclear to the cosmological. Physics seeks to understand the way the universe “works,” from the very small scale (quarks and neutrinos) to the human scale (materials encountered in daily life) to the very large (the structure of the cosmos). Different approaches and technologies are used in these different regimes.

Department Programs

Majors

• Physics Major, B.A. (p. 1)
• Physics Major, B.S. (http://catalog.unc.edu/undergraduate/programs-study/physics-major-bs)

Minors

• Astronomy Minor (http://catalog.unc.edu/undergraduate/programs-study/astronomy-minor)
• Physics Minor (http://catalog.unc.edu/undergraduate/programs-study/physics-minor)

Graduate Programs

• M.S. in Physics (http://catalog.unc.edu/graduate/departments/physics-astronomy)
• Ph.D. in Physics (http://catalog.unc.edu/graduate/departments/physics-astronomy)

Student Learning Outcomes

Upon completion of the physics program, students should be able to:

• Demonstrate knowledge of major concepts, theoretical reasoning, and empirical findings in physics and/or astronomy — Knowledge Base in Physics
• Apply knowledge of physics and mathematics to solve problems — Critical Thinking and Problem Solving
• Effectively conduct research under guidance of faculty member — Research and the Advancement of Physics and Astronomy
• Gain entry to top graduate programs, employment as physicists in industry, teaching positions in high school physics and astronomy, or apply their skills in other rewarding careers — Preparation for Future Career

Requirements

In addition to the program requirements, students must

• attain a final cumulative GPA of at least 2.0
• complete a minimum of 45 academic credit hours earned from UNC–Chapel Hill courses
• take at least half of their major course requirements (courses and credit hours) at UNC–Chapel Hill
• earn a minimum of 18 hours of C or better in the major core requirements (some majors require 21 hours).

For more information, please consult the degree requirements section of the catalog (http://catalog.unc.edu/undergraduate/general-education-curriculum-degree-requirements/#degreerequirements).
**Physica Major, B.A. – Astronomy Option**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>PHYS 118</td>
<td>Introductory Calculus-based Mechanics and Relativity</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 119</td>
<td>Introductory Calculus-based Electromagnetism and Quanta</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 201</td>
<td>Basic Mechanics ¹</td>
<td>3</td>
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<tr>
<td>or PHYS 401</td>
<td>Mechanics I</td>
<td></td>
</tr>
<tr>
<td>PHYS 211</td>
<td>Intermediate Electromagnetism ²</td>
<td>3</td>
</tr>
<tr>
<td>or PHYS 311</td>
<td>Electromagnetism I</td>
<td></td>
</tr>
<tr>
<td>PHYS 281L</td>
<td>Experimental Techniques in Physics</td>
<td>2</td>
</tr>
<tr>
<td>PHYS 331</td>
<td>Numerical Techniques for the Sciences I</td>
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<td>PHYS 295</td>
<td>Research with Faculty Mentor I</td>
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<td>PHYS 395</td>
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<tr>
<td>PHYS 585</td>
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<tr>
<td>PHYS 691H</td>
<td>Senior Honor Thesis Research I</td>
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<td>PHYS 692H</td>
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**Additional Requirements**

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<td>Introduction to Astronomy: The Solar System ²</td>
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<td>ASTR 101L</td>
<td>Introduction to Astronomy Laboratory: Our Place in Space</td>
<td>1</td>
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<td>or ASTR 111L</td>
<td>Educational Research in Radio Astronomy</td>
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<td>ASTR 202</td>
<td>Introduction to Astrophysics ²</td>
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<td>MATH 231</td>
<td>Calculus of Functions of One Variable I ²</td>
<td>4</td>
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<tr>
<td>MATH 232</td>
<td>Calculus of Functions of One Variable II ²</td>
<td>4</td>
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<tr>
<td>MATH 233</td>
<td>Calculus of Functions of Several Variables ²</td>
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<tr>
<td>MATH 383</td>
<td>First Course in Differential Equations ²</td>
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</table>

