

# BS IN PHYSICS

Units required for Major: 74-82, includes units of study in chosen concentration (see below).

Total units required for BS: 120

## Program Description

Physics is the most fundamental science and underlies our understanding of nearly all areas of science and technology. In a broad sense, physics is concerned with the study of energy, space, and matter, and with the interactions between matter and the laws that govern these interactions. More specifically, physicists study mechanics, heat, light, electric and magnetic fields, gravitation, relativity, atomic and nuclear physics, and condensed matter physics.

The BS degrees are recommended for students seeking a career in the technology sector or planning to pursue a graduate degree.

## Program Requirements

| Code                                                   | Title                                               | Units        |
|--------------------------------------------------------|-----------------------------------------------------|--------------|
| <b>Required Lower Division Core Courses (27 Units)</b> |                                                     |              |
| MATH 30                                                | Calculus I <sup>1</sup>                             | 4            |
| MATH 31                                                | Calculus II <sup>1</sup>                            | 4            |
| MATH 32                                                | Calculus III                                        | 4            |
| MATH 45                                                | Differential Equations for Science and Engineering  | 3            |
| PHYS 11A                                               | General Physics: Mechanics <sup>1</sup>             | 4            |
| PHYS 11B                                               | General Physics: Heat, Light, Sound, Modern Physics | 4            |
| PHYS 11C                                               | General Physics: Electricity and Magnetism          | 4            |
| <b>Required Upper Division Core Courses (17 Units)</b> |                                                     |              |
| PHYS 105                                               | Mathematical Methods in Physics                     | 3            |
| PHYS 106                                               | Introduction to Modern Physics                      | 3            |
| PHYS 110                                               | Classical Mechanics                                 | 3            |
| PHYS 124                                               | Thermodynamics and Statistical Mechanics            | 3            |
| PHYS 135                                               | Electricity And Magnetism                           | 3            |
| PHYS 175                                               | Advanced Physics Laboratory                         | 2            |
| <b>Physics Colloquium Attendance</b>                   |                                                     |              |
| Fulfill a minimum attendance requirement. <sup>2</sup> |                                                     |              |
| <b>Concentration (30-38 Units)</b>                     |                                                     |              |
| Select from the following concentrations:              |                                                     | 30           |
|                                                        |                                                     | -            |
|                                                        |                                                     | 38           |
| General Physics                                        |                                                     |              |
| Applied Physics                                        |                                                     |              |
| Biophysics                                             |                                                     |              |
| <b>Total Units</b>                                     |                                                     | <b>74-82</b> |

<sup>1</sup> Course also satisfies General Education (GE)/Graduation Requirement.

<sup>2</sup> Majors must fulfill a minimum attendance requirement at Department Colloquia. Students should consult with the Department for details.

## Concentration in General Physics (30-31 units)

| Code                                                                                                | Title                                              | Units        |
|-----------------------------------------------------------------------------------------------------|----------------------------------------------------|--------------|
| <b>Required Courses (27-28 Units)</b>                                                               |                                                    |              |
| CHEM 1A                                                                                             | General Chemistry I                                | 5            |
| CHEM 1B                                                                                             | General Chemistry II                               | 5            |
| PHYS 115                                                                                            | Electronics and Instrumentation                    | 3 - 4        |
| or PHYS 145                                                                                         | Optics                                             |              |
| PHYS 136                                                                                            | Electrodynamics of Waves, Radiation, and Materials | 3            |
| PHYS 150                                                                                            | Quantum Mechanics                                  | 3            |
| PHYS 151                                                                                            | Advanced Modern Physics                            | 3            |
| PHYS 156                                                                                            | Classical and Statistical Mechanics                | 3            |
| PHYS 191                                                                                            | Senior Project <sup>3</sup>                        | 2            |
| <b>Elective Courses (3 Units)</b>                                                                   |                                                    |              |
| Select three units of upper-division coursework chosen in consultation with an advisor <sup>4</sup> |                                                    | 3            |
| <b>Total Units</b>                                                                                  |                                                    | <b>30-31</b> |

<sup>3</sup> Students must complete 2 units of PHYS 191, which can be taken as 1 unit over two consecutive semesters, or as 2 units in one semester.

<sup>4</sup> See list below for a list of Department approved electives.

