Physics, B.S.

The goal of the undergraduate majors in Physics and Applied Physics is to develop expert problem solvers with a broad understanding of physical principles. The programs are flexible and prepare students for careers in industrial research, applications programming, education, law, or business, as well as for graduate study in astronomy, biomedical physics, engineering, or physics.

Students choose a major in either pure Physics or Applied Physics. The major in Physics includes a standard track for graduate study in physics, a Specialization in Astrophysics, and Concentrations in Computational Physics, the Philosophy of Physics, and Physics Education. The major in Applied Physics allows students to combine physics courses with courses from overlapping disciplines, such as materials science, electrical engineering, geosciences, biomedical imaging, or other fields. Annual mandatory meetings with faculty advisors assist students in selecting the right program for their aptitudes and interests.

Different sequences of lower-division physics courses are distinguished by their intended audience, their mathematical prerequisites, and the extent to which they offer preparation for more advanced courses. These aspects of the introductory courses are summarized as follows:

Physics 3: *Intended audience:* Premedical students, Biological Sciences majors. *Prerequisites:* concurrent enrollment in MATH 2A. *Preparation for advanced courses:* PHYSICS 7D with permission.

Physics 7: *Intended audience:* Physical Sciences and Engineering majors. *Prerequisite:* concurrent enrollment in MATH 2B. *Preparation for advanced courses:* PHYSICS 51A or PHYSICS 61A.

Physics 12-21: *Intended audience:* Nonscience majors. *Prerequisites:* none. *Preparation for advanced courses:* none.

Students may be admitted to the Physics or Applied Physics majors upon entering the University as freshmen, via change of major, or as transfer students from other colleges and universities. Information about change of major policies is available in the Physical Sciences Student Affairs Office and at the UCI Change of Major Criteria website (http://www.changeofmajor.uci.edu/). For transfer student admission, preference will be given to junior-level applicants with the highest grades overall and who have satisfactorily completed the following required courses: one year of approved calculus and one year of calculus-based physics with laboratory for engineering and physics majors. Completion of multivariable calculus, linear algebra, and differential equations is recommended.

All students must meet the University Requirements (http://catalogue.uci.edu/informationforadmittedstudents/requirementsforabachelorsdegree/).

School Requirements: None.

Departmental Requirements

MATH 2A	Single-Variable Calculus I
or MATH 5A	Calculus for Life Sciences I
MATH 2B	Single-Variable Calculus II
MATH 2D- 2E	Multivariable Calculus I and Multivariable Calculus II
MATH 3A	Introduction to Linear Algebra
MATH 3D	Elementary Differential Equations
PHYSICS 7C- 7D- 7E	Classical Physics and Classical Physics and Classical Physics
PHYSICS 7LC- 7LD	Classical Physics Laboratory and Classical Physics Laboratory
PHYSICS 50	Introductory Mathematical Physics
PHYSICS 52A- 52B- 52C	Fundamentals of Experimental Physics and Fundamentals of Experimental Physics and Fundamentals of Experimental Physics
PHYSICS 53	Introduction to Programming and Numerical Analysis (or another programming course)
PHYSICS 60	Thermal Physics
PHYSICS 61A	Modern Physics for Majors
PHYSICS 61B	Modern Physics for Majors
or PHYSICS 61C	Introduction to Astrophysics
PHYSICS 111A- 111B	Classical Mechