

# PHYSICS, B.S. (SCIENCE)

Seven Penn State campuses are scheduled for closure after Spring 2027: DuBois, Fayette, New Kensington, Mont Alto, Shenango, Wilkes-Barre, and York. New students are not being admitted at these campuses.

**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 | 90-97   |
| Electives                  | 0-3     |

**16-18 of the 45 credits for General Education are included in the Requirements for the Major. This includes: 7-9 credits of GN courses (9 credits only for Medical Physics Option); 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/students/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/>).

### Common Requirements for the Major (All Options)

| Code                                                      | Title                                            | Credits |
|-----------------------------------------------------------|--------------------------------------------------|---------|
| <b>Prescribed Courses</b>                                 |                                                  |         |
| CHEM 111                                                  | Experimental Chemistry I                         | 1       |
| CHEM 112                                                  | Chemical Principles II                           | 3       |
| MATH 220                                                  | Matrices                                         | 2-3     |
| <i>Prescribed Courses: Require a grade of C or better</i> |                                                  |         |
| CHEM 110                                                  | Chemical Principles I                            | 3       |
| ENGL 202C                                                 | Effective Writing: Technical Writing             | 3       |
| MATH 140                                                  | Calculus With Analytic Geometry I                | 4       |
| MATH 141                                                  | Calculus with Analytic Geometry II               | 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                   | 3-4     |
| PHYS 400                                                  | Intermediate Electricity and Magnetism           | 3-4     |
| PHYS 410                                                  | Introduction to Quantum Mechanics I              | 3-4     |
| PHYS 419                                                  | Theoretical Mechanics                            | 3       |
| PHYS 420                                                  | Thermal Physics                                  | 3       |
| PHYS 444                                                  | Topics in Contemporary Physics                   | 2       |
| PHYS 457W                                                 | Experimental Physics                             | 3       |
| <b>Additional Courses</b>                                 |                                                  |         |
| 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++                 |  |
| CMPSC 204 | Introduction to Computational Sciences Programming |  |

*Additional Courses: Require a grade of C or better*

|                        |                                                                    |   |
|------------------------|--------------------------------------------------------------------|---|
| MATH 230               | Calculus and Vector Analysis                                       | 4 |
| or MATH 231 & MATH 232 | Calculus of Several Variables and Integral Vector Calculus         |   |
| MATH 251               | Ordinary and Partial Differential Equations                        | 4 |
| or MATH 250 & MATH 252 | Ordinary Differential Equations and Partial Differential Equations |   |

|                                                           |       |
|-----------------------------------------------------------|-------|
| <b>Supporting Courses and Related Areas</b>               |       |
| Select 3 credits of 400-level MATH from departmental list | 3     |
| <b>Requirements for the Option</b>                        |       |
| Select an option                                          | 24-27 |

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

| Code                                        | Title                                           | Credits |
|---------------------------------------------|-------------------------------------------------|---------|
| <b>Prescribed Courses</b>                   |                                                 |         |
| MATH 455                                    | Introduction to Numerical Analysis I            | 3       |
| MATH 456                                    | Introduction to Numerical Analysis II           | 3       |
| <b>Additional Courses</b>                   |                                                 |         |
| CMPSC 122                                   | Intermediate Programming <sup>1</sup>           | 3       |
| or CMPSC 132                                | Programming and Computation II: Data Structures |         |
| <b>Supporting Courses and Related Areas</b> |                                                 |         |
| Select 9 credits from department list       |                                                 | 9       |
| 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                              |                                                 |         |

<sup>1</sup> 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)

| Code                                                                                     | Title                               | Credits |
|------------------------------------------------------------------------------------------|-------------------------------------|---------|
| <b>Prescribed Courses</b>                                                                |                                     |         |
| EE 210                                                                                   | Circuits and Devices                | 4       |
| <b>Additional Courses</b>                                                                |                                     |         |
| Select 8 credits from the following:                                                     |                                     | 8       |
| CMPEN 270                                                                                | Digital Design: Theory and Practice |         |
| EE 310                                                                                   | Electronic Circuit Design I         |         |
| EE 350                                                                                   | Continuous-Time Linear Systems      |         |
| <b>Supporting Courses and Related Areas</b>                                              |                                     |         |
| Select 9 credits from department list, a maximum of 6 credits may be from 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 6 credits of EE 300- or 400-level courses |                                   | 6 |

