

# PHYSICS

College of Natural and Behavioral Sciences  
Department of Physics

## Program Description

Physics is the study of the natural world at its foundation. As such it is the basis of other disciplines such as biology, medicine, chemistry, computer science, geology, astronomy, and engineering. Physicists study the world from the smallest particles of matter (quarks and leptons), nuclei, atoms, and molecules; through forces and motions which determine the properties of solids, liquids, gases, and plasmas; to descriptions of the behavior of matter on all scales up to stars, galaxies, and even the origin and fate of the universe. Other researchers explore how physics itself can be learned. Physics is also

For the traditional physics baccalaureate degree, the department offers a General Physics Option, which provides access to advanced theoretical and technical careers. In addition, students may gain experience by participating in research projects (e.g. neutrino experiments, nuclear physics experiments, Physics Education Research, Nuclear Counter-Terrorism and Homeland Security, and Biophysics).

Since many physics majors find their niche in teaching, the department offers a Physical Science Option tailored to meet education standards and satisfy waiver requirements for a single subject teaching credential. The Physics faculty are committed to teaching excellence, and to teacher education in the sciences. The department provides essential laboratory hands-on experience in understanding and demonstrating science.

For students intending to pursue graduate work or employment in Electrical Engineering, the department offers an Electrical Engineering option, intended to facilitate a seamless transition after graduation. A new agreement with the CSU Long Beach's College of Electrical Engineering, through the use of the concurrent enrollment program, allows students to gain the specific skill to open their opportunities for careers in fields associated with Electrical Engineering as well as foundations to allow them to apply to Electrical Engineering graduate programs. This partnership requires students to take 5 upper-division EE courses with the CSULB EE department starting their junior year.

The Physics Minor has flexible upper division requirements to encourage students majoring in other fields to broaden their expertise to fit a niche in contemporary technology or research. Students are invited to meet with a physics advisor to map areas of interest and expertise. The most successful physics minors distinguish themselves as mathematics majors in applied math, computer science majors in computer hardware, chemistry students in physical chemistry, music majors in electronics and instrumentation, and clinical science majors with elements of nuclear physics (modern physics).

The Physics Department offers a Master's of Science in Systems Engineering (MSSE), the first degree-granting program on the CSUDH campus. This program is designed for professionals who are interested in gaining deeper knowledge and/or training in Systems Engineering. The MSSE program at CSUDH provides students with the latest, cutting-edge skills and design methods for the realization and management of the complex, interdependent systems required to develop and maintain today's products and systems in rapidly changing environments. The curriculum balances theory with practical projects and case studies, enabling students to understand and implement applicable models to

enhance and complement systems engineering activities throughout a project's life cycle.

## Features

The CSUDH Physics department is the most diverse physics department in the country in terms of its faculty. We pride ourselves on our ability to utilize our diverse backgrounds and lived experiences to connect with all students in our courses and within our campus as a whole. Our full-time faculty's research represents a broad range of specialties and we welcome all physics and STEM students to join our research groups to advance the work we do locally as well as nationally. Our department is dedicated to creating a welcoming and supportive environment for all students who decide to join our major or take our courses in the pursuit of their academic goals. We are particularly in tune with the experiences of 1<sup>st</sup> generation college students, variety of socioeconomic status, educational and mathematical preparation levels, and what is often described as non-traditional students, students who come to college later in life, work full-time or have other home obligations like caretaking of family members. Our non-tenure-track faculty are highly valued and supported in the physics department. In addition to their teaching contributions, they often share their expertise and knowledge through workshops and professional development sessions in other areas of research as well as through their industry professional careers.

Another attractive feature of the department is its small class size, allowing students to interact frequently and effectively with instructors within and outside of class. It also permits instructors to easily identify students in need of additional assistance and to supply such assistance. Many of our majors work part-time in local high-tech organizations. Upper-division courses are often offered in the late afternoon or evening to make courses more accessible for these students.

Progress in this science often depends on our innovation in designing advanced experimentation to observe natural phenomena (when driven to its limits), or in computational or mathematical modeling to match a complex phenomenological response. Since new discoveries and techniques are instantly shared with the global community, the department is committed to introducing students to computer analysis techniques and internet web literacy. Excellent computer facilities are available on campus.

We support the development of a physics identity and a physics community by encouraging our students to join and participate in our physics club, a campus-recognized student organization. Though our physics club is student-run, the department supports professional development, peer-mentoring, and social activities through the guidance of a faculty advisor.