## Elective List

| Code      | Title                                                         | Units |
|-----------|---------------------------------------------------------------|-------|
| PHYS 115  | Electronics and Instrumentation <sup>5</sup>                  | 4     |
| PHYS 116  | Advanced Electronics and Instrumentation                      | 3     |
| PHYS 130  | Acoustics                                                     | 3     |
| PHYS 142  | Applied Solid State Physics                                   | 3     |
| PHYS 145  | Optics <sup>5</sup>                                           | 3     |
| PHYS 162  | Scientific Computing: Basic Methods                           | 3     |
| PHYS 163  | Scientific Computing: Modeling, Simulation, and Visualization | 3     |
| PHYS 172  | Biological Physics                                            | 3     |
| PHYS 195  | Teaching Internship                                           | 1 - 2 |
| PHYS 199  | Special Problems                                              | 1 - 3 |
| ASTR 150  | Dark Matter and Dark Energy                                   | 3     |
| MATH 105B | Advanced Mathematics for Science and Engineering II           | 4     |
| NSM 195A  | STEM Pedagogical Practices                                    | 1     |
| NSM 195B  | Field Experience in Secondary STEM Classrooms                 | 1     |

<sup>5</sup> If not used to satisfy other requirement of the degree (Example: PHYS 115 or PHYS 145 are required for the Bachelor of Science. If both are taken, one will count as an elective).

## General Education Requirements <sup>6</sup>

| Code                                    | Title                 | Units |
|-----------------------------------------|-----------------------|-------|
| <b>Area A: Basic Subjects (9 Units)</b> |                       |       |
| A1                                      | Oral Communication    | 3     |
| A2                                      | Written Communication | 3     |
| A3                                      | Critical Thinking     | 3     |

**Area B: Physical Universe and Its Life Forms (6 Units)**

|                                                                                                                               |   |
|-------------------------------------------------------------------------------------------------------------------------------|---|
| B1 - Physical Science <sup>7</sup>                                                                                            | 0 |
| B2 - Life Forms                                                                                                               | 3 |
| B3 - Lab (Note: Lab experience to be taken with one of the following: B1, B2 or B5) <sup>7</sup>                              | 0 |
| B4 - Math Concepts <sup>7</sup>                                                                                               | 0 |
| B5 - Additional Course (Any B to reach 12 units) - Take upper-division course to complete Area & upper division requirements. | 3 |

**Area C: Arts and Humanities (12 Units)**

|                                                                                                    |   |
|----------------------------------------------------------------------------------------------------|---|
| C1 - Arts                                                                                          | 3 |
| C2 - Humanities                                                                                    | 3 |
| C1/C2 - Area C Course                                                                              | 3 |
| C1/C2 - Area C Course - Take upper-division course to complete Area & upper division requirements. | 3 |

**Area D: The Individual and Society (9 Units)**

|                                                                                            |   |
|--------------------------------------------------------------------------------------------|---|
| Area D Course                                                                              | 3 |
| Area D Course                                                                              | 3 |
| Area D Course - Take upper-division course to complete Area & upper division requirements. | 3 |

**Area E: Understanding Personal Development (3 Units)**

|               |   |
|---------------|---|
| Area E Course | 3 |
|---------------|---|

**Area F: Ethnic Studies (3 Units)**

|               |   |
|---------------|---|
| Area F Course | 3 |
|---------------|---|

**Total Units** **42**

<sup>6</sup> To help you complete your degree in a timely manner and not take more units than absolutely necessary, there are ways to use single courses to meet more than one requirement (overlap). For further information, please visit the General Education page (<https://catalog.csus.edu/colleges/academic-affairs/general-education/>).

**Note:** There is no way to list all possible overlaps so please consult with a professional advisor. The Academic Advising Center can be visited online (<http://www.csus.edu/acad/>), by phone (916) 278-1000, or email ([advising@csus.edu](mailto:advising@csus.edu)).

<sup>7</sup> Required in Major; also satisfies GE.

**Graduation Requirements <sup>6</sup>**

| Code                                                                    | Title | Units |
|-------------------------------------------------------------------------|-------|-------|
| <b>Graduation Requirements (required by CSU) (9 Units)</b>              |       |       |
| American Institutions: U.S. History                                     |       | 3     |
| American Institutions: U.S. Constitution & CA Government                |       | 3     |
| Writing Intensive (WI)                                                  |       | 3     |
| <b>Graduation Requirements (required by Sacramento State) (6 Units)</b> |       |       |
| English Composition II                                                  |       | 3     |
| Race and Ethnicity in American Society (RE)                             |       | 3     |
| Foreign Language Proficiency Requirement <sup>8</sup>                   |       | 0     |

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**Note:** There is no way to list all possible overlaps so please consult with a professional advisor. The Academic Advising Center can be visited online (<http://www.csus.edu/acad/>), by phone (916) 278-1000, or email ([advising@csus.edu](mailto:advising@csus.edu)).

