

# PHYSICS, B.S. (SCIENCE)

**Begin Campus:** Any Penn State Campus

**End Campus:** University Park

## Program Description

This major provides a sound program of technical and general education for students planning a career in physics and related fields.

- The General option provides broad coverage with the most physics and mathematics course requirements and is useful for students intending to pursue graduate study in Physics or similar disciplines.
- The Medical and Electronics options incorporate coursework in support of the application of physics and mathematics in various life-science or engineering related fields.
- A Computation option provides background in the application of physical principles and mathematical methods in the solution of scientific problems, simulations, or visualizations using computer and numerical techniques.
- The Nanotechnology/Material Science option provides students with background in the understanding of condensed matter physics at either the nano- or micro/macro- levels.

## What is Physics?

Physicists study natural phenomena in the universe, from the smallest length scales to the largest in the cosmos, to discover the basic principles or laws which govern the physical world. Knowledge of physics is crucial to truly understanding the world around us, the world inside us, and the world beyond us. This degree will provide students with the fundamental conceptual, mathematical, computational, and experimental tools that are needed to attack the scientific and technological problems of today and in the future.

## You Might Like This Program If...

- You are curious about how things work.
- You are fascinated by how the natural world is organized, how mathematics describes so much of it, how experiments can probe that understanding, and how one can predict new physical phenomena.
- You want to explore these connections via hands-on work in labs, mathematical reasoning and calculations, or using computers and programming.
- You want to solve sophisticated problems beyond standard pencil-and-paper examples using advanced mathematical and experimental technique or computational methods.

## Entrance to Major

In order to be eligible for entrance to the Physics major, a student must have:

1. attained at least a 2.00 cumulative grade-point average;
2. completed and earned a grade of C or better in each of the following courses: CHEM 110, MATH 140, MATH 141, PHYS 211, and PHYS 212.

## 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

### 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 (<http://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.)

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

### Knowledge Domains

- **Arts (GA):** 6 credits
- **Health and Wellness (GHW):** 3 credits
- **Humanities (GH):** 6 credits
- **Social and Behavioral Sciences (GS):** 6 credits
- **Natural Sciences (GN):** 9 credits

### Integrative Studies (may also complete a Knowledge Domain requirement)

- **Inter-Domain or Approved Linked Courses:** 6 credits

18 of these 45 credits are included in the Requirements for the Major.

## 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 (<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

This includes 18 credits of General Education courses: 9 credits of GN courses; 6 credits of GQ courses; 3 credits of GWS courses.

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)

Code	Title	Credits
<b>Prescribed Courses</b>		
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
<i>Prescribed Courses: Require a grade of C or better</i>		
CHEM 110	Chemical Principles I	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
MATH 251	Ordinary and Partial Differential Equations	4
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
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## Additional Courses

Select 3 credits from the following: 3

CMPSC 101	Introduction to C++ 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 & MATH 232	Calculus of Several Variables 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
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### Prescribed Courses

MATH 455	Introduction to Numerical Analysis I	3
MATH 456	Introduction to Numerical Analysis II	3

### Additional Courses

CMPSC 122	Intermediate Programming <sup>1</sup>	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		

<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
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### Prescribed Courses

EE 210	Circuits and Devices	4
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### Additional Courses

Select 8 credits from the following: 8

EE 310	Electronic Circuit Design I	
EE 350	Continuous-Time Linear Systems	
CMPEN 270	Digital Design: Theory and Practice	

## 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- or 400-level courses 6

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

Code	Title	Credits
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#### 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

#### 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	Theoretical Mechanics	
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 <sup>2</sup>	
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

<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 (24-25 credits)

This option prepares students for graduate study in medical physics, medical school, or bioengineering. The courses in option (b) below help satisfy the requirements for a minor in Biomedical Engineering. Application for the BME minor must be made to the Department of Biomedical Engineering.

