ASTRONOMY AND ASTROPHYSICS, B.S.

Begin Campus: Any Penn State Campus
End Campus: University Park

Degree Requirements
For the Bachelor of Science degree in Astronomy and Astrophysics, a minimum of 125 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>98</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. 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

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
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>ASTRO 320</td>
<td>Observational Astronomy Laboratory</td>
<td>3</td>
</tr>
<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>ENGL 202C</td>
<td>Effective Writing: Technical Writing</td>
<td>3</td>
</tr>
<tr>
<td>MATH 230</td>
<td>Calculus and Vector Analysis</td>
<td>4</td>
</tr>
<tr>
<td>MATH 251</td>
<td>Ordinary and Partial Differential Equations</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 237</td>
<td>Introduction to Modern Physics</td>
<td>3</td>
</tr>
</tbody>
</table>

Prescribed Courses: Require a grade of C or better

- ASTRO 291 | Astronomical Methods and the Solar System | 3 |
- ASTRO 292 | Astronomy of the Distant Universe | 3 |
- CHEM 110 | Chemical Principles I | 3 |
- MATH 140 | Calculus With Analytic Geometry I | 4 |
- MATH 141 | Calculus with Analytic Geometry II | 4 |
<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
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<tbody>
<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>
</tbody>
</table>

**Additional Courses**

Select one of the following:

- CMPSC 121  Introduction to Programming Techniques  
- CMPSC 201  Programming for Engineers with C++  
- CMPSC 202

**Supporting Courses and Related Areas**

**Supporting Courses and Related Areas: Require a grade of C or better**

Select 12 credits from 400-level ASTRO courses

**Requirements for the Option**

Select an option

Except ASTRO 401, ASTRO 402W, ASTRO 494H, and ASTRO 496.

**Requirements for the Option**

**Graduate Study Option (33 credits)**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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</tr>
</thead>
<tbody>
<tr>
<td>PHYS 400</td>
<td>Intermediate Electricity and Magnetism</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 410</td>
<td>Introduction to Quantum Mechanics I</td>
<td>3-4</td>
</tr>
<tr>
<td>PHYS 419</td>
<td>Theoretical Mechanics</td>
<td>3</td>
</tr>
</tbody>
</table>

**Additional Courses**

Select one of the following:

- MATH 405  Advanced Calculus for Engineers and Scientists I  
- MATH 411  Ordinary Differential Equations  
- MATH 417  Qualitative Theory of Differential Equations

Select 6-7 credits of the following:

- EE 471/  
  AERSP 490/  
  NUCE 490  Introduction to Plasmas
- PHYS 402  Electronics for Scientists
- PHYS 406  Subatomic Physics
- PHYS 411  Introduction to Quantum Mechanics II
- PHYS 420  Thermal Physics
- PHYS 457  Experimental Physics
- PHYS 457W Experimental Physics
- PHYS 458  Intermediate Optics
- PHYS 479  Special and General Relativity

**Supporting Courses and Related Areas**

Select 3 additional credits from advanced courses in computer science and engineering, mathematics, or statistics

Select 12 credits in consultation with adviser from department list

**Computer Science Option (33 credits)**

<table>
<thead>
<tr>
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<th>Title</th>
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<tbody>
<tr>
<td>CMPSC 122</td>
<td>Intermediate Programming</td>
<td>3</td>
</tr>
<tr>
<td>CMPSC 221</td>
<td>Object Oriented Programming with Web-Based Applications</td>
<td>3</td>
</tr>
<tr>
<td>CMPSC 451</td>
<td>Numerical Computations</td>
<td>3</td>
</tr>
</tbody>
</table>

**Additional Courses**

Select one of the following:

- STAT 318  Elementary Probability
- STAT 319  Elementary Mathematical Statistics
- STAT 401  Experimental Methods
- STAT 414  Introduction to Probability Theory

Select two of the following:

- CMPEN 271  Introduction to Digital Systems
- CMPEN 331  Computer Organization And Design
- CMPSC 360  Discrete Mathematics for Computer Science
- CMPSC 465  Data Structures and Algorithms

**Supporting Courses and Related Areas**

Select 3 additional credits from advanced courses in computer science and engineering, mathematics, or statistics

Select 12 credits in consultation with adviser from department list