<sup>8</sup> If not satisfied before entering Sacramento State, it may be satisfied in General Education Area C2 (Humanities). "C- or better required." The alternative methods for satisfying the Foreign Language Proficiency Requirement are described here: <https://www.csus.edu/college/arts-letters/world-languages-literatures/foreign-language-requirement.html> (<https://www.csus.edu/college/arts-letters/world-languages-literatures/foreign-language-requirement.html>)

**Note:** Students with a declared major of BS in Physics are exempt from the Foreign Language Graduation Requirement.

The following roadmaps are sample planning resources. Please consult your academic advisor and Academic Catalog for graduation requirements as you develop your individualized academic plan.

**Physics, BS: 4-Year Roadmap**

| Course                                                | Title                                               | Units        |
|-------------------------------------------------------|-----------------------------------------------------|--------------|
| <b>Year 1</b>                                         |                                                     |              |
| <b>First Semester</b>                                 |                                                     |              |
| MATH 30                                               | Calculus I                                          | 4            |
| GE Area 1C - Oral Communication <sup>2</sup>          |                                                     | 3            |
| GE Area 3A - Arts <sup>2</sup>                        |                                                     | 3            |
| GR American Institutions (GOVT) <sup>2</sup>          |                                                     | 3            |
| Elective of Choice                                    |                                                     | 3            |
| <b>Units</b>                                          |                                                     | <b>16</b>    |
| <b>Second Semester</b>                                |                                                     |              |
| MATH 31                                               | Calculus II                                         | 4            |
| PHYS 11A                                              | General Physics: Mechanics                          | 4            |
| GE Area 1A - English Composition <sup>2</sup>         |                                                     | 3            |
| GE Area 5B - Biological Science <sup>2</sup>          |                                                     | 3            |
| <b>Units</b>                                          |                                                     | <b>14</b>    |
| <b>Year 2</b>                                         |                                                     |              |
| <b>First Semester</b>                                 |                                                     |              |
| MATH 32                                               | Calculus III                                        | 4            |
| MATH 45                                               | Differential Equations for Science and Engineering  | 3            |
| PHYS 11C                                              | General Physics: Electricity and Magnetism          | 4            |
| GE Area 1B - Critical Thinking <sup>2</sup>           |                                                     | 3            |
| GE Area 3B - Humanities <sup>2</sup>                  |                                                     | 3            |
| <b>Units</b>                                          |                                                     | <b>17</b>    |
| <b>Second Semester</b>                                |                                                     |              |
| ENGL 20                                               | College Composition II                              | 3            |
| PHYS 11B                                              | General Physics: Heat, Light, Sound, Modern Physics | 4            |
| GE Area 4 - Social & Behavioral Sciences <sup>2</sup> |                                                     | 3            |
| GE Area 6 - Ethnic Studies <sup>2</sup>               |                                                     | 3            |
| GR American Institutions (US History) <sup>2</sup>    |                                                     | 3            |
| <b>Units</b>                                          |                                                     | <b>16</b>    |
| <b>Year 3</b>                                         |                                                     |              |
| <b>First Semester</b>                                 |                                                     |              |
| CHEM 1A                                               | General Chemistry I                                 | 5            |
| PHYS 105                                              | Mathematical Methods in Physics                     | 3            |
| PHYS 106                                              | Introduction to Modern Physics                      | 3            |
| PHYS 115<br>or PHYS 145                               | Electronics and Instrumentation<br>or Optics        | 3 - 4        |
| <b>Units</b>                                          |                                                     | <b>14-15</b> |
| <b>Second Semester</b>                                |                                                     |              |
| CHEM 1B                                               | General Chemistry II                                | 5            |
| PHYS 110                                              | Classical Mechanics                                 | 3            |

|                                                                                                      |                                                    |                |
|------------------------------------------------------------------------------------------------------|----------------------------------------------------|----------------|
| PHYS 124                                                                                             | Thermodynamics and Statistical Mechanics           | 3              |
| PHYS 135                                                                                             | Electricity And Magnetism                          | 3              |
| Upper Division GE Area 3 - Arts or Humanities + Writing Intensive <sup>2</sup>                       |                                                    | 3              |
| <b>Units</b>                                                                                         |                                                    | <b>17</b>      |
| <b>Year 4</b>                                                                                        |                                                    |                |
| <b>First Semester</b>                                                                                |                                                    |                |
| PHYS 136                                                                                             | Electrodynamics of Waves, Radiation, and Materials | 3              |
| PHYS 150                                                                                             | Quantum Mechanics                                  | 3              |
| PHYS 156                                                                                             | Classical and Statistical Mechanics                | 3              |
| Physics Elective <sup>3</sup>                                                                        |                                                    | 3              |
| Upper Division GE Area 5 or 2 - Science or Mathematical Concepts/Quantitative Reasoning <sup>2</sup> |                                                    | 3              |
| <b>Units</b>                                                                                         |                                                    | <b>15</b>      |
| <b>Second Semester</b>                                                                               |                                                    |                |
| PHYS 151                                                                                             | Advanced Modern Physics                            | 3              |
| PHYS 175                                                                                             | Advanced Physics Laboratory                        | 2              |
| PHYS 191                                                                                             | Senior Project                                     | 1 - 2          |
| Upper Division GE Area 4 - Social & Behavioral Sciences <sup>2</sup>                                 |                                                    | 3              |
| Elective of Choice                                                                                   |                                                    | 3              |
| <b>Units</b>                                                                                         |                                                    | <b>12-13</b>   |
| <b>Total Units</b>                                                                                   |                                                    | <b>121-123</b> |

