



Faculty

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Degrees and Programs

Physics, B.S.	163
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Physics is the search for the fundamental physical laws of nature. In particular, physics is the study of forces and motion of physical entities, seeking to find basic relations that synthesize these phenomena. The goal is to discover ways to control and predict natural occurrences and to understand and explain the physical universe. To achieve this goal involves observation and experimentation from which physical and mathematical models are developed that suggest concepts and theories. Although modern science limits itself to a naturalistic view of reality and to experimental ways of obtaining knowledge, the *Physics Department* takes the view that physical phenomena are consistent with the concept of a divine Creator.

Degrees offered include a four-year B.S. in Physics and a four-year B.S. in Biophysics.

Undergraduate Research Opportunities

Since 2008, PUC students have participated in world-class physics research, most of which has been funded through grants from the National Science Foundation and NASA. As a result, students have traveled to many national laboratories and international conferences; some are currently in the process of publishing the results of their research in peer-reviewed journals.

Major in Physics, B.S.

A minimum of 102.5 hours (35 upper-division hours)

► Required Core Courses (96.5 hours):

ASTR 115	Astronomy	5
CHEM 111+111L	General Chemistry I + Lab	4+1
CHEM 112+112L	General Chemistry II + Lab	4+1
CHEM 113+113L	General Chemistry III + Lab	4+1
INFS 115	Intro to Programming	4
MATH 131+132	Calculus I, II	4+4
MATH 265	Elementary Linear Algebra	4
MATH 267	Vector Calculus	5
MATH 269	Elementary Differential Equations	4
PHYS 216	Circuit Analysis	4
PHYS 290	Sophomore Seminar	0.5
PHYS 314	Elementary Modern Physics	4
PHYS 341+342	Classical Dynamics I,II	3+3
PHYS 361+362+363	Electromagnetic Theory I, II, III	3+3+3
PHYS 389L	Experimental Physics	1
PHYS 445	Thermal Physics	4
PHYS 461+462	Quantum Physics I, II	3+3
PHYS 489L	Advanced Experimental Physics	1

One of the following options: 12-16

PHYS 211+212+213 Physics with Calculus I, II, III (4+4+4)

or

PHYS 111+112+113 General Physics I, II, III (4+4+4)

and PHYS 265 Calculus Applications for Physics (4)

► Required Core Electives (10 hours)

At least 10 hours of non-service PHYS courses, of which 4 hours must be upper-division: 10

Additional non-service PHYS courses laboratory, project and/or independent research.

This course of study is adequate for the student who is preparing for graduate study in physics.

Physics

Major in Biophysics, B.S.

A minimum of 106.5 hours (39 upper-division hours)

► Required Core Courses (96.5 hours)

BIOL 112+111+113	Biological Foundations II, I, III	5+5+5
BIOL 320	Cellular and Molecular Biology	4
BIOL 348	Systems Physiology	5
CHEM 111+111L	General Chemistry I + Lab	4+1
CHEM 112+112L	General Chemistry II + Lab	4+1
CHEM 113+113L	General Chemistry III + Lab	4+1
CHEM 371+371L	Organic Chemistry I + Lab	3+1
CHEM 372+372L	Organic Chemistry II + Lab	3+1
CHEM 373+373L	Organic Chemistry III + Lab	3+1
CHEM 481	Biochemistry I	4
MATH 131+132	Calculus I, II	4+4
MATH 267	Multivariable Calculus	5
PHYS 216	Circuit Analysis	4
PHYS 290	Sophomore Seminar	0.5
PHYS 314	Elementary Modern Physics	4
PHYS 321	Biophysics	3
PHYS 322	Medical Physics	3
PHYS 389L	Experimental Physics	1
PHYS 489L	Advanced Experimental Physics	1

One of the following options: 12-16

PHYS 211+212+213 Physics with Calculus I, II, III (4+4+4)

or

PHYS 111+112+113 General Physics I, II, III (4+4+4)
and PHYS 265 Calculus Applications for Physics (4)

► Required Core Electives (10 hours)

At least 10 hours from the following: 10

(Including at least 2 upper-division hours)

In consultation with the advisor, select additional non-service BIOL and PHYS courses. CHEM 450L, CHEM 451, and CHEM 452 may also apply.

Recommended Courses:

INFS 115	Intro to Computer Programming (4)
MICR 134	General Microbiology (5)

This program provides the additional emphasis in the physical sciences demanded for graduate study in biophysics, physiology, medicine, medical research, radiation biology, and molecular biology. This program is also recommended as a broad major for teaching at the secondary-school level.

