

## 2009-11 Cal Poly Catalog

### Physics Department

#### PHYS–PHYSICS

- PHYS 104 Introductory Physics (4)** **GE B3**  
Elementary introduction to mechanics, gases, liquids and solids, heat, vibrations and waves, light, electricity and magnetism. Intended to provide non-science students with an understanding of basic physical concepts. Not open to students who have credit in a college physics course. 4 lectures. Prerequisite: Passing score on ELM examination, or an ELM exemption, or credit in MATH 104. Fulfills GE B3.
- PHYS 107 Introduction to Meteorology (4)** **GE B3**  
Physics of Earth's atmosphere. Topics include the physical basis for temperature, wind generation, atmospheric circulation, humidity, adiabatic processes, cloud formation, cyclone development, precipitation, and storm growth. Other topics include the variety of storms and their effects, satellite imaging, and air pollution and its possible effect on global temperature change. 4 lectures. Prerequisite: Passing score on ELM examination, or an ELM exemption, or credit in MATH 104. Fulfills GE B3.
- PHYS 111 Contemporary Physics for Nonscientists (4)** **GE B3**  
Exploration of the key concepts of quantum mechanics and Einstein's special and general theories of relativity. Particle-wave duality, Heisenberg's uncertainty principle, Schrodinger's cat, warped spacetime, black holes. 4 lectures. Fulfills GE B3.
- PHYS 115 Physics of Sound and Music (4)** **GE B3**  
Fundamental physical principals of sound production in musical instruments; woodwind, brass, strings, piano and percussion. Generation and interference of mechanical and sound waves; overtone series, musical scales and Fourier spectra of complex waves. Electronic sound recording and production. Hearing and voice. Auditorium and room acoustics. 4 lectures. Prerequisite: Passing score on the ELM examination for MATH 116 eligibility, or an ELM exemption, or MATH 104. Fulfills GE B3.
- PHYS 118 Introductory College Physics (4)**  
Introductory course in physics emphasizing motion, force, torque, momentum, and energy. Applications to human motion and metabolism. Primarily for students in kinesiology. Not open to students with credit in PHYS 121 or PHYS 131 or PHYS 141. 4 lectures. Prerequisite: MATH 118 and high school trigonometry, or MATH 119. *Change effective Winter 2010.*
- PHYS 121 College Physics I (4)** **GE B3 & B4**  
Introductory course in mechanics emphasizing motion, force, and energy. Not open to students having a grade of C- or better in PHYS 131 or PHYS 141. 3 lectures, 1 laboratory. Prerequisite: MATH 118 and high school trigonometry, or MATH 119. Fulfills GE B3 & B4.
- PHYS 122 College Physics II (4)** **GE B3 & B4**  
Continuation of PHYS 121. Topics include properties of materials, fluids, waves and vibrations, sound, heat, light and optics. Not open for credit to students having a grade of C- or better in PHYS 132. 3 lectures, 1 laboratory. Prerequisite: PHYS 118, PHYS 121, PHYS 131, or PHYS 141. Fulfills GE B3 & B4. *Change effective Spring 2011.*
- PHYS 123 College Physics III (4)**  
Continuation of PHYS 121 and 122. Electrostatics, electric current, magnetic fields and induction. Elements of modern physics. Not open for credit to students having a grade of C- or better in PHYS 133. 3 lectures, 1 laboratory. Prerequisite: PHYS 118, PHYS 121, PHYS 131, or PHYS 141. Recommended: PHYS 122. *Change effective Spring 2011.*
- PHYS 131 General Physics I (4)** **GE B3 & B4**  
Fundamental principles of mechanics. Vectors, particle kinematics. Equilibrium of a rigid body. Work and energy, linear momentum, rotational kinematics and dynamics. Primarily for engineering students, and for students majoring in the physical sciences. Not open to students with credit in PHYS 141. 3 lectures, 1 laboratory. Prerequisite: MATH 141 with grade C- or better and MATH 142 or MATH 182 (or concurrent enrollment). Recommended: high school physics. For ME and AERO students only. *Crosslisted as HNRS/PHYS 131.* Fulfills GE B3 & B4.

#### **PHYS 132 General Physics II (4)** **GE B3 & B4**

Oscillations, waves in elastic media, sound waves. Temperature, heat and the first law of thermodynamics. Kinetic theory of matter, second law of thermodynamics. Geometrical and physical optics. 3 lectures, 1 laboratory. Prerequisite: PHYS 131 or HNRS 131 or PHYS 141. *Crosslisted as HNRS/PHYS 132.* Fulfills GE B3 & B4.