**Total Hours**

- 51

**Notes:**

- Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

  1. Spring course.
  2. Fall course.

---

**Physics Major, B.A. – Biological Physics Option**

<table>
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<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>PHYS 118</td>
<td>Introductory Calculus-based Mechanics and Relativity</td>
<td>4</td>
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<tr>
<td>PHYS 119</td>
<td>Introductory Calculus-based Electromagnetism and Quanta</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 201</td>
<td>Basic Mechanics ¹</td>
<td>3</td>
</tr>
<tr>
<td>or PHYS 401</td>
<td>Mechanics I</td>
<td></td>
</tr>
<tr>
<td>PHYS 211</td>
<td>Intermediate Electromagnetism ²</td>
<td>3</td>
</tr>
<tr>
<td>or PHYS 311</td>
<td>Electromagnetism I</td>
<td></td>
</tr>
<tr>
<td>PHYS 281L</td>
<td>Experimental Techniques in Physics</td>
<td>2</td>
</tr>
<tr>
<td>PHYS 331</td>
<td>Numerical Techniques for the Sciences I</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 405</td>
<td>Biological Physics ²</td>
<td>3</td>
</tr>
<tr>
<td>or CHEM 481</td>
<td>Physical Chemistry I</td>
<td></td>
</tr>
<tr>
<td>PHYS 585</td>
<td>Imaging Science: From Cells to Stars (capstone)</td>
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**Additional Requirements**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>BIOL 101</td>
<td>Principles of Biology ³</td>
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<td>CHEM 101 &amp; 101L</td>
<td>General Descriptive Chemistry I &amp; Quantitative Chemistry Laboratory I</td>
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<tr>
<td>CHEM 102 &amp; 102L</td>
<td>General Descriptive Chemistry II &amp; Quantitative Chemistry Laboratory II ³</td>
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<tr>
<td>MATH 231</td>
<td>Calculus of Functions of One Variable I ³</td>
<td>4</td>
</tr>
<tr>
<td>MATH 232</td>
<td>Calculus of Functions of One Variable II ³</td>
<td>4</td>
</tr>
<tr>
<td>MATH 233</td>
<td>Calculus of Functions of Several Variables ³</td>
<td>4</td>
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<tr>
<td>MATH 383</td>
<td>First Course in Differential Equations ³</td>
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<tr>
<td>BIOL (numbered above 200)</td>
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<tr>
<td>CHEM 261</td>
<td>Introduction to Organic Chemistry I ³</td>
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<tr>
<td>CHEM 262</td>
<td>Introduction to Organic Chemistry II ³</td>
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<td>CHEM 430</td>
<td>Introduction to Biological Chemistry ³</td>
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<td>PHYS (numbered above 200)</td>
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**Total Hours**

- 61

**Notes:**

- Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

  1. Spring course.
  2. Fall course.

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**Physics Major, B.A. – Energy Option**

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<tbody>
<tr>
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<td>Introductory Calculus-based Mechanics and Relativity</td>
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<tr>
<td>PHYS 119</td>
<td>Introductory Calculus-based Electromagnetism and Quanta</td>
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Astronomy (ASTR) and Physics (PHYS) course descriptions (http://catalog.unc.edu/undergraduate/departments/physics-astronomy/#coursestext).

Astronomy (ASTR) and Physics (PHYS) course descriptions (http://catalog.unc.edu/undergraduate/departments/physics-astronomy/#coursestext).
### Physics Major, B.A. – Quantitative Finance Option

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<tr>
<td>PHYS 119</td>
<td>Introductory Calculus-based Electromagnetism and Quanta</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 201</td>
<td>Basic Mechanics</td>
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<tr>
<td></td>
<td>or PHYS 401 Mechanics I</td>
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<tr>
<td>PHYS 211</td>
<td>Intermediate Electromagnetism</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>or PHYS 311 Electromagnetism I</td>
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<td>PHYS 281L</td>
<td>Experimental Techniques in Physics</td>
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<tr>
<td>PHYS 331</td>
<td>Numerical Techniques for the Sciences I</td>
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<tr>
<td>PHYS 351</td>
<td>Electronics I</td>
<td>4</td>
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<tr>
<td>PHYS 581</td>
<td>Renewable Electric Power Systems</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>or PHYS 582 Decarbonding Fuels</td>
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<tr>
<td>BIOL 101</td>
<td>Principles of Biology and Introductory Biology Laboratory H</td>
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<td>BIOL 101</td>
<td>Principles of Biology and Introductory Biology Laboratory H</td>
<td>4</td>
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<tr>
<td>BIOL 202</td>
<td>Molecular Biology and Genetics H</td>
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<td></td>
<td>or BIOL 271 Plant Biology</td>
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<td>CHEM 101</td>
<td>General Descriptive Chemistry I and Quantitative Chemistry Laboratory I</td>
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<td>CHEM 102</td>
<td>General Descriptive Chemistry II H</td>
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<td>CHEM 261</td>
<td>Introduction to Organic Chemistry I H</td>
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<td>CHEM 481</td>
<td>Physical Chemistry I</td>
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<td>MATH 231</td>
<td>Calculus of Functions of One Variable I H</td>
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<tr>
<td>MATH 232</td>
<td>Calculus of Functions of One Variable II H</td>
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<td>MATH 233</td>
<td>Calculus of Functions of Several Variables H</td>
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<tr>
<td>MATH 383</td>
<td>First Course in Differential Equations H</td>
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</table>

