PHYSICS, B.S. (SCIENCE)

Begin Campus: Any Penn State Campus

End Campus: University Park

Degree Requirements

For the Bachelor of Science degree in Physics, a minimum of 120 credits is required:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education</td>
<td>45</td>
</tr>
<tr>
<td>Requirements for the Major</td>
<td>93-96</td>
</tr>
</tbody>
</table>

18 of the 45 credits for General Education are included in the Requirements for the Major. This includes: 9 credits of GN courses; 6 credits of GQ courses; 3 credits of GWS courses.

General Education

Connecting career and curiosity, the General Education curriculum provides the opportunity for students to acquire transferable skills necessary to be successful in the future and to thrive while living in interconnected contexts. General Education aids students in developing intellectual curiosity, a strengthened ability to think, and a deeper sense of aesthetic appreciation. These are requirements for all baccalaureate students and are often partially incorporated into the requirements of a program. For additional information, see the General Education Requirements (https://bulletins.psu.edu/undergraduate/general-education/baccalaureate-degree-general-education-program/) section of the Bulletin and consult your academic adviser.

The keystone symbol appears next to the title of any course that is designated as a General Education course.

The requirements for some programs may exceed 120 credits.

Requirements for the Major

3 credits required from the college of graduation and likely prescribed as part of major requirements.

Writing Across the Curriculum

3 credits required from the college of graduation and likely prescribed as part of major requirements.

Total Minimum Credits

A minimum of 120 degree credits must be earned for a baccalaureate degree. The requirements for some programs may exceed 120 credits. Students should consult with their college or department adviser for information on specific credit requirements.

Quality of Work

Candidates must complete the degree requirements for their major and earn at least a 2.00 grade-point average for all courses completed within their degree program.

Limitations on Source and Time for Credit Acquisition

The college dean or campus chancellor and program faculty may require up to 24 credits of course work in the major to be taken at the location or in the college or program where the degree is earned. Credit used toward degree programs may need to be earned from a particular source or within time constraints (see Senate Policy 83-80 [http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#83-80]). For more information, check the Suggested Academic Plan for your intended program.

Requirements for the Major

To graduate, a student enrolled in the major must earn a grade of C or better in each course designated by the major as a C-required course, as specified by Senate Policy 82-44 [http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#82-44].

Common Requirements for the Major (All Options)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 111</td>
<td>Experimental Chemistry I</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 112</td>
<td>Chemical Principles II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 113</td>
<td>Experimental Chemistry II</td>
<td>1</td>
</tr>
<tr>
<td>ENGL 202C</td>
<td>Effective Writing: Technical Writing</td>
<td>3</td>
</tr>
<tr>
<td>MATH 220</td>
<td>Matrices</td>
<td>2</td>
</tr>
</tbody>
</table>

Prescribed Courses: Require a grade of C or better

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 110</td>
<td>Chemical Principles I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 140</td>
<td>Calculus With Analytic Geometry I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 141</td>
<td>Calculus with Analytic Geometry II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 251</td>
<td>Ordinary and Partial Differential Equations</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 211</td>
<td>General Physics: Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 212</td>
<td>General Physics: Electricity and Magnetism</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 213</td>
<td>General Physics: Fluids and Thermal Physics</td>
<td>2</td>
</tr>
<tr>
<td>PHYS 214</td>
<td>General Physics: Wave Motion and Quantum Physics</td>
<td>2</td>
</tr>
<tr>
<td>PHYS 237</td>
<td>Introduction to Modern Physics</td>
<td>3</td>
</tr>
</tbody>
</table>
PHYS 400  Intermediate Electricity and Magnetism  4
PHYS 410  Introduction to Quantum Mechanics I  4
PHYS 419  Theoretical Mechanics  3
PHYS 420  Thermal Physics  3
PHYS 444  Topics in Contemporary Physics  2
PHYS 457W  Experimental Physics  3

**Additional Courses**
Select 3 credits from the following:  3
- CMPSC 101  Introduction to Programming
- CMPSC 121  Introduction to Programming Techniques
- CMPSC 131  Programming and Computation I: Fundamentals
- CMPSC 200  Programming for Engineers with MATLAB
- CMPSC 201  Programming for Engineers with C++

**Additional Courses: Require a grade of C or better**
MATH 230  Calculus and Vector Analysis  4
or MATH 231  Calculus of Several Variables
& MATH 232  and Integral Vector Calculus

**Supporting Courses and Related Areas**
Select 3 credits of 400-level MATH from departmental list  3

**Requirements for the Option**
Select an option  24-27

**Requirements for the Option**
**Computation Option (24 credits)**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 455</td>
<td>Introduction to Numerical Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 456</td>
<td>Introduction to Numerical Analysis II</td>
<td>3</td>
</tr>
</tbody>
</table>

**Additional Courses**
CMPSC 122  Intermediate Programming  3
or CMPSC 132  Programming and Computation II: Data Structures

**Supporting Courses and Related Areas**
Select 6 credits from program list  6
Select 3 credits of natural science (GN) courses that are not listed in the major  3
Select 6 credits from the following:  6
- AERSP 424  Advanced Computer Programming
- PHYS 430  Introduction to Computational Physics
- 300-400-level CMPSC
- 400-level MATH from departmental list
- 400-level STAT

1. CMPSC 122 has CMPSC 121 as a prerequisite and CMPSC 132 has CMPSC 131 as a prerequisite so care should be taken when choosing the 'programming requirement' under the Common Requirements for the major.