Minor in Physics

A minimum of 27 hours (12 upper-division hours)

Take 27 hours (12 upper-division) chosen from any non-service PHYS courses.

Teaching Credential

Students desiring to enter a program of studies leading to a California teaching credential in science with a concentration in physics should take the B.S. degree in Biophysics. Students will need to pass the science (physics concentration) portion of the CSET exam one quarter prior to doing full-time student teaching. Students are invited to discuss the program with their major advisor in the Physics Department.

Those who plan to teach on the secondary level should consult with the credential analyst in the Education Department and should become acquainted with the specific requirements for admission to and successful completion of the Teacher Education Program as outlined in the Education section of this catalog.

Astronomy

LOWER-DIVISION COURSE:

ASTR 115 **5 F, W** **Astronomy**

An introduction for the general student to the basic elements of astronomy. Topics include models of the solar system, stars and their processes, clusters, galaxies, cosmology, and relevant physics topics such as light, spectroscopy, nuclear reactions, and relativity. Emphasizes the development of scientific ideas and models for the structure and contents of the universe and the effects of those ideas on western civilization. Laboratory activities emphasize personal observations of various astronomical objects, as weather permits. Four lectures and one evening laboratory per week. Prerequisite: MATH 096 or equivalent.

Physics

SERVICE COURSES:

(Not applicable to a major or minor in this department)

PHYS 105 **5 S** **Introduction to Physics**

Emphasizes the ideas and concepts of conventional topics in physics with illustrations from everyday living. Assumes no previous physics course. (Students who need this course to meet a curricular requirement may also need to register for PHYS 106L.) Prerequisite: MATH 096 or equivalent.

PHYS 106L **1 S** **Introduction to Physics Laboratory**

A laboratory emphasizing physical measurements for those curricula requiring an introductory physics course with laboratory. One laboratory per week. Prerequisite or corequisite: PHYS 105.

LOWER-DIVISION COURSES:

PHYS 111+112+113 **4+4+4 F+W+S** **General Physics I, II, III**

A three-quarter standard sequence introducing the fundamental natural phenomena of the physical universe, with an emphasis on fundamental principles and methods of physics. Suitable for pre-professional students and also acceptable as part of the general-education requirement in basic science. Three lectures and one laboratory per week. Must be taken in sequence. Prerequisite: Knowledge of algebra and trigonometry at the level provided by MATH 130 or by MATH 106 and 113.

PHYS 111: Newtonian mechanics, fluids, waves and vibrations, and sound.

PHYS 112: Kinetic theory, thermodynamics, electricity, and magnetism.

PHYS 113: Optics, atomic and nuclear physics, elementary particle physics, and special relativity.

PHYS 211+212+213 **4+4+4 F+W+S** **Physics with Calculus I, II, III**

A three-quarter calculus-based sequence introducing the fundamental natural phenomena of the physical universe, with an emphasis on fundamental principles and methods of physics. Intended primarily for students majoring in the physical sciences, engineering or mathematics, but also appropriate for other students with the necessary background in mathematics. Three lectures and one laboratory per week. Must be taken in sequence. Prerequisite: MATH 131-132. PHYS 211: Newtonian mechanics, fluids, waves and vibrations, and sound.

PHYS 212: Kinetic theory, thermodynamics, electricity, and magnetism.

PHYS 213: Optics, atomic and nuclear physics, elementary particle physics, and special relativity.

PHYS 216 **4 S** **Circuit Analysis**

Introductory circuit analysis for engineering and physics students. Circuit variables and parameters; Kirchhoff's laws and network solution; equivalent circuits, network theorems; natural and complete response; sinusoidal steady-state, phasors and impedance; frequency characteristics; power and power factor. Three lectures and one laboratory per week. Prerequisite: MATH 131+132.

PHYS 265 **4 S** **Calculus Applications for Physics**

Applications of fundamental physical principles such as thermodynamics, solid state physics, and modern optics to selected technological and/or practical uses. Includes atomic transport processes in condensed phases, solid state physics in semiconductor, and modern optics. Three lectures and one laboratory per week. Prerequisite: PHYS 113 or 213.

PHYS 290 **0.5 W** **Sophomore Seminar**

(See also MATH 290)

Preparation of students for successful pursuit of opportunities in physics related fields of work and study. Includes an introduction to tools and resources used in physics work, CV/résumé writing, major portfolio preparation, and identifying/pursuing internships and research experiences for undergraduates (REUs). Graded S/F.