**Total Hours: 65**

- **H** Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.
- **1** Spring course.
- **2** Fall course.

Physics (PHYS) course descriptions ([http://catalog.unc.edu/undergraduate/departments/physics-astronomy/#coursestext](http://catalog.unc.edu/undergraduate/departments/physics-astronomy/#coursestext)).

Business Administration (BUSI) course descriptions ([http://catalog.unc.edu/undergraduate/schools-college/kenan-flagler-business-school/#coursestext](http://catalog.unc.edu/undergraduate/schools-college/kenan-flagler-business-school/#coursestext)).

### Sample Plan of Study

Sample plans can be used as a guide to identify the courses required to complete the major and other requirements needed for degree completion within the expected eight semesters. The actual degree plan may differ depending on the course of study selected (second major, minor, etc.). Students should meet with their academic advisor to create a degree plan that is specific and unique to their interests. The sample plans represented in this catalog are intended for first-year students.
entering UNC–Chapel Hill in the fall term. Some courses may not be
offered every term.

### Standard Option

#### First Year

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Fall</td>
<td>MATH 231</td>
<td>Calculus of Functions of One Variable H</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>CHEM 101 &amp; 101L</td>
<td>General Descriptive Chemistry I and Quantitative Chemistry Laboratory I</td>
<td>4</td>
</tr>
<tr>
<td>Spring</td>
<td>MATH 232</td>
<td>Calculus of Functions of One Variable II H</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>CHEM 102 &amp; 102L</td>
<td>General Descriptive Chemistry II and Quantitative Chemistry Laboratory II H</td>
<td>4</td>
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#### Sophomore Year

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>Fall</td>
<td>PHYS 118</td>
<td>Introductory Calculus-based Mechanics and Relativity</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>MATH 233</td>
<td>Calculus of Functions of Several Variables H</td>
<td>4</td>
</tr>
<tr>
<td>Spring</td>
<td>PHYS 119</td>
<td>Introductory Calculus-based Electromagnetism and Quanta</td>
<td>4</td>
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<tr>
<td></td>
<td>MATH 383</td>
<td>First Course in Differential Equations H</td>
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#### Junior Year

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Fall</td>
<td>PHYS 211 or 311</td>
<td>Intermediate Electromagnetism or Electromagnetism I</td>
<td>3</td>
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<tr>
<td>Spring</td>
<td>PHYS 201 or 401</td>
<td>Basic Mechanics or Mechanics I</td>
<td>3</td>
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<tr>
<td></td>
<td>PHYS 331</td>
<td>Numerical Techniques for the Sciences I</td>
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#### Senior Year

<table>
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<th>Course Title</th>
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### Astronomy Option

#### First Year

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<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Fall</td>
<td>MATH 231</td>
<td>Calculus of Functions of One Variable II H</td>
<td>4</td>
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<tr>
<td></td>
<td>ASTR 101 &amp; 101L</td>
<td>Introduction to Astronomy: The Solar System and Introduction to Astronomy Laboratory: Our Place in Space H</td>
<td>4</td>
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<tr>
<td>Spring</td>
<td>MATH 232</td>
<td>Calculus of Functions of One Variable II H</td>
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#### Sophomore Year