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

| Code | Title | Credits |
|------|-------|---------|
|------|-------|---------|

**Additional Courses**

|             |                            |   |
|-------------|----------------------------|---|
| PHYS 402    | Electronics for Scientists | 4 |
| or PHYS 458 | Intermediate Optics        |   |

Select 6-7 credits from items A, B, and/or C: <sup>1</sup> 6-7

|          |                                                                                    |  |
|----------|------------------------------------------------------------------------------------|--|
| <b>A</b> |                                                                                    |  |
| PHYS 337 | Introduction to Quantum Information Science and Engineering                        |  |
| PHYS 406 | Subatomic Physics                                                                  |  |
| PHYS 411 | Introduction to Quantum Mechanics II                                               |  |
| PHYS 412 | Solid State Physics I                                                              |  |
| PHYS 414 | Solid State Physics                                                                |  |
| PHYS 430 | Introduction to Computational Physics                                              |  |
| PHYS 437 | Physical implementation of qubits                                                  |  |
| PHYS 465 | Network analysis of biological systems                                             |  |
| 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>B</b>    |                                         |  |
| PHYS 402    | Electronics for Scientists <sup>2</sup> |  |
| or PHYS 458 | Intermediate Optics                     |  |

|           |                                       |  |
|-----------|---------------------------------------|--|
| <b>C</b>  |                                       |  |
| ASTRO 410 | Computational Astrophysics            |  |
| ASTRO 440 | Introduction to Astrophysics          |  |
| ASTRO 485 | Introduction to High-Energy Astronomy |  |

**Supporting Courses and Related Areas**

Select 12 credits from department list, with a maximum of 6 credits of the following: 12

|          |                                   |  |
|----------|-----------------------------------|--|
| 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 department list 3

<sup>1</sup> Only 3 credits of ASTRO courses may be used.

<sup>2</sup> The course not selected above may be used.

**Medical Physics Option (24-26 credits)**

This option prepares students for graduate study in medical physics, medical school, or bioengineering.

| Code | Title | Credits |
|------|-------|---------|
|------|-------|---------|

**Additional Courses**

Select course set A or B: 15-17

|              |                                          |  |
|--------------|------------------------------------------|--|
| <b>Set A</b> |                                          |  |
| BIOL 110     | Biology: Basic Concepts and Biodiversity |  |
| BIOL 230W    | Biology: Molecules and Cells             |  |

or BIOL 240WBiology: Function and Development of Organisms

|          |                                 |  |
|----------|---------------------------------|--|
| CHEM 113 | Experimental Chemistry II       |  |
| CHEM 210 | Organic Chemistry I             |  |
| CHEM 212 | Organic Chemistry II            |  |
| CHEM 213 | Laboratory in Organic Chemistry |  |

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

**Supporting Courses and Related Options**

Select 9 credits from department list, a maximum of 6 credits may be from 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 |  |

**Nanotechnology/Material Science Option (24-25 credits)**

| Code | Title | Credits |
|------|-------|---------|
|------|-------|---------|

**Prescribed Courses**

|          |                       |   |
|----------|-----------------------|---|
| PHYS 412 | Solid State Physics I | 3 |
|----------|-----------------------|---|

**Additional Courses**

Select course set A or B: <sup>1</sup> 12-13

|                                      |                                                                                     |  |
|--------------------------------------|-------------------------------------------------------------------------------------|--|
| <b>Set A</b>                         |                                                                                     |  |
| 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>Set B</b>                           |                                      |  |
| MATSE 201                              | Introduction to Materials Science    |  |
| MATSE 402                              | Materials Process Kinetics           |  |
| or MATSE 430                           | 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 9 credits from department list, with a maximum of 6 credits from 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 |  |

<sup>1</sup> The courses in Set 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.)**

- **Arts (GA):** 3 credits
- **Health and Wellness (GHW):** 3 credits
- **Humanities (GH):** 3 credits
- **Social and Behavioral Sciences (GS):** 3 credits
- **Natural Sciences (GN):** 3 credits

### **Integrative Studies**

- **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/students/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/>)). For more information, check the Suggested Academic Plan for your intended program.