#### **PHYS 133 General Physics III (4)** **GE B3 & B4**

Charge and matter, electric field, electric potential, dielectrics, capacitance, current and resistance, electromotive force and circuits, magnetic fields, magnetic field of a moving charge, induced emf. 3 lectures, 1 laboratory. Prerequisite: PHYS 131 or HNRS 131 or PHYS 141, and MATH 142. Fulfills GE B3 & B4.

#### **PHYS 141 General Physics IA (4)** **GE B3**

Fundamental principles of mechanics. Vectors, particle kinematics. Equilibrium of a rigid body. Work and energy, linear momentum, rotational kinematics and dynamics. Primarily for engineering and science students. Not open to students with credit in PHYS 131. 4 lectures. Prerequisite: MATH 141 with grade C- or better and MATH 142 or MATH 182 (or concurrent enrollment). Recommended: High school physics. *Crosslisted as HNRS 134/PHYS 141.* Fulfills GE B3.

#### **PHYS 200 Special Problems for Undergraduates (1–2)**

Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of department chair.

#### **PHYS 201 Learning Center Tutor (1) (CR/NC)**

Act as a tutor in the Physics Learning Center. Help students with problem solving techniques and introductory physics course material. Total credit limited to 3 units, with a maximum of 1 unit per quarter. Credit/No Credit grading only. Prerequisite: PHYS 133 and consent of instructor.

#### **PHYS 202 Physics on the Computer (4)**

Introduction to using computers for solving problems in physics: differential equations, matrix manipulations, simulations and numerical techniques, nonlinear dynamics. 4 lectures. Prerequisite: PHYS 133, and MATH 241 or MATH 244 (preferred) and computer literacy.

#### **PHYS 206 Instrumentation in Experimental Physics (3)**

L-R-C circuits and electronic circuit elements emphasizing the applications of analog and digital electronics to instrumentation in modern physics. 3 lectures. Prerequisite: PHYS 133, MATH 143, and concurrent enrollment in PHYS 256.

#### **PHYS 211 Modern Physics I (4)**

Special relativity, fundamental principles of quantum mechanics, emphasizing the modern description of atomic phenomena. Kinetic theory, wave particle duality, Bohr theory, Schrodinger equation, elementary atomic structure. 4 lectures. Prerequisite: PHYS 123, or PHYS 132 and PHYS 133, and MATH 241.

#### **PHYS 212 Modern Physics II (4)**

Applications of quantum physics to atoms, nuclei, and elementary particles. Quantum statistics, principles of the laser. Topics in solid state physics such as the free electron theory of metals, bonding in solids and energy bands. Nuclear structure and nuclear energy. 4 lectures. Prerequisite: PHYS 211.

#### **PHYS 256 Electrical Measurements Laboratory (1)**

Experimental studies of circuit analysis and electronics; introduction to digital techniques; instrumentation. 1 laboratory. Prerequisite: PHYS 133, MATH 143, and concurrent PHYS 206.

#### **PHYS 270 Selected Topics (1–4)**

Directed group study of selected topics. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1 to 4 lectures. Prerequisite: Open to undergraduate students and consent of instructor.

#### **PHYS 301 Thermal Physics I (3/4)**

Thermodynamics and statistical mechanics. Entropy, temperature, ensembles, partition functions, chemical potential, free energy. Selected applications including paramagnetism, ideal gas, Fermi-Dirac and Bose-Einstein distributions. *Correction: 3 lectures through Winter 2010; 4 lectures –change effective Spring 2010.* Prerequisite: PHYS 132, PHYS 211, MATH 241.

#### **PHYS 302 Classical Mechanics I (4)**

Laws of motion, kinematics and dynamics of a particle. Work and energy. Linear and angular momentum. Use of numerical methods for solving problems. Oscillatory motion (damped and forced oscillation). Coupled oscillators. Newton's Law of gravity, orbital motion, and central force

problems. 4 lectures. Prerequisite: PHYS 131 or PHYS 141, MATH 242 or MATH 244 or MATH 344 (preferred).

**PHYS 303 Classical Mechanics II (3)**

Dynamics of a rigid body. Three-dimensional motion of a rigid body. Introduction to Lagrange's and Hamilton's equations. 3 lectures. Prerequisite: PHYS 302. Concurrent: MATH 344.

**PHYS 310 Physics of Energy (3)**

Physics and mathematics applied to broad energy topics. Efficient usage, transportation, solar energy, nuclear fission and fusion. Plasma, hydrogen economy, fuel cells, wind wave, tidal, and geothermal energy. Transmission, storage, fossils. National planning, and energy economics. 3 lectures. Prerequisite: PHYS 133.