Code	Title	Credits
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#### Additional Courses

Select course set A or B: 15-16

#### Set A

BIOL 110	Biology: Basic Concepts and Biodiversity	
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BIOL 230W	Biology: Molecules and Cells	
or BIOL 240W	Biology: Function and Development of Organisms	

CHEM 210	Organic Chemistry I	
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CHEM 212	Organic Chemistry II	
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CHEM 213	Laboratory in Organic Chemistry	
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#### Set B

BIOL 141	Introductory 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	
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BIOL 230W	Biology: Molecules and Cells	
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BME 201	Fundamentals of Cells and Molecules	
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### Supporting Courses and Related Options

Select 9 credits from program list, a maximum of 6 credits may be from the following: 9

PHYS 496	Independent Studies	
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SC 295	Science Co-op Work Experience I	
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SC 395	Science Co-op Work Experience II	
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SC 495	Science Co-op Work Experience III	
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### Nanotechnology/Material Science Option (24-25 credits)

Code	Title	Credits
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#### Prescribed Courses

PHYS 412	Solid State Physics I	3
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#### Additional Courses

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

#### A

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

#### B

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

### 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

<sup>1</sup> The courses in option A help satisfy the requirements for the Nanotechnology minor.

## Academic Advising

The objectives of the university's academic advising program are to help advisees identify and achieve their academic goals, to promote their intellectual discovery, and to encourage students to take advantage of both in-and-out-of class educational opportunities in order that they become self-directed learners and decision makers.

Both advisers and advisees share responsibility for making the advising relationship succeed. By encouraging their advisees to become engaged in their education, to meet their educational goals, and to develop the habit of learning, advisers assume a significant educational role. The advisee's unit of enrollment will provide each advisee with a primary academic adviser, the information need to plan the chosen program of study, and referrals to other specialized resources.

READ SENATE POLICY 32-00: ADVISING POLICY (<http://senate.psu.edu/policies-and-rules-for-undergraduate-students/32-00-advising-policy>)

## University Park

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## Suggested Academic Plan

### General Option at University Park Campus

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

#### First Year

Fall	Credits Spring	Credits
PHYS 211 <sup>*#</sup>	4 PHYS 212 <sup>*#</sup>	4
MATH 140 <sup>*†#†</sup>	4 MATH 141 <sup>*†#†</sup>	4
CHEM 110 <sup>*†#†</sup>	3 CHEM 112 <sup>†</sup>	3
CHEM 111 <sup>†</sup>	1 CHEM 113 <sup>†</sup>	1
PSU 16	1 ENGL 15, 30, or ESL 15 <sup>‡</sup>	3
General Education Course	3	
	16	15

#### Second Year

Fall	Credits Spring	Credits
PHYS 213 & PHYS 214 <sup>*</sup>	4 PHYS 237 <sup>*</sup>	3
MATH 230 <sup>*</sup>	4 MATH 251 <sup>*</sup>	4
MATH 220	2 General Education Course	3
General Education Course	3 CMPSC 101, 121, 200, 201, or 202	3
General Education Course (GHW)	1.5 CAS 100, 100A, 100B, or 100C <sup>‡</sup>	3
	14.5	16

#### Third Year

Fall	Credits Spring	Credits
PHYS 400 <sup>*</sup>	4 PHYS 410 <sup>*</sup>	4
PHYS 419 <sup>*</sup>	3 PHYS 420 <sup>*</sup>	3
MATH 400 level selection (consult with an academic adviser for options) <sup>1</sup>	3 MATH 400 level selection (consult with an academic adviser for options) <sup>1</sup>	3
General Education Course	3 PHYS 444 <sup>*</sup>	2

General Education Course	3 General Education Course	3
	16	15

#### Fourth Year

Fall	Credits Spring	Credits
PHYS 400 level selection (consult with an academic adviser for options)	3 PHYS 400 level selection (consult with an academic adviser for options)	3
PHYS 402 or 457W <sup>2</sup>	3-4 PHYS 457W or 458 <sup>2</sup>	3-4
General Education Course	3 Supporting Course (consult with an academic adviser for options)	3
ENGL 202C <sup>‡</sup>	3 Supporting Course (consult with an academic adviser for options)	3
Elective <sup>2</sup>	3 General Education Course (GHW)	1.5
	15-16	13.5-14.5

Total Credits 121-123

#### University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

All incoming Schreyer Honors College first-year students at University Park will take ENGL/CAS 137 in the fall semester and ENGL/CAS 138 in the spring semester. These courses carry the GWS designation and replace both ENGL 30 and CAS 100. Each course is 3 credits.