## Academic Advising

All prospective students should meet with a Physics department faculty member to learn more about the physics major and minor and to receive assistance in planning a schedule of courses. All physics majors must review their course list with a physics advisor prior to registration each semester.

## Preparation

Prior to beginning, a program in physics students are required to complete two years of high school algebra, one year of trigonometry, and one year of geometry. Two years of laboratory science and four years

of college preparatory English are required. Prior courses in computer programming and calculus are recommended.

Students transferring from an articulating community college should have completed three semesters of calculus (through differential and integral calculus of several variables), two semesters of calculus-based physics, and one semester of general chemistry. If those students have not had an introduction to modern physics and/or mathematical physics, they must take PHY 134: General Physics III and PHY 306 Math Methods In Physics as soon as possible upon arrival at CSUDH. Transfer students are responsible for checking in advance that their general electives will meet transfer requirements. A transfer student who has effectively completed their calculus and calculus-based introductory physics sequence is given credit for the lower division courses and should be able to complete our physics upper-division requirements in two years.

## Scholarships for Full-time Physics Majors

Contact the Physics Department Office, NSM B-202, for information on available scholarships that the department offers each year.

## Graduation with Honors

An undergraduate student may be a candidate for graduation with Honors in the Physics major provided he or she has fulfilled the following:

1. Has filed an approved graduation check for a B.S. in Physics during the current academic year with the General Physics, Physical Science, or Electrical Engineering option;
2. Has attained an overall CSUDH GPA of 3.35 and a GPA in the Physics major of 3.25;
3. Has or will have taken upon graduation the last 12 semester units of upper-division requirements and the last 20 units overall in residence at CSUDH. Transfer units may be included if they help the student satisfy the GPA requirements;
4. Has been reviewed and recommended by the Physics faculty for graduation with honors in Physics.

## Departmental-Professional Organizations, and Co-curricular Activities

The CSUDH Physics Club, Society of Physics Students, and Sigma Pi Sigma (National Physics Honor Society) cooperate in offering lectures, social programs and field trips to promote student participation in and enjoyment of the sciences. These activities are enriching and greatly enhance our students' growth within our community of scholars. In addition, faculty are often willing to sponsor inexpensive student memberships in national physics organizations that publish ongoing research in various areas of physics and engineering. The department sponsors a colloquium series with talks a few times each semester on various topics in physics and engineering.

## Career Possibilities

Graduates find technical positions in industry, government, or teaching; or pursue advanced degrees for research, design, or analysis in physics, engineering or related fields. The campus is surrounded by electronics, aerospace, and semiconductor companies, among others, who hire physicists to work in applications of optics, electrical engineering, biophysics, computer science, geophysics, aerospace, and astronomy.

## Undergraduate Programs

### Bachelor

- Physics, Bachelor of Science (<https://catalog.csudh.edu/academics/physics/physics-bs/>)

### Minor

- Physics, Minor (<https://catalog.csudh.edu/academics/physics/physics-minor/>)

## Faculty

Ximena C. Cid, Department Chair  
 Antonia Boadi, Horace Crogman, James (Jim) Hill, John W. Price, Miguel Rodriguez

## Full-Time Staff

To Dang, Technician  
 Christina Trujillo, Office Manager

## Emeritus Faculty Courses

Michael Durand, Kenneth Ganezer, H. Keith Lee, Samuel L. Wiley

## Courses

### PHY 100. Patterns In Nature. (3 Units)

Unifying principles of elastic, sound, light and matter waves. Models of nature. Successes and failures of wave and particle models and their synthesis. Designed for non-science students. Partially meets the lower division General Education requirement in Natural Sciences.  
 Offered Fall, Spring

### PHY 110. Computer Methods in Applied Physics. (3 Units)

Prerequisite: MAT 151 or MAT 153. Introduction to programming with physics applications. Students will gain insight into physical phenomena. They will learn to relate theory to experiment through the use of interactive physics simulations.  
 Offered All terms, Spring

### PHY 120. Elements Of Physics I. (4 Units)

Prerequisite: High school or college algebra. Motion, energy, waves and heat treated from a non-calculus point of view. Three hours of lecture and three hours of laboratory per week.  
 Offered Fall, Spring, Summer

