Area: Science and Engineering  
Dean: Dr. Rina Roy  
Phone: (916) 484-8107  
Counseling: (916) 484-8572  

Degree:  
A.S. - Physical Science/Mathematics  
A.S. for Transfer Degree - Physics  
A.S. - General Science  

Physical Science/Mathematics Degree  
This degree provides a broad study in the fields of physical science and mathematics. It is a good foundation for transfer to a four-year program in science, technology, engineering, or mathematics (STEM).  

Student Learning Outcomes  
Upon completion of this program, the student will be able to:  
- recognize and utilize correctly the terminology of math, statistics and/or science.  
- analyze and interpret data, charts and graphs using quantitative and qualitative methods.  
- recognize and construct valid arguments using deductive and inductive reasoning.  
- evaluate new and accepted ideas about the natural universe using testable methodology.  

Career Opportunities  
This program is intended to provide a broad foundation of skills and knowledge to help students succeed in the completion of a bachelor's degree in a variety of science, math or engineering-related areas.  

Requirements for Degree  
A minimum of 18 units from the following:  

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTR</td>
<td></td>
</tr>
<tr>
<td>CHEM</td>
<td></td>
</tr>
<tr>
<td>ENGR</td>
<td></td>
</tr>
<tr>
<td>GEOG</td>
<td></td>
</tr>
<tr>
<td>GEOL</td>
<td></td>
</tr>
<tr>
<td>MATH</td>
<td></td>
</tr>
<tr>
<td>PHYS</td>
<td></td>
</tr>
<tr>
<td>PS</td>
<td></td>
</tr>
<tr>
<td>STAT</td>
<td></td>
</tr>
</tbody>
</table>

Associate Degree Requirements: The Physical Science/Mathematics Associate in Science (A.S.) Degree may be obtained by completion of the required program, plus general education requirements, plus sufficient electives to meet a 60-unit total. See ARC graduation requirements.  

Physics A.S. for Transfer Degree  
The Associate in Science in Physics for Transfer degree provides students with a major that fulfills the general requirements of the California State University for transfer. Students with this degree will receive priority admission with junior status to the California State University system.  

The Associate in Science in Physics for Transfer degree (A.S.-T.) may be obtained by the completion of 60 transferable, semester units with a minimum of a 2.0 GPA, including (a) the major or area of emphasis described in the Required Program outlined below (earning a C or better in these courses), and (b) the Intersegmental General Education Transfer Curriculum (IGETC).  

Students interested in transferring to a CSU campus to pursue a bachelor's degree in physics should meet with a counselor to confirm the courses required for lower division preparation in the major. Although additional preparatory courses are not required for this degree, students will be better prepared if they complete differential equations, linear algebra, general chemistry, and at least one computer programming course prior to transferring.  

Requirements for Degree  

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 400 - Calculus I</td>
<td>5</td>
</tr>
<tr>
<td>MATH 401 - Calculus II</td>
<td>5</td>
</tr>
<tr>
<td>MATH 402 - Calculus III</td>
<td>5</td>
</tr>
<tr>
<td>PHYS 410 - Mechanics of Solids and Fluids</td>
<td>5</td>
</tr>
<tr>
<td>PHYS 421 - Electricity and Magnetism</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 431 - Heat, Waves, Light and Modern Physics</td>
<td>4</td>
</tr>
</tbody>
</table>

Associate in Arts for Transfer Degree Requirements: The Associate in Science in Physics for Transfer (AA-T) degree may be obtained by completion of 60 transferable, semester units with a minimum 2.0 GPA, including (a) the major or area of emphasis described in the Required Program, and (b) the Intersegmental General Education Transfer Curriculum (IGETC) Requirements.
General Science Degree

This program provides a broad study in the fields of biological and physical sciences in preparation for transfer to a four-year program and continuation of studies in upper division science courses.

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- evaluate new and accepted ideas about the natural universe using scientific methods.
- analyze a wide variety of natural phenomena using basic definitions and fundamental theories of biological or physical sciences.
- apply appropriate quantitative and qualitative methods to interpret and analyze pertinent data.
- describe the basic definitions and fundamental theories of an introductory natural science.
- articulate orally and/or in writing the importance of continuous examination and modification of accepted ideas as a fundamental element in the progress of science.
- recognize ethical components of scientific decision making and apply personal and social values within the process of decision making in scientific endeavors.

Requirements for Degree 18 Units

A minimum of 18 units from the following: .............................................. 18

Physical Science Courses:
- ASTR 300, 310, 320, 330, 400, 481, 495, 499
- CHEM 305, 306, 309, 310, 311, 400, 401, 420, 421, 423, 495, 499
- GEOG 300, 301, 305, 306, 307, 308, 309, 390, 391, 495, 499
- GEOL 300, 301, 305, 306, 310, 311, 320, 325, 330, 331, 342, 345, 390, 495, 499
- PHYS 310, 311, 312, 350, 410, 421, 431, 495, 499
- PS 300, 301, 495, 499

Biological Science Courses:
- ANTH 300, 301, 303, 370, 372, 480, 495, 499
- BIOL 300, 301, 303, 305, 310, 322, 332, 342, 352, 370, 390, 400, 410, 415, 420, 430, 431, 440, 442, 482, 490, 491, 495, 499
- BIOT 301, 305, 307, 308, 311, 312, 499
- PSYC 310, 311, 495, 499

1 must be transfer-level and must include one laboratory course in a physical science and one laboratory course in a biological science

Associate Degree Requirements: The General Science Associate in Science (A.S.) Degree may be obtained by completion of the required program, plus general education requirements, plus sufficient electives to meet a 60-unit total. See ARC graduation requirements.