- <sup>1</sup> MATH 400 level selection can be taken from the following list: MATH 405, 40, 408, 411, 412, 414, 415, 416, 417, 418, 421, 422, 425, 430, 431, 441, 444, 445, 446, 447, 449, 450, 451, 455, 456, 484 or 486.
- <sup>2</sup> PHYS 457W requires a grade of C or better.

### Medical Option at University Park Campus

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

**First Year**

Fall	Credits Spring	Credits
PHYS 211 <sup>*#</sup>	4 PHYS 212 <sup>*#</sup>	4
MATH 140 <sup>*†#†</sup>	4 MATH 141 <sup>*†#†</sup>	4
CHEM 110 <sup>*†#†</sup>	3 CHEM 112 <sup>†</sup>	3
CHEM 111 <sup>†</sup>	1 CHEM 113 <sup>†</sup>	1
PSU 16	1 ENGL 15, 30, or ESL 15 <sup>‡</sup>	3
General Education Course	3	
	16	15

**Second Year**

Fall	Credits Spring	Credits
PHYS 213 & PHYS 214 <sup>*</sup>	4 PHYS 237 <sup>*</sup>	3
MATH 230 <sup>*</sup>	4 MATH 251 <sup>*</sup>	4
BIOL 110 or 141 <sup>†</sup>	3-4 BIOL 240W or BME 201 <sup>†</sup>	3-4
General Education Course	3 General Education Course	3
	CAS 100, 100A, 100B, or 100C <sup>‡</sup>	3
	14-15	16-17

**Third Year**

Fall	Credits Spring	Credits
PHYS 400 <sup>*</sup>	4 PHYS 419 <sup>*</sup>	3
MATH 400 level selection (consult with an academic adviser for options) <sup>1</sup>	3 PHYS 444	2
MATH 220	2 CMPSC 101, 121, 200, 201, or 202	3
CHEM 210 (or BME Elective)	3 CHEM 212 (or BME Elective)	3
General Education Course	3 General Education Requirement	3
	15	14

**Fourth Year**

Fall	Credits Spring	Credits
PHYS 410 <sup>*</sup>	4 PHYS 420 <sup>*</sup>	3
CHEM 213 (or BME Elective)	2 PHYS 457W <sup>*</sup>	3
ENGL 202C <sup>‡</sup>	3 Supporting Course (consult with an academic adviser for options)	3
General Education Course	3 Supporting Course (consult with an academic adviser for options)	3
General Education Course (GHW)	1.5 Supporting Course (consult with an academic adviser for options)	3
	General Education Course (GHW)	1.5
	13.5	16.5

Total Credits 120-122

\* Course requires a grade of C or better for the major

‡ Course requires a grade of C or better for General Education

# Course is an Entrance to Major requirement

† Course satisfies General Education and degree requirement

**University Requirements and General Education Notes:**

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

All incoming Schreyer Honors College first-year students at University Park will take ENGL/CAS 137 in the fall semester and ENGL/CAS 138 in the spring semester. These courses carry the GWS designation and replace both ENGL 30 and CAS 100. Each course is 3 credits.

- MATH 400 level selection can be taken from the following list: MATH 405, 40, 408, 411, 412, 414, 415, 416, 417, 418, 421, 422, 425, 430, 431, 441, 444, 445, 446, 447, 449, 450, 451, 455, 456, 484 or 486.