UPPER-DIVISION COURSES:

PHYS 314 **4 F** **Elementary Modern Physics**

A continuation of PHYS 211+212+213. Offers an overview of the fundamentals of relativity and quantum physics and selected topics such as atomic and molecular physics, statistical mechanics, solid state physics, nuclear physics, and

Physics

elementary particles. Three lectures and one laboratory per week. Prerequisites: MATH 269, PHYS 213 or PHYS 265.

PHYS 321 **3 W** **Biophysics**

For the upper-division physics student with adequate preparation in biology. Covers a variety of topics in which physical analysis and techniques are applied to study molecular and cellular phenomena. Prerequisites: BIOL 111+112+113, CHEM 113, PHYS 314. Even years.

PHYS 322 **3 S** **Medical Physics**

A continuation of PHYS 321. Includes the physical principles of radiology, diagnostic imaging, and nuclear medicine. Prerequisite PHYS 321. Even years.

PHYS 341+342 **3+3 F+W** **Classical Dynamics I, II**

Classical mechanics including Newtonian mechanics and Lagrangian dynamics, which are used to solve problems associated with central-force motion, rigid object dynamics, oscillations, and wave motion. The theoretical bases of problems are emphasized, together with the development of different problem-solving techniques. Prerequisites: MATH 265, 267, 269, PHYS 213. Even years.

PHYS 361+362+363 **3+3+3 F+W+S** **Electromagnetic Theory I, II, III**

Topics include electrostatics, magnetostatics, electromagnetism, electromagnetic radiation, and relativistic electrodynamics. The concepts of field and potentials are emphasized. Prerequisites: MATH 265, 267, 269, PHYS 213. Odd years.

PHYS 389L **1 F, W, S** **Experimental Physics**

Provides experience with real science apparatus such as lasers, high field magnets, detectors, radioactive sources,

and sophisticated electronics. Activities include experiments in mechanics, electromagnetism, optics, heat, and atomic and nuclear physics. One laboratory per week. Repeatable to a maximum of 5 credits. Prerequisites: PHYS 216. Corequisite: PHYS 314.

PHYS 390 **3 Arranged** **History and Philosophy of Science** (See also PHIL 390)

The historical roots of modern science, the nature of scientific knowledge, its development and methodology, the impact of science on culture (and vice versa), and the influence of philosophical and theological concepts on science. Prerequisites: PHYS 105 or CHEM 101; PHIL 101 or demonstrated preparedness for course.

PHYS 445 **4 S** **Thermal Physics**

A statistical description of a system of particles. Different ensembles and their associated partition functions are emphasized and applied to various thermal systems. Prerequisites: MATH 265, 267, 269; PHYS 314. Even years.

PHYS 461+462 **3+3 W+S** **Quantum Physics I, II**

Quantum mechanics and atomic physics. Topics include wave packets, Schrödinger's equation and its solutions, operator methods, angular momentum, matrix representation, spin, perturbation theory, the hydrogen atom, and radiation by atoms. Prerequisites: MATH 265, 267, 269; PHYS 314. Odd years.

PHYS 485 **3 Arranged** **Issues in Science and Religion** (See also PHIL 485)

The relationship and interaction between science and religion: epistemology, the methods, languages, scope and limitations of science and religion, problems of ethics and science. Prerequisites:

PHYS 105, CHEM 101, or equivalent; PHIL 101 or demonstrated preparedness for course.

PHYS 486 **1-4 Arranged** **Special Topics in Physics**

Study of a selected topic not covered elsewhere in the curriculum. Course content varies from year to year, with topics such as Solid State Physics, High Energy Physics, and Applied Optics. Repeatable for credit.

PHYS 489L **1 S** **Advanced Experimental Physics**

Culminating educational experience for physics major students as the final experimental physics course required to complete the physics curriculum. In addition to continuing the experience and activities provided in PHYS 389L, students will communicate and/or publish their results. Prerequisite: PHYS 389L. Qualifies for IP grading.

PHYS 495 **1-3 Arranged** **Independent Study**

Properly qualified students majoring in physics may, with the approval of the department chair, undertake an independent study of a topic suited to their background and experience. Repeatable to a maximum of 3 credits.

PHYS 499 **1-3 F, W, S** **Independent Research**

Properly qualified students majoring in physics may, with the approval of the department chair, undertake a directed research problem suited to their background and experience. Repeatable to a maximum of 9 credits.