### PHY 122. Elements Of Physics II. (4 Units)

Prerequisite: PHY 120. Electricity, magnetism and light. Nuclear radiation. Quantum phenomena. Atomic structure. Three hours of lecture and three hours of laboratory per week.  
 Offered Fall, Spring

### PHY 130. General Physics I. (5 Units)

Prerequisite: MAT 191 or concurrent enrollment. Kinematics and dynamics of particles, rigid bodies and fluids. Kinetic theory, temperature and thermodynamics. Calculus-based course. Four hours of lecture and three hours of laboratory per week.  
 Offered Fall, Spring

### PHY 132. General Physics II. (5 Units)

Prerequisites: MAT 193 or concurrent enrollment, and PHY 130. Waves, light, electricity and magnetism. Four hours of lecture and three hours of laboratory per week.  
 Offered Fall, Spring

**PHY 134. General Physics III. (4 Units)**

Prerequisite: PHY 132 or consent of instructor. Twentieth century physics, including concepts of relativity and quantum theory and particle classification. Applications to radiation, atoms, elementary particles and nuclei. Three hours of lecture and three hours of laboratory per week. Offered Fall, Spring

**PHY 195. Selected Topics in Physics. (1-4 Units)**

Prerequisites: Consent of instructor. The study of an area of Physics that is not normally available in other courses. Repeatable course. Offered As needed

**PHY 201. Experimental Methods. (3 Units)**

Fabrication techniques applicable in the laboratory per week. Properties of materials. Three hours of laboratory per week. Offered Infrequent

**PHY 207. Physics W/Clin Sci App. (4 Units)**

Prerequisites: High school algebra, CHE 110 and CHE 112. Electricity, magnetism and electromagnetic waves. Light, including the photon model. Laboratory emphasis on solid state devices and electronic instrumentation. Designed for students in the Clinical Sciences. Three hours of lecture and three hours of laboratory per week. Offered Infrequent

**PHY 295. Selected Topics in Physics. (3 Units)**

Prerequisites: Consent of instructor. The study of an area of Physics that is not normally available in other courses. Repeatable course. Offered As needed

**PHY 300. Physical Science for Teachers. (4 Units)**

Prerequisite: Admission to the Liberal Studies major. Designed specifically for future elementary and middle school teachers. Emphasis on the fundamental concepts of physical science and their applications. Laboratory experiments use mostly low cost everyday objects. Topics include mechanics, fluids, heat, waves, electromagnetism, light, atoms, periodic table and chemical bonding. Three hours of lecture and three hours of laboratory per week. Offered Fall, Spring, Summer

**PHY 302. Wrkshp Phys Sci Fr Teachr. (3 Units)**

Lecture-demonstration-laboratory covering fundamental concepts in physical science, designed especially for in-service teachers (K-12). Class emphasizes on hands-on activities using everyday objects. Two hours of lecture and three hours of laboratory per week. Not for physics majors or minors. CR/NC grading. Offered Infrequent

**PHY 306. Math Methods In Physics. (3 Units)**

Prerequisite: MAT 211. Application of the following techniques to physics: vectors, Gauss' and Stokes' theorems, series solutions of differential equations, Sturm - Liouville theory, and Fourier Series. Offered Fall, Spring

**PHY 310. Theoretical Mechanics I. (3 Units)**

Prerequisites: PHY 130, PHY 306 and MAT 211. Newtonian dynamics of one and two particles. Introduction to Lagrange's equations. Includes computer simulations. Offered Fall

**PHY 320. Physical Optics. (3 Units)**

Prerequisite: PHY 132 or consent of instructor. Scalar wave equations, interference and diffraction, spacial filtering, coherence and holography. Offered Spring

**PHY 331. Audio Electronics. (3 Units)**

Prerequisite: PHY 100 or consent of instructor. Selection and utilization of electronic components and instrumentation. Solid state circuit design and construction. Fundamental electronics through linear amplifiers, power supplies, filters and feedback. A project is required. Designed for students interested in audio techniques. Two hours of lecture and three hours of laboratory per week. Offered Infrequent

**PHY 333. Analog Electronics. (3 Units)**

Prerequisite: PHY 122 or PHY 132 or consent of instructor. Selection and utilization of electronic components and instrumentation. Solid state circuit design and construction. Amplifiers, feedback techniques, operational amplifiers, SCRs, FETs, etc. A project is required. Two hours of lecture and three hours of laboratory per week. Offered Fall, Spring