**Electronics Option at University Park Campus**

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

**First Year**

Fall	Credits Spring	Credits
PHYS 211 <sup>*#</sup>	4 PHYS 212 <sup>*#</sup>	4
MATH 140 <sup>*†#†</sup>	4 MATH 141 <sup>*†#†</sup>	4
CHEM 110 <sup>*†#†</sup>	3 CHEM 112 <sup>†</sup>	3
CHEM 111 <sup>†</sup>	1 CHEM 113 <sup>†</sup>	1
PSU 16	1 ENGL 15, 30, or ESL 15 <sup>‡</sup>	3
General Education Course	3	
	16	15

**Second Year**

Fall	Credits Spring	Credits
PHYS 213 & PHYS 214 <sup>*</sup>	4 PHYS 237 <sup>*</sup>	3
MATH 230 <sup>*</sup>	4 MATH 251 <sup>*</sup>	4
MATH 220	2 CMPEN 270 (or Electrical Engineering 300 level selection)	4
EE 210	4 CMPSC 101, 121, 200, 201, or 202	3

General Education Course		3
14		17
<b>Third Year</b>		
Fall	Credits Spring	Credits
PHYS 400*	4 PHYS 419*	3
CMPEN 270 (or Electrical Engineering 300 level selection)	4 PHYS 444*	2
MATH 400 level selection (consult with an academic adviser for options) <sup>1</sup>	3 Electral Engineering 300 or 400 level selection (consult with an academic adviser for options)	3
General Education Course	3 General Education Course	3
CAS 100, 100A, 100B, or 100C <sup>‡</sup>	3 General Education Course	3
17		14
<b>Fourth Year</b>		
Fall	Credits Spring	Credits
PHYS 410*	4 PHYS 420*	3
Electral Engineering 300 or 400 level selection (consult with an academic adviser for options)	3 PHYS 457W*	3
ENGL 202C <sup>‡</sup>	3 General Education Course	3
General Education Course	3 Supporting Course (consult with an academic adviser for options)	3
General Education Selection (GHW)	1.5 Supporting Course (consult with an academic adviser for options)	3
	GHA Elective	1.5
14.5		16.5

Total Credits 124

\* Course requires a grade of C or better for the major

‡ Course requires a grade of C or better for General Education

# Course is an Entrance to Major requirement

† Course satisfies General Education and degree requirement

#### University Requirements and General Education Notes:

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W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate

an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

All incoming Schreyer Honors College first-year students at University Park will take ENGL/CAS 137 in the fall semester and ENGL/CAS 138 in the spring semester. These courses carry the GWS designation and replace both ENGL 30 and CAS 100. Each course is 3 credits.

<sup>1</sup> MATH 400 level selection can be taken from the following list: MATH 405, 40, 408, 411, 412, 414, 415, 416, 417, 418, 421, 422, 425, 430, 431, 441, 444, 445, 446, 447, 449, 450, 451, 455, 456, 484 or 486

### Computational Option at University Park Campus

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

#### First Year

Fall	Credits Spring	Credits
PHYS 211 <sup>*#</sup>	4 PHYS 212 <sup>*#</sup>	4
MATH 140 <sup>*†#†</sup>	4 MATH 141 <sup>*†#†</sup>	4
CHEM 110 <sup>*†#†</sup>	3 CHEM 112 <sup>†</sup>	3
CHEM 111 <sup>†</sup>	1 CHEM 113 <sup>†</sup>	1
PSU 16	1 ENGL 15, 30, or ESL 15 <sup>‡</sup>	3
General Education Course		
13		15

#### Second Year

Fall	Credits Spring	Credits
PHYS 213 & PHYS 214*	4 PHYS 237*	3
MATH 230*	4 MATH 251*	4
CMPSC 121	3 CMPSC 122	3
General Education Course	3 MATH 220	2
General Education Course (GHW)	1.5 General Education Course	3
15.5		15

#### Third Year

Fall	Credits Spring	Credits
PHYS 400*	4 PHYS 410*	4
PHYS 419 (or MATH 4xx)*	3 PHYS 419 (or MATH 400 level selection)*	3
MATH 455	3 MATH 456	3
CAS 100, 100A, 100B, or 100C <sup>‡</sup>	3 PHYS 444*	2
General Education Course	3 General Education Course (GHW)	1.5
	Supporting Course (consult with an academic adviser for options)	3
16		16.5

