BACHELOR OF SCIENCE IN PHYSICS

Undergraduate Programs in Physics and Astronomy

High school preparation for these programs should include two years of algebra, one year of geometry, one semester of trigonometry, one year of chemistry, and one year of physics. Some experience in computer programming is valuable. All students, especially those who have not completed a substantial chemistry course in high school, are strongly urged to take CHEM 115, CHEM 215, and CHEM 216 in their first year of college.

It is suggested that students in these programs consult with their advisor before selecting courses to meet General Education requirements. Unnecessary repetition of elementary topics might be avoided by careful selection of courses. A plan of study prepared in consultation with a department advisor is a prerequisite to entry into upper-division study.

Students who are considering teaching physics at the secondary school level should see a credential advisor in the department before planning their major coursework. A competency assessment is required for admission to the credential program.

- A maximum of 6 units taken CR/NC may be counted toward any undergraduate degree.
- All prerequisites for upper-division courses must be completed with a grade of C– or better. See course descriptions for prerequisite requirements.

Physics (B.S.) — 71 units

Lower Division Prerequisites (27 units)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>MATH 226</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 227</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 228</td>
<td>Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>MATH 245</td>
<td>Elementary Differential Equations and Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 376</td>
<td>Ordinary Differential Equations I</td>
<td></td>
</tr>
<tr>
<td>PHYS 220 &amp; PHYS 222</td>
<td>General Physics with Calculus I Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 230 &amp; PHYS 232</td>
<td>General Physics with Calculus II Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 240 &amp; PHYS 242</td>
<td>General Physics with Calculus III Laboratory</td>
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</tbody>
</table>

Upper Division Requirements (44 units)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>CSC 309</td>
<td>Computer Programming for Scientists and Engineers 1</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 320</td>
<td>Modern Physics I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 321</td>
<td>Modern Physics Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>PHYS 330</td>
<td>Analytical Mechanics I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 360</td>
<td>Electricity and Magnetism I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 370</td>
<td>Thermodynamics and Statistical Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 385</td>
<td>Introduction to Theoretical Physics I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 430</td>
<td>Quantum Mechanics I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 457</td>
<td>Introduction to Analog Electronics</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 460</td>
<td>Electricity and Magnetism II</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 490</td>
<td>Physics Project Laboratory</td>
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<tr>
<td>PHYS 491GW</td>
<td>Advanced Laboratory II - GWAR</td>
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<tr>
<td>PHYS 695</td>
<td>Culminating Experience in Physics</td>
<td>1</td>
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</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Division Electives: Astronomy, Physics, Mathematics, or related sciences</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

1 Additional upper division elective units in astronomy, mathematics, or physics may be substituted for CSC 309 by students proficient in computer programming, subject to approval by the department chair.

General Education Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Course Level</th>
<th>Units</th>
<th>Area Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral</td>
<td>LD</td>
<td>3</td>
<td>A1</td>
</tr>
<tr>
<td>Written</td>
<td>LD</td>
<td>3</td>
<td>A2</td>
</tr>
<tr>
<td>Critical</td>
<td>LD</td>
<td>3</td>
<td>A3</td>
</tr>
<tr>
<td>Physical</td>
<td>LD</td>
<td>3</td>
<td>B1</td>
</tr>
<tr>
<td>Lab</td>
<td>LD</td>
<td>1</td>
<td>B3</td>
</tr>
<tr>
<td>Mathematics</td>
<td>LD</td>
<td>3</td>
<td>B4</td>
</tr>
<tr>
<td>Arts</td>
<td>LD</td>
<td>3</td>
<td>C1</td>
</tr>
<tr>
<td>Humanities</td>
<td>LD</td>
<td>3</td>
<td>C2</td>
</tr>
<tr>
<td>Arts or</td>
<td>LD</td>
<td>3</td>
<td>C1 or C2</td>
</tr>
<tr>
<td>Humanities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social</td>
<td>LD</td>
<td>3</td>
<td>D1</td>
</tr>
<tr>
<td>Sciences:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US History</td>
<td>LD</td>
<td>3</td>
<td>D2</td>
</tr>
<tr>
<td>Social</td>
<td>LD</td>
<td>3</td>
<td>D3</td>
</tr>
<tr>
<td>Sciences:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>US &amp; CA Government</td>
<td>LD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifelong Learning</td>
<td>LD</td>
<td>3</td>
<td>E</td>
</tr>
<tr>
<td>and Self- Development (LLD)</td>
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</tr>
<tr>
<td>Physical and/or Life Science</td>
<td>UD</td>
<td>3</td>
<td>UD-B</td>
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<tr>
<td>Arts and/or Humanities</td>
<td>UD</td>
<td>3</td>
<td>UD-C</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>UD</td>
<td>3</td>
<td>UD-D</td>
</tr>
</tbody>
</table>

