## 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:

| Requirement | Credits |
| :--- | :--- |
| General Education | 45 |
| Requirements for the Major | $93-96$ |

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.

## 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 (https://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) |  |  |
| :---: | :---: | :---: |
| Code | Title | Credits |
| Prescribed Courses |  |  |
| CHEM 111 | Experimental Chemistry I | 1 |
| CHEM 112 | Chemical Principles II | 3 |
| CHEM 113 | Experimental Chemistry II | 1 |
| ENGL 202C | Effective Writing: Technical Writing | 3 |
| MATH 220 | Matrices | 2 |
| Prescribed Courses: Require a grade of C or better |  |  |
| CHEM 110 | Chemical Principles I | 3 |
| MATH 140 | Calculus With Analytic Geometry I | 4 |
| MATH 141 | Calculus with Analytic Geometry II | 4 |
| MATH 251 | Ordinary and Partial Differential Equations | 4 |
| PHYS 211 | General Physics: Mechanics | 4 |
| PHYS 212 | General Physics: Electricity and Magnetism | 4 |
| PHYS 213 | General Physics: Fluids and Thermal Physics | 2 |
| PHYS 214 | General Physics: Wave Motion and Quantum Physics | 2 |
| PHYS 237 | Introduction to Modern Physics | 3 |
| 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:

| 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 |
| 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) ..... Code Title Credits
Prescribed Courses
MATH 456 Introduction to Numerical Analysis II ..... 3
Additional Courses
CMPSC 122 Intermediate Programming ${ }^{1}$ ..... 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 ..... 3the major
Select 6 credits from the following: ..... 6
AERSP 424 Advanced Computer Programming
PHYS 430 Introduction to Computational Physics
300-400-level CMPSC400-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.


## General Physics Option (25-26 credits)

Code Title Credits

## Additional Courses

PHYS $402 \quad$ Electronics for Scientists 4 or PHYS 458 Intermediate Optics

| Select 6-7 credits from items A, B, and/or C: ${ }^{1}$ |  | 6-7 |
| :---: | :---: | :---: |
| A |  |  |
| PHYS 406 | Subatomic Physics |  |
| PHYS 411 | Introduction to Quantum Mechanics II |  |
| PHYS 412 | Solid State Physics I |  |
| PHYS 413 |  |  |
| 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 <br> or PHYS 45 | Electronics for Scientists ${ }^{2}$ 8 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 3 the major
Select 9 credits from program list, with a maximum of 6 credits of the 9 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 |
| Select 3 credits of 400 -level MATH from program list |  |

${ }^{1}$ 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.


| 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) <br> Code Title Credits <br> Prescribed Courses <br> PHYS 412 Solid State Physics I 3

Additional Courses
Select course set A or B: ${ }^{1} \quad 12-13$

A
ESC 312 Engineering Applications of Wave, Particle, and
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 43ظlechanical 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 3 the major
${ }^{1}$ The courses in option A help satisfy the requirements for the Nanotechnology minor.

## 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. Program requirements may also satisfy General Education requirements and vary for each program.

## Foundations (grade of $C$ or better is required and Inter-Domain courses do not meet this requirement.)

- Quantification (GQ): 6 credits
- Writing and Speaking (GWS): 9 credits


## Breadth in the Knowledge Domains (Inter-Domain courses do not meet this requirement.) <br> - Arts (GA): 3 credits <br> - Health and Wellness (GHW): 3 credits <br> - Humanities (GH): 3 credits <br> - Social and Behavioral Sciences (GS): 3 credits <br> - Natural Sciences (GN): 3 credits <br> Integrative Studies <br> - Inter-Domain Courses (Inter-Domain): 6 credits

## Exploration

- GN, may be completed with Inter-Domain courses: 3 credits
- GA, GH, GN, GS, Inter-Domain courses. This may include 3 credits of World Language course work beyond the 12th credit level or the requirements for the student's degree program, whichever is higher: 6 credits


## University Degree Requirements

## First Year Engagement

All students enrolled in a college or the Division of Undergraduate Studies at University Park, and the World Campus are required to take 1 to 3 credits of the First-Year Seminar, as specified by their college First-Year Engagement Plan.

Other Penn State colleges and campuses may require the First-Year Seminar; colleges and campuses that do not require a First-Year Seminar provide students with a first-year engagement experience.

First-year baccalaureate students entering Penn State should consult their academic adviser for these requirements.

## Cultures Requirement

6 credits are required and may satisfy other requirements

- United States Cultures: 3 credits
- International Cultures: 3 credits


## 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 (https://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.