#### Fourth Year

Fall	Credits Spring	Credits
PHYS 420*	3 PHYS 457W	3

MATH 400 level or STAT 400 level or CMPSC 300/400 level selection (consult with an academic adviser for options)	3 MATH 400 level or STAT 400 level or CMPSC 300/400 level selection (consult with an academic adviser for options)	3
General Education Course	3 General Education Course	3
General Education Course	3 Supporting Course (consult with an academic adviser for options)	3
ENGL 202C <sup>‡</sup>	3 Supporting Course (consult with an academic adviser for options)	3
15		15

Total Credits 121

\* Course requires a grade of C or better for the major

‡ Course requires a grade of C or better for General Education

# Course is an Entrance to Major requirement

† Course satisfies General Education and degree requirement

#### University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

All incoming Schreyer Honors College first-year students at University Park will take ENGL/CAS 137 in the fall semester and ENGL/CAS 138 in the spring semester. These courses carry the GWS designation and replace both ENGL 30 and CAS 100. Each course is 3 credits.

### Materials-Nanotechnology Option: Nanotechnology Track at University Park Campus

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

#### First Year

Fall	Credits Spring	Credits
PHYS 211 <sup>*#</sup>	4 PHYS 212 <sup>*#</sup>	4
MATH 140 <sup>*‡#†</sup>	4 MATH 141 <sup>*‡#†</sup>	4

CHEM 110 <sup>*‡#†</sup>	3 CHEM 112 <sup>†</sup>	3
CHEM 111 <sup>†</sup>	1 CHEM 113 <sup>†</sup>	1
PSU 16	1 ENGL 15, 30, or ESL 15 <sup>‡</sup>	3
General Education Course	3	
16		15

#### Second Year

Fall	Credits Spring	Credits
PHYS 213 & PHYS 214 <sup>*</sup>	4 PHYS 237 <sup>*</sup>	3
MATH 230 <sup>*</sup>	4 MATH 251 <sup>*</sup>	4
MATH 220	2 CAS 100, 100A, 100B, or 100C <sup>‡</sup>	3
General Education Course	3 CMPSC 101, 121, 200, 201, or 202	3
General Education Course (GHW)	1.5 General Education Course	3
14.5		16

#### Third Year

Fall	Credits Spring	Credits
PHYS 400 <sup>*</sup>	4 PHYS 410 <sup>*</sup>	4
PHYS 419 (or MATH 400 level selection (consult with an academic adviser for options)) <sup>*</sup>	3 PHYS 419 (or MATH 400 level selection (consult with an academic adviser for options)) <sup>*</sup>	3
ESC 312	3 PHYS 444 <sup>*</sup>	2
General Education Course	3 ESC 313	3
General Education Course	3 General Education Course	3
16		15

#### Fourth Year

Fall	Credits Spring	Credits
PHYS 420	3 PHYS 457W <sup>*</sup>	3
PHYS 412	3 ESC 400 level selection (consult with an academic adviser for options)	3
ESC 400 Level Selection (consult with an academic adviser for options)	3 Supporting Course (consult with an academic adviser for options)	3
ENGL 202C <sup>‡</sup>	3 Supporting Course (consult with an academic adviser for options)	3
General Education Course	3 General Education Course (GHW)	1.5
15		13.5

Total Credits 121

\* Course requires a grade of C or better for the major

‡ Course requires a grade of C or better for General Education

# Course is an Entrance to Major requirement

† Course satisfies General Education and degree requirement

#### University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

All incoming Schreyer Honors College first-year students at University Park will take ENGL/CAS 137 in the fall semester and ENGL/CAS 138 in the spring semester. These courses carry the GWS designation and replace both ENGL 30 and CAS 100. Each course is 3 credits.