**Electronics Option (27 credits)**

<table>
<thead>
<tr>
<th>Code</th>
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</tr>
</thead>
<tbody>
<tr>
<td>EE 210</td>
<td>Circuits and Devices</td>
<td>4</td>
</tr>
</tbody>
</table>

**Additional Courses**
Select 8 credits from the following:  8
- CMPEN 270  Digital Design: Theory and Practice
- EE 310    300-400-level Electronic Circuit Design I

**Supporting Courses and Related Areas**
Select 6 credits from program list  6
Select 3 credits of natural science (GN) courses that are not listed in the major  3
Select 6 credits of EE 300-400-level courses  6

**General Physics Option (25-26 credits)**

<table>
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<tr>
<th>Code</th>
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<tbody>
<tr>
<td>PHYS 402</td>
<td>Electronics for Scientists</td>
<td>4</td>
</tr>
<tr>
<td>or PHYS 458</td>
<td>Intermediate Optics</td>
<td></td>
</tr>
</tbody>
</table>

Select 6-7 credits from items A, B, and/or C:  6-7

**A**
- PHYS 406  Subatomic Physics
- PHYS 411  Introduction to Quantum Mechanics II
- PHYS 412  Solid State Physics I
- PHYS 413  Solid State Physics II
- PHYS 414  Solid State Physics
- PHYS 430  Introduction to Computational Physics
- PHYS 461
- PHYS 472  Elements of Nuclear Physics and its Applications to Medical Imaging and Treatments
- PHYS 479  Special and General Relativity
- PHYS 496  Independent Studies
- PHYS 497  Special Topics

**B**
- PHYS 402  Electronics for Scientists  2
  or PHYS 458 Intermediate Optics

**C**
- ASTRO 410  Computational Astrophysics
- ASTRO 440  Introduction to Astrophysics
- ASTRO 485  Introduction to High-Energy Astronomy

**Supporting Courses and Related Areas**
Select 3 credits of natural science (GN) courses that are not listed in the major  3
Select 9 credits from program list, with a maximum of 6 credits of the following:  9
- PHYS 496  Independent Studies
- SC 295  Science Co-op Work Experience I
- SC 395  Science Co-op Work Experience II
- SC 495  Science Co-op Work Experience III

Select 3 credits of 400-level MATH from program list  3

1. Only 3 credits of ASTRO courses may be used.
2. The course not selected above may be used.

**Medical Physics Option (24-25 credits)**
This option prepares students for graduate study in medical physics, medical school, or bioengineering.

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<tbody>
<tr>
<td>AERSP 424</td>
<td>Advanced Computer Programming</td>
<td></td>
</tr>
</tbody>
</table>
| EE 310    300-400-level Electronic Circuit Design I

**Supporting Courses and Related Areas**
Select course set A or B:  15-16

Set A
BIOL 110  Biology: Basic Concepts and Biodiversity
BIOL 230W Biology: Molecules and Cells
or BIOL 240W Biology: Function and Development of Organisms
CHEM 210  Organic Chemistry I
CHEM 212  Organic Chemistry II
CHEM 213  Laboratory in Organic Chemistry

Set B
BIOL 141  Introduction to Human Physiology
or BIOL 472  Mammalian Physiology
9 credits of PHYS 472 or BME at the 300- or 400-level
Select one of the following:
BMB 251  Molecular and Cell Biology I
BIOL 230W  Biology: Molecules and Cells
BME 201  Fundamentals of Cells and Molecules

Supporting Courses and Related Options
Select 9 credits from program list, a maximum of 6 credits may be
from the following:
PHYS 496  Independent Studies
SC 295  Science Co-op Work Experience I
SC 395  Science Co-op Work Experience II
SC 495  Science Co-op Work Experience III

Nanotechnology/Material Science Option (24-25 credits)

Prescribed Courses
PHYS 412  Solid State Physics I

Additional Courses
Select course set A or B: 1

A
ESC 312  Engineering Applications of Wave, Particle, and
Ensemble Concepts
ESC 313  Introduction to Principles, Fabrication Methods,
and Applications of Nanotechnology
6 credits from ESC 400-level courses

B
MATSE 201  Introduction to Materials Science
MATSE 402  Materials Process Kinetics
or MATSE 436  Mechanical Properties of Materials
MATSE 430  Materials Characterization
MATSE 460  Introductory Laboratory in Materials
3 credits from 400-level MATSE courses

Supporting Courses and Related Areas
Select 6 credits from program list
Select 3 credits of natural science (GN) courses that are not listed in
the major

1 The courses in option A help satisfy the requirements for the
Nanotechnology minor.