### PHYS 310 Conceptual Physics 3 Units

**Prerequisite:** MATH 32 with a grade of “C” or better, or placement through the assessment process.
**Advisory:** Eligible for ENGRD 310 or ENGRD 312 AND ENGW 300; OR ESLR 340 AND ESLW 340.
**General Education:** AA/AS Area IV; CSU Area B1; IGETC Area 5A

**Course Transferable to UC/CSU**

**Hours:** 54 hours LEC

This course covers selected topics in motion, gravity, heat, sound, electricity, magnetism, light, and atomic and nuclear physics. It is designed for non-science majors and students who have not taken a course in physics. (Part of C-ID PHYS 140)

### PHYS 311 Basic Physics 3 Units

**Prerequisite:** MATH 330 with a grade of “C” or better
**Advisory:** Eligible for ENGRD 310 or ENGRD 312 AND ENGW 300; OR ESLR 340 AND ESLW 340.
**General Education:** AA/AS Area IV; CSU Area B1; IGETC Area 5A

**Course Transferable to UC/CSU**

**Hours:** 54 hours LEC

This survey course emphasizes problem solving in physics. Topics include motion in one and two dimensions, forces, energy, and momentum. It is designed for science majors who plan to continue with PHYS 410 or 350.

### PHYS 312 Conceptual Physics Laboratory 1 Unit

**Corequisite:** PHYS 310

**Advisory:** MATH 100, 104, or 132

**General Education:** AA/AS Area IV; CSU Area B3; IGETC Area 5C

**Course Transferable to UC/CSU**

**Hours:** 54 hours LAB

This laboratory course provides hands-on observation activities and interpretation of data in a variety of experimental situations. Topics include motion, sound, light, heat, electricity, and magnetism. (Part of C-ID PHYS 140)

### PHYS 350 General Physics 4 Units

**Prerequisite:** MATH 330 with a grade of “C” or better
**Advisory:** PHYS 311; and eligible for ENGRD 310 or ENGRD 312 AND ENGW 300; OR ESLR 340 AND ESLW 340.
**General Education:** AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C

**Course Transferable to UC/CSU**

**Hours:** 54 hours LEC; 54 hours LAB

This trigonometry-based physics course covers the mechanics of particles, rigid bodies, and fluids. It also covers mechanical waves, sound, heat, and thermodynamics. The PHYS 350/360 series is designed for biological science students, including those in pre-medical, pre-dental, agricultural, and forestry programs. (C-ID PHYS 105; Part of C-ID PHYS 100S)

### PHYS 360 General Physics 4 Units

**Prerequisite:** PHYS 350 with a grade of “C” or better
**Advisory:** ENGRD 102 and ENGRD 116 with a grade of “C” or better OR ESLW 320 and ESLR 320 and ESLW 320 with a grade of “C” or better.
**General Education:** CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C

**Course Transferable to UC/CSU**

**Hours:** 54 hours LEC; 54 hours LAB

This trigonometry-based physics course covers electricity, magnetism, basic electric circuit theory, optics, wave behavior, and modern physics. The PHYS 350/360 series is designed for biological science students, including those in pre-medical, pre-dental, agricultural, and forestry programs. (C-ID PHYS 110; Part of C-ID PHYS 100S)
PHYS 410  Mechanics of Solids and Fluids  5 Units
Prerequisite: MATH 400 with a grade of “C” or better
Corequisite: MATH 401
Advisory: PHYS 311; and eligible for ENGRD 310 or ENGRD 312
AND ENGRD 300; OR ESLR 340 AND ESLW 340.
General Education: AA/AS Area IV; CSU Area B1; CSU Area B3;
IGETC Area 5A; IGETC Area 5C
Course Transferable to UC/CSU
Hours: 72 hours LEC; 54 hours LAB
This calculus-based physics course covers the mechanics of particles,
rigid bodies, and fluids. The PHYS 410, 421, 431 sequence
is required for majors in physics, chemistry, or engineering.
(C-ID PHYS 205; Part of C-ID PHYS 200S)

PHYS 421  Electricity and Magnetism  4 Units
Prerequisite: MATH 401 and PHYS 410 with grades of “C” or better
Advisory: Eligible for ENGRD 310 or ENGRD 312 AND
ENGRD 300; OR ESLR 340 AND ESLW 340.
Course Transferable to UC/CSU
Hours: 54 hours LEC; 54 hours LAB
This calculus-based physics course is an in-depth treatment of
electricity and magnetism. It involves problem solving with an
emphasis on physics problems that require integral calculus.
(C-ID PHYS 210; Part of C-ID PHYS 200S)

PHYS 431  Heat, Waves, Light and Modern Physics  4 Units
Prerequisite: MATH 401 and PHYS 410 with grades of “C” or better
Advisory: Eligible for ENGRD 310 or ENGRD 312 AND
ENGRD 300; OR ESLR 340 AND ESLW 340.
Course Transferable to UC/CSU
Hours: 54 hours LEC; 54 hours LAB
This calculus-based physics course explores the fundamental
theories of thermodynamics, waves, optics, and modern physics.
Topics include heat, temperature, kinetic theory, waves, sound,
light reflection and refraction, optics, interference, diffraction,
atomic theory, and nuclear physics. (C-ID PHYS 215; Part of C-ID
PHYS 200S)

PHYS 495  Independent Studies in Physics  1-3 Units
Prerequisite: None
Course Transferable to CSU
Hours: 54-162 hours LAB
Independent Study is an opportunity for the student to extend
classroom experience in this subject, while working independently of
a formal classroom situation. Independent study is an extension of
work offered in a specific class in the college catalog. To be eligible
for independent study, students must have completed the basic
regular catalog course at American River College. They must also
discuss the study with a professor in this subject and secure approval.
Only one independent study for each catalog course will be allowed.