## Materials-Nanotechnology Option: Materials Track at University Park Campus

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

### First Year

Fall	Credits	Spring	Credits
PHYS 211 <sup>*#</sup>	4	PHYS 212 <sup>*#</sup>	4
MATH 140 <sup>*‡#†</sup>	4	MATH 141 <sup>*‡#†</sup>	4
CHEM 110 <sup>*‡#†</sup>	3	CHEM 112 <sup>†</sup>	3
CHEM 111 <sup>†</sup>	1	CHEM 113 <sup>†</sup>	1
PSU 16	1	ENGL 15, 30, or ESL 15 <sup>†</sup>	3
General Education Course	3		
	16		15

### Second Year

Fall	Credits	Spring	Credits
PHYS 213 & PHYS 214 <sup>*</sup>	4	PHYS 237 <sup>*</sup>	3
MATH 230 <sup>*</sup>	4	MATH 251 <sup>*</sup>	4
MATH 220	2	CAS 100	3
MATSE 201	3	CMPSC 101, 121, 200, 201, or 202	3
General Education (GHW)	1.5	General Education Course	3
	14.5		16

### Third Year

Fall	Credits	Spring	Credits
PHYS 400 <sup>*</sup>	4	PHYS 410 <sup>*</sup>	4
PHYS 419 (or MATH 400 level selection (consult with an academic adviser for options)) <sup>*</sup>	3	PHYS 419 (or MATH 400 level selection (consult with an academic adviser for options)) <sup>*</sup>	3
MATSE 430	3	PHYS 444 <sup>*</sup>	2
MATSE 460	1	MATSE 436 or 402	3

General Education Course	3	General Education Course	3
General Education Course (GHW)	1.5		
	15.5		15

### Fourth Year

Fall	Credits	Spring	Credits
PHYS 412 <sup>*</sup>	3	PHYS 457W <sup>*</sup>	3
PHYS 420 (or MATSE 400 level selection (consult with an academic adviser for options)) <sup>*</sup>	3	PHYS 420 (or MATSE 400 level selection (consult with an academic adviser for options)) <sup>*</sup>	3
ENGL 202C <sup>†</sup>	3	General Education Course	3
General Education Course	3	Supporting Course (consult with an academic adviser for options)	3
General Education Course	3	Supporting Course (consult with an academic adviser for options)	3
	15		15

Total Credits 122

\* Course requires a grade of C or better for the major

‡ Course requires a grade of C or better for General Education

# Course is an Entrance to Major requirement

† Course satisfies General Education and degree requirement

### University Requirements and General Education Notes:

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## Career Paths

It's often said that physicists are first and foremost problem solvers. With strong analytical skills in multiple areas, physicists are versatile and adaptable, and find career flexibility in many fields. A BS in Physics provides strong training for direct employment in a wide variety of careers or for further training at the graduate level in many STEM fields. Examples include jobs in private industries, national labs, and small

companies involving basic or applied research, engineering applications, data analysis, or modeling, programming, and simulations.

## Careers

Physics majors use their analytic and problem-solving skills in a wide variety of 'real world' jobs in both the public and private sector, from national laboratories, the aerospace industry, and advanced technology and communications industries to patent law.

MORE INFORMATION (<http://www.aps.org/careers>)

## Opportunities for Graduate Studies

About half of all Physics B.S. students pursue additional graduate education at some point. Many students proceed directly to a Physics Ph.D. program and the vast majority of students who are accepted into such programs receive both a stipend and have full tuition paid for by the institution. Some students find that their employers subsidize additional education in a technical field useful to the company. Physics majors have successfully pursued graduate degrees in all engineering fields, mathematics, statistics, and data science, law school and medical school, and other life science related areas, such as medical physics and neuroscience.

MORE INFORMATION (<http://www.gradschoolshopper.com/gradschool>)

## Professional Resources

- The American Physical Society (<http://www.aps.org>)
- The American Institute of Physics (<http://www.aip.org>)
- The National Society of Physics Students (SPS) (<http://www.spsnational.org>)
- The National Sigma Pi Sigma ( $\Sigma\Pi\Sigma$ ) Physics honor society (<http://www.sigmapisigma.org/sigmapisigma>)
- The National Society of Black Physicists (NSBP) (<https://www.nsbp.org>)
- The National Society of Hispanic Physicists (NSHP) (<http://www.hispanicphysicists.org>)
- American Association of Physicists in Medicine (AAPM) (<http://www.aapm.org>)

## Contact

### University Park

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