**PHYS 313 Introduction to Atmospheric Physics (3)**

Properties of the atmosphere, atmospheric motions, solar and terrestrial radiation. Emphasis on conservation laws of momentum, energy and mass applied to understanding the Earth's atmospheric motions. 3 lectures. Prerequisite: PHYS 132 or PHYS 122 and MATH 241. Recommended: MATH 304.

**PHYS 315 Introduction to Lasers and Laser Applications (3)**

Interaction of radiation with matter, theory of laser action, characteristics and modification of laser output, types of lasers. Holography and other applications. 3 lectures. Prerequisite: PHYS 133, or PHYS 123 and MATH 143. Recommended: PHYS 211.

**PHYS 317 Special Theory of Relativity (3)**

Fundamental experiments and basic postulates of special relativity. Simultaneity, length and time measurements. Lorentz transformations. Four-Vectors. Space-time diagrams. Relativistic mechanics and electromagnetism. 3 lectures. Prerequisite: PHYS 211.

**PHYS 322 Vibrations and Waves (3)**

Introduction to vibrations and waves and their applications. Harmonic oscillator, waves, complex notation, superposition, interference, coherence, Fourier analysis. Applications may include sound, optics, quantum mechanics, and electromagnetic radiation. 3 lectures. Prerequisite: PHYS 132, MATH 244. Recommended: MATH 344.

**PHYS 323 Optics (4)**

Geometric optics, lens systems, aberration, physical optics and polarization. 3 lectures, 1 laboratory. Prerequisite: PHYS 133, MATH 241. Recommended: PHYS 322.

**PHYS 340 Quantum Physics Laboratory I (2)**

Experimental studies of the quantum properties of atoms and nuclei. Measurements of fundamental constants. Statistics and data analysis. 1 lecture, 1 laboratory. Prerequisite: PHYS 212 and PHYS 256.

**PHYS 341, 342 Quantum Physics Laboratory II, III (2) (1)**

Advanced experimental studies of quantum properties of atoms and nuclei. Interactions with radiation, particles and fields. Courses must be taken in numerical order. PHYS 341: 2 laboratories; PHYS 342: 1 laboratory. Prerequisite: PHYS 340.

**PHYS 357 Advanced Instrumentation in Experimental Physics (3)**

Advanced analog and digital electronics, computer interfacing to experiments, robotics. 2 lectures, 1 laboratory. Prerequisite: PHYS 206 and PHYS 256.

**PHYS 363 Undergraduate Seminar (2)**

Study and oral presentation of physics topics of interest to students and faculty. Discussion of projects and research by students and faculty. 2 seminars.

**PHYS 400 Special Problems for Advanced Undergraduates (1-2)**

Individual investigations, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of department chair.

**PHYS 401 Thermal Physics II (3)**

Additional topics in thermodynamics and statistical physics, including chemical equilibrium, phase transitions, transport processes, and cryogenics. 3 lectures. Prerequisite: PHYS 301.

**PHYS 403 Nuclear and Particle Physics (3)**

Advanced nuclear physics topics. The two-nucleon problem at low energy. The deuteron. Subnuclear particles and their structure. Elementary particles. Symmetries and conservation laws. Parity, charge conjugation and time reversal

invariance. Hadronic interactions. The weak interaction. 3 lectures. Prerequisite: PHYS 212 and PHYS 405.

**PHYS 405 Quantum Mechanics I (4)**

Wave nature of matter and the basic postulates of quantum mechanics. The wave function, operators, and their interpretation. Schroedinger's equation and its solutions in one and more dimensions. The hydrogen atom and the periodic table. 4 lectures. Prerequisite: PHYS 211, MATH 244. Recommended: PHYS 212, PHYS 322, MATH 344.

**PHYS 406 Quantum Mechanics II (3)**

Angular momentum operators and problems in three dimensions including the hydrogen atom. The elements of matrix mechanics and spin wave functions. Perturbation theory. 3 lectures. Prerequisite: PHYS 405.