|                                                                      |              |
|----------------------------------------------------------------------|--------------|
| Upper Division GE Area 4 - Social & Behavioral Sciences <sup>2</sup> | 3            |
| Elective of Choice                                                   | 3            |
| <b>Units</b>                                                         | <b>15-16</b> |
| <b>Total Units</b>                                                   | <b>60-62</b> |

1. Any course not completed in the first semester should be taken in the second or a later semester.
2. Please see General Education/Graduation Requirement **course options** ([https://www.csus.edu/academic-affairs/curriculum-%20workflow/\\_internal/\\_documents/program-road-maps/als\\_2yr/art\\_transfer-%20roadmap-2024-25.pdf](https://www.csus.edu/academic-affairs/curriculum-%20workflow/_internal/_documents/program-road-maps/als_2yr/art_transfer-%20roadmap-2024-25.pdf)).
3. Please see an academic advisor for elective options.

**Career Options:** Astronomers, Atmospheric and Space Scientists, Nuclear Technicians, Nuclear Monitoring Technicians, Nanotechnology Engineering Technologists and Technicians, Mechatronics Engineers, Robotics Engineers, Data Scientists, Computer Programmers, Software Developers, Physics Teachers, Physicists, Postsecondary

### Physics, BS : 2-Year Roadmap

| Course                                                                                               | Title                                              | Units        |
|------------------------------------------------------------------------------------------------------|----------------------------------------------------|--------------|
| <b>Year 1</b>                                                                                        |                                                    |              |
| <b>First Semester</b>                                                                                |                                                    |              |
| PHYS 105                                                                                             | Mathematical Methods in Physics                    | 3            |
| PHYS 106                                                                                             | Introduction to Modern Physics                     | 3            |
| PHYS 115 or PHYS 145                                                                                 | Electronics and Instrumentation or Optics          | 3 - 4        |
| Upper Division GE Area 5 or 2 - Science or Mathematical Concepts/Quantitative Reasoning <sup>2</sup> |                                                    | 3            |
| GR American Institutions (GOVT) <sup>2</sup>                                                         |                                                    | 3            |
| <b>Units</b>                                                                                         |                                                    | <b>15-16</b> |
| <b>Second Semester</b>                                                                               |                                                    |              |
| PHYS 110                                                                                             | Classical Mechanics                                | 3            |
| PHYS 124                                                                                             | Thermodynamics and Statistical Mechanics           | 3            |
| PHYS 135                                                                                             | Electricity And Magnetism                          | 3            |
| Upper Division GE Area 3 - Arts or Humanities + Writing Intensive <sup>2</sup>                       |                                                    | 3            |
| Elective of Choice                                                                                   |                                                    | 3            |
| <b>Units</b>                                                                                         |                                                    | <b>15</b>    |
| <b>Year 2</b>                                                                                        |                                                    |              |
| <b>First Semester</b>                                                                                |                                                    |              |
| PHYS 136                                                                                             | Electrodynamics of Waves, Radiation, and Materials | 3            |
| PHYS 150                                                                                             | Quantum Mechanics                                  | 3            |
| PHYS 156                                                                                             | Classical and Statistical Mechanics                | 3            |
| GR American Institutions (US History) <sup>2</sup>                                                   |                                                    | 3            |
| Elective of Choice                                                                                   |                                                    | 3            |
| <b>Units</b>                                                                                         |                                                    | <b>15</b>    |
| <b>Second Semester</b>                                                                               |                                                    |              |
| PHYS 151                                                                                             | Advanced Modern Physics                            | 3            |
| PHYS 175                                                                                             | Advanced Physics Laboratory                        | 2            |
| PHYS 191                                                                                             | Senior Project                                     | 1 - 2        |
| Physics Elective <sup>3</sup>                                                                        |                                                    | 3            |