SF State Studies

Courses certified as meeting the SF State Studies requirements may be upper or lower division in General Education (GE), a major or minor, or an elective.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Course Level</th>
<th>Units</th>
<th>Area Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Ethnic and Racial Minorities</td>
<td>LD or UD</td>
<td>3</td>
<td>AERM</td>
</tr>
<tr>
<td>Environmental Sustainability</td>
<td>LD or UD</td>
<td>3</td>
<td>ES</td>
</tr>
</tbody>
</table>

1 Units may be taken CR/NC.
Degree completion in 60 units cannot be guaranteed when a student is pursuing a "similar" major after transfer. Determinations about "similar" majors at SF State are made by the major department during the first semester of attendance. Limited GE deferral is available when entering as an upper division student. Students who have earned an ADT should seek advising in the major department during the first semester of attendance.

General Advising Information for Transfer Students

1. Before transfer, complete as many lower-division requirements or electives for this major as possible.
2. The following courses are not required for admission but are required for graduation. Students are strongly encouraged to complete these units before transfer; doing so will provide more flexibility in course selection after transfer.
   - a course in U.S. History
   - a course in U.S. & California Government

For information about satisfying the requirements described in (1) and (2) above at a California Community College (CCC), please visit http://www.assist.org. Check any geographically accessible CCCs; sometimes options include more than one college. Use ASSIST to determine:
   - Which courses at a CCC satisfy any lower-division major requirements for this major;

Remedial courses are not transferable and do not apply to the minimum 60 units/90 quarters required for admission.

Additional units for courses that are repeated do not apply to the minimum 60 units required for upper-division transfer (for example, if a course was not passed on the first attempt or was taken to earn a better grade).

Before leaving the last California Community College of attendance, obtain a summary of completion of lower-division General Education units (IGETC or CSU GE Breadth). This is often referred to as a GE certification worksheet. SF State does not require delivery of this certification to Admissions, but students should retain this document for verifying degree progress after transfer.

Credit for Advanced Placement, International Baccalaureate, or College-Level Examination Program courses: AP/IB/CLEP credit is not automatically transferred from the previous institution. Units are transferred only when an official score report is delivered to SF State. Credit is based on the academic year during which exams were taken. Refer to the University Bulletin in effect during the year of AP/IB/CLEP examination(s) for details regarding the award of credit for AP/IB/CLEP.

Students pursuing majors in science, technology, engineering, and mathematics (STEM) disciplines often defer 6-9 units of lower-division general education in Areas C and D until after transfer to focus on remediation.
preparation courses for the major. This advice does not apply to students pursuing associate degree completion before transfer.

**Transferring From Institutions Other Than CCCs or CSUs**

Review SF State's lower-division General Education requirements. Note that, as described below, the four basic skills courses required for admission meet A1, A2, A3, and B4 in the SF State GE pattern. Courses that fulfill the remaining areas of SF State's lower-division GE pattern are available at most two-year and four-year colleges and universities.

Of the four required basic skills courses, a course in critical thinking (GE A3) may not be widely offered outside the CCC and CSU systems. Students should attempt to identify and take an appropriate course no later than the term of application to the CSU. To review more information about the A3 requirement, please visit [http://bulletin.sfsu.edu/undergraduate-education/general-education/lower-division/#AAEL](http://bulletin.sfsu.edu/undergraduate-education/general-education/lower-division/#AAEL).

Waiting until after transfer to take a single course at SF State that meets both US and CA/local government requirements may be an appropriate option, particularly if transferring from outside of California.

**All Students Must Meet the Transfer Eligibility Requirements Outlined Below for Admission.**

For more information, visit the [Undergraduate Admissions section](http://bulletin.sfsu.edu/undergraduate-education/general-education/lower-division/#AAEL).

- Complete 60 or more transferable semester units or 90 or more quarter units
- Earn a college grade point average of 2.0 or better in all transferable courses. Non-local area residents may be held to a higher GPA standard.
- Be in good standing at the last college or university attended
- Complete 30-semester units (45-quarter units) of general education, including four basic skills courses:
  a. One course in oral communication (same as CSU GE Area A1)
  b. One course in written composition (same as CSU GE Area A2)
  c. One course in critical thinking (same as CSU GE Area A3)
  d. One course in mathematics or quantitative reasoning (same as CSU GE Area B4)
- The four basic skills courses and a minimum of 60 transferable semester units (90-quarter units) must be completed by the spring semester prior to fall admission, or by the fall semester prior to spring admission. Earn a "C-" or better grade in each basic skills course.