**PHY 335. Digital Electronics. (3 Units)**

Prerequisites: PHY 122 or PHY 132 or consent of instructor is required, PHY 333 is recommended. Design and use of systems employing digital integrated circuits. Gates, Boolean algebra, combinatorial and sequential design. Multiplexers, flip-flops, shift registers, ALUs and memories. Two hours of lecture and three hours of laboratory per week. Offered Spring

**PHY 337. Microprocessors. (3 Units)**

Prerequisite: PHY 335 or consent of instructor. Architecture, programming and interfacing of microcomputers. Input/output, instruction sets, subroutines, interrupts, serial communications and process control. Two hours of lecture and three hours of laboratory per week. Offered Infrequent

**PHY 339. Instrumentation. (3 Units)**

Prerequisite: PHY 333. Measurement techniques, transducers, noise reduction, signal processing in the analog and digital domains. Computer controlled instrumentation and data acquisition. Bus configurations and interfacing. Two hours of lecture and three hours of laboratory per week. Offered Infrequent

**PHY 341. Advanced Laboratory. (2 Units)**

Prerequisites: PHY 132 (or 122) and 333. Advanced experimental work, including data acquisition and error analysis techniques. Experiments are taken from several of the major areas of physics, such as optics and spectroscopy, solid state, acoustics, nuclear physics and electronics. Course may be repeated for credit with instructor's approval. One hour of lecture and one three hours laboratory period per week. Offered Spring

**PHY 346. Thermal Physics. (3 Units)**

Prerequisites: PHY 130 and MAT 211. Laws of thermodynamics. Equations of state, entropy, free energies, kinetic theory and concepts of statistical physics. Offered Spring

**PHY 350. Electromagnetic Theory I. (3 Units)**

Prerequisites: PHY 132, PHY 306 and MAT 211 are required; MAT 213 is recommended. Electro- and magnetostatics. Electromagnetic properties of matter, Faraday's law of induction, direct and alternating currents. Includes computer simulations. Offered Fall

**PHY 352. Electromagnetic Theory II. (3 Units)**

Prerequisite: PHY 350. Derivation and applications of Maxwell's equations in vacuum and material media. Electromagnetic radiation. Includes computer simulations. Offered Spring

**PHY 356. Astrophysics. (3 Units)**

Prerequisites: PHY 132 and PHY 134. Quantitative study of stellar astronomy with emphasis on stellar evolution and cosmology. Includes computer simulations.  
Offered Spring even

**PHY 380. Non-Linear Phenomena. (3 Units)**

Prerequisites: MAT 311 or PHY 306; PHY 310 recommended. Linear systems, iterated maps, differential flows, conservative systems, routes to chaos, strange attractors, fractals, coherent structures, and pattern formation. Visits to computer lab will be included.  
Offered Spring

**PHY 395. Selected Topics in Physics. (1-4 Units)**

Prerequisites: Consent of instructor. The study of an area of Physics that is not normally available in other courses. Repeatable course.  
Offered As needed

**PHY 460. Quantum Mechanics I. (3 Units)**

Prerequisites: PHY 134, PHY 306 and MAT 211. Quantum phenomena; postulates and interpretation; Schroedinger's equation in one, two and three dimensions. Applications to atoms and barrier penetration.  
Offered Fall

**PHY 462. Quantum Mechanics II. (3 Units)**

Prerequisite: PHY 460. Spin, identical particles. Applications of quantum mechanics to problems of current interest in physics, such as solid state, nuclear, astrophysics and particle physics.  
Offered Spring odd

**PHY 494. Independent Study. (3 Units)**

Prerequisites: Upper division standing and completion of an independent study contract are required. A reading program on a specialized topic in Physics under the supervision of a faculty member. Repeatable course.  
Offered Fall, Spring

**PHY 495. Selected Topics Physics. (3 Units)**

Prerequisites: Upper division standing and consent of instructor. The study of an area of Physics that is not normally available in other courses. Repeatable course.  
Offered As needed

**PHY 498. Directed Research. (1-3 Units)**

Prerequisites: Upper division standing and consent of instructor. Advanced laboratory work in an area related to physics or instrumentation. The student participates in an independent investigation under faculty supervision. Repeatable course. Three to nine hours of laboratory per week.  
Offered Fall, Spring

**PHY 595. Special Topics in Physics. (1-4 Units)**

Prerequisite: Consent of instructor. Advanced course of special interest to graduate students. Topic and content will vary as announced.  
Offered As needed