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<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Fall</td>
<td>PHYS 211 or 311</td>
<td>Intermediate Electromagnetism or Electromagnetism I</td>
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<td></td>
<td>MATH 233</td>
<td>Calculus of Functions of Several Variables H</td>
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</tr>
<tr>
<td>Spring</td>
<td>PHYS 281L</td>
<td>Experimental Techniques in Physics</td>
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<tr>
<td></td>
<td>MATH 383</td>
<td>First Course in Differential Equations H</td>
<td>3</td>
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#### Junior Year

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
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<tr>
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<td>ASTR 202</td>
<td>Introduction to Astrophysics</td>
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<td>PHYS 211 or 311</td>
<td>Intermediate Electromagnetism or Electromagnetism I</td>
<td>3</td>
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<tr>
<td>Spring</td>
<td>PHYS 201 or 401</td>
<td>Basic Mechanics or Mechanics I</td>
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<tr>
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<td>Numerical Techniques for the Sciences I</td>
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#### Senior Year

<table>
<thead>
<tr>
<th>Semester</th>
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<th>Course Title</th>
<th>Hours</th>
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<tbody>
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<td>One course from ASTR (numbered above 300) and PHYS (numbered above 200)</td>
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H Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

---

1 Three credits chosen from ASTR (numbered above 300) and PHYS 231, PHYS 295, PHYS 395, PHYS 585, PHYS 691H, PHYS 692H.
### Biological Physics Option

**First Year**

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course</th>
<th>Hours</th>
</tr>
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<tbody>
<tr>
<td><strong>Fall Semester</strong></td>
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<tr>
<td>MATH 231</td>
<td>Calculus of Functions of One Variable I&lt;br&gt;(^{H})</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 101</td>
<td>Principles of Biology&lt;br&gt;(^{H})</td>
<td>3</td>
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<tr>
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<td><strong>Spring Semester</strong></td>
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<tr>
<td>PHYS 118</td>
<td>Introductory Calculus-based Mechanics and Relativity</td>
<td>4</td>
</tr>
<tr>
<td>MATH 232</td>
<td>Calculus of Functions of One Variable II&lt;br&gt;(^{H})</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 101</td>
<td>General Descriptive Chemistry I&lt;br&gt;(^{H}) and Quantitative Chemistry Laboratory I</td>
<td>4</td>
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<tr>
<td><strong>Hours</strong></td>
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**Sophomore Year**

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<th>Course</th>
<th>Hours</th>
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<tr>
<td><strong>Fall Semester</strong></td>
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<tr>
<td>PHYS 119</td>
<td>Introductory Calculus-based Electromagnetism and Quanta</td>
<td>4</td>
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<tr>
<td>MATH 233</td>
<td>Calculus of Functions of Several Variables&lt;br&gt;(^{H})</td>
<td>4</td>
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<tr>
<td>CHEM 102</td>
<td>General Descriptive Chemistry II&lt;br&gt;(^{H}) and Quantitative Chemistry Laboratory II</td>
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<tr>
<td><strong>Hours</strong></td>
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<td><strong>Spring Semester</strong></td>
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<td>PHYS 281L</td>
<td>Experimental Techniques in Physics</td>
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<td>MATH 383</td>
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<tr>
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**Junior Year**

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<tr>
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<td>PHYS 405</td>
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<td>3</td>
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<tr>
<td>Elective course(^2)</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td><strong>Hours</strong></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td><strong>Spring Semester</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYS 201 or PHYS 401</td>
<td>Basic Mechanics or Mechanics I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 331</td>
<td>Numerical Techniques for the Sciences I</td>
<td>4</td>
</tr>
<tr>
<td>Elective course(^2)</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td><strong>Hours</strong></td>
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<td>10</td>
</tr>
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</table>

**Senior Year**

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall Semester</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYS 211 or PHYS 311</td>
<td>Intermediate Electromagnetism or Electromagnetism I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 441 or CHEM 481</td>
<td>Thermal Physics or Physical Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td><strong>Hours</strong></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td><strong>Spring Semester</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHYS 585</td>
<td>Imaging Science: From Cells to Stars</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Hours</strong></td>
<td></td>
<td>61</td>
</tr>
</tbody>
</table>

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\(^{H}\) Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