**PHYS 408 Electromagnetic Fields and Waves I (4)**

Electric and magnetic field theory using vector analysis. Electric fields, dielectric materials, magnetic fields, induced emf, magnetic materials, Maxwell's equations, wave equation. 4 lectures. Prerequisite: MATH 304. *Change effective Winter 2011.*

**PHYS 409 Electromagnetic Fields and Waves II (3)**

Wave equation, plane electromagnetic waves, guided waves. Dipole radiation, radiation from an accelerated charge. Special relativity. 3 lectures. Prerequisite: PHYS 408. Recommended: PHYS 322. *Change effective Winter 2011.*

**~~PHYS 408, 409 Electromagnetic Fields and Waves I, II (4) (3)~~**

~~Electric and magnetic field theory using vector analysis. Electric fields, dielectric materials, magnetic fields, induced emf's, magnetic materials, Maxwell's equations, wave equation, plane electromagnetic waves. Dipole radiation, radiation from an accelerated charge. 4 lectures, 3 lectures. Prerequisite: MATH 304. Recommended for PHYS 409: PHYS 322. *Change effective Winter 2011 (see above).*~~

**PHYS 410 Physics of the Solid Earth (3)**

Gravity and the figure of the Earth. Body wave seismology, structure and composition of the Earth, heat flow and heat sources, Earth tides, rotational dynamics, the geomagnetic field and its source, paleomagnetism. 3 lectures. Prerequisite: PHYS 133 and MATH 244 or equivalent.

**PHYS 412 Solid State Physics (3)**

**GE B6 with PHYS 452**

Properties of solids including the structural, mechanical, thermal, and electronic properties, energy band theory and the properties of metals and semiconductors. 3 lectures. Prerequisite: PHYS 211 or MATE 340, MATH 244. Fulfills GE B6 with PHYS 452.

**PHYS 413 Advanced Topics in Solid State Physics (3)**

Semiconducting devices, including junction and field-effect transistors, LED's, and diode lasers. Magnetic properties of solids. Superconductivity, including discussion of high-temperature superconductors. Other topics of current interest in solid state physics. 3 lectures. Prerequisite: PHYS 412.

**PHYS 417 Nonlinear Dynamical Systems (4)**

**GE B6**

Analysis of linear and nonlinear dynamical systems with emphasis on geometrical methods and visualization techniques. Fixed points, phase plane analysis, bifurcations and limit cycles. Laboratory component includes data acquisition and analysis using computers, numerical simulations of dynamical systems, and analysis of discrete systems. 3 lectures, 1 laboratory. Prerequisite: MATH 242 or MATH 244, and junior standing. Fulfills GE B6.

**PHYS 422 Polymer Electronics Laboratory (1)**

Experimental procedures in polymer electronics. Investigation of the characteristics of a polymer electronic device. 1 laboratory. Prerequisite: EE 347 *with a C- grade or better* or MATE 340 or CHEM 319 or PHYS 340. *Crosslisted as EE/PHYS 422. (Change effective Spring 2010)*

**PHYS 423 Advanced Optics (4)**

Advanced topics of modern optics. May include: fiber optics, Fourier optics, quantum optics, lasers, holography, non-linear optics. 3 lectures, 1 laboratory. Prerequisite: PHYS 323.

**PHYS 424 Theoretical Physics (3)**

Contour integration in the complex plane, properties of the delta function, properties of some common functions of theoretical physics, Green's function techniques for solving differential equations. 3 lectures. Prerequisite: PHYS 133, MATH 304, MATH 344.

**PHYS 452 Solid State Physics Laboratory (1) GE B6 with PHYS 412**

Selected experiments on X-ray diffraction, Hall effect, optical absorption, thermo-electric effect, photovoltaic cells, diode characteristics, and superconductivity. 1 laboratory. Prerequisite or concurrent: PHYS 412. Fulfills GE B6 with PHYS 412.

**PHYS 461, 462 Senior Project I, II (2) (2)**

Selection and completion of a project under faculty supervision. Projects typical of problems which graduates must solve in their fields of employment. Project results are presented in a formal report. Minimum 120 hours total time.

Prerequisite: Consent of instructor.

**PHYS 463, 464 Senior Project - Laboratory Research I, II (2) (2)**

Selection and completion of a laboratory research project under faculty supervision. Projects typical of problems which graduates will encounter in industry or graduate school. Project results are presented in a formal report. Minimum 120 hours total time. 2 laboratories. Prerequisite: Consent of instructor.

**PHYS 470 Selected Advanced Topics (1-4)**

Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1 to 4 lectures. Prerequisite: Consent of instructor.

**PHYS 471 Selected Advanced Laboratory (1-4)**

Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1 to 4 laboratories. Prerequisite: Consent of instructor.

**PHYS 485 Cooperative Education Experience (6) (CR/NC)**

Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 12 units; major credit limited to 2 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

**PHYS 495 Cooperative Education Experience (12) (CR/NC)**

Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 12 units; major credit limited to 2 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.