\(^2\) Courses may be chosen from BIOL (numbered above 200), CHEM 261, CHEM 262, CHEM 430, PHYS (numbered above 200).
Senior Year
Fall Semester
PHYS 351  
Electronics I  
4

Spring Semester
PHYS 581  
Renewable Electric Power Systems  
or  
PHYS 582  
Decarbonizing Fuels  
3

H  Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

Quantitative Finance Option
First Year
Fall Semester
MATH 231  
Calculus of Functions of One Variable I  
H  
4
CHEM 101  
General Descriptive Chemistry I  
3

Hours  
7

Spring Semester
PHYS 118  
Introductory Calculus-based Mechanics and Relativity  
4
MATH 232  
Calculus of Functions of One Variable II  
H  
4
CHEM 102  
General Descriptive Chemistry II  
H  
3

Hours  
11

Sophomore Year
Fall Semester
PHYS 119  
Introductory Calculus-based Electromagnetism and Quanta  
4
MATH 233  
Calculus of Functions of Several Variables  
H  
4

Hours  
8

Spring Semester
PHYS 281L  
Experimental Techniques in Physics  
2
PHYS 331  
Numerical Techniques for the Sciences I  
4
MATH 383  
First Course in Differential Equations  
H  
3

Hours  
9

Junior Year
Fall Semester
PHYS 211  
Intermediate Electromagnetism  
or  
PHYS 311  
Electromagnetism I  
3
PHYS 441  
Thermal Physics  
or  
CHEM 481  
Physical Chemistry I  
3
BUSI 408  
Corporate Finance  
3

Hours  
9

Spring Semester
PHYS 201  
Basic Mechanics  
or  
PHYS 401  
Mechanics I  
3
BUSI 580  
Investments  
H  
3

Hours  
6

Special Opportunities in Physics and Astronomy
Honors in Physics and Astronomy
The honors program offers exceptionally well-qualified students an opportunity to perform original research with a faculty member and graduate with honors or highest honors. It requires an overall grade point average of at least 3.3 and a grade point average of at least 3.4 for physics courses at the end of the junior year.

Students who wish to enter the honors program should consult with the departmental coordinator (http://physics.unc.edu/undergraduate-program/undergraduate-research) for the program no later than the preregistration period in the spring semester of their junior year.

Departmental Involvement
The Society of Physics Students, open to anyone interested in physics, builds connections between undergraduates, graduate students, faculty, and alumni. The society invites visitors to give talks and sponsors a number of events for students each year. Women in Physics at UNC–Chapel Hill, an organization that aims to provide resources, advice, and an encouraging social atmosphere for women in the field of physics, welcomes physics majors and all women interested in physics.

UNC–BEST
The UNC Baccalaureate Education in Science and Teaching (UNC–BEST) Program is a collaboration between the School of Education and the College of Arts and Sciences and is designed to allow undergraduate science majors interested in teaching high school science the opportunity to earn their science degree and obtain licensure as a North Carolina high school science teacher in four years. UNC–BEST students meet all the degree requirements for their degree using PHYS 410 as one of their upper-level physics courses.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
</table>
| PHYS 410 | Teaching and Learning Physics  
| EDUC 689 | Foundations of Special Education (may substitute EDUC 516)  | 3     |

3 Courses may be chosen from BUSI 407, BUSI 410, BUSI 584, MATH (numbered above 200), and PHYS (numbered above 200).
EDUC 532  Human Development and Learning (may substitute EDUC 403)  3
EDUC 615  Schools and Community Collaboration (may substitute EDUC 533)  3
EDUC 593  Internship/Student Teaching  12
EDUC 601  Education Workshops  1

For more details on admission requirements, application deadlines, and submitting an online application, visit the School of Education Web site (http://www.unc.edu/uncbest/options.html).

Undergraduate Awards
The department gives awards each year to the senior (Shearin Award) and junior (Johnson Award) who demonstrate the greatest achievement. In addition, the department awards the major with the most research achievement the Robert Sheldon Award for Undergraduate Research.

Undergraduate Research
All majors conduct at least one semester of research under the supervision of a faculty member. Many enjoy the experience so much that they continue for several semesters. An approved learning contract is required prior to registering for PHYS 295 and PHYS 395, and students must be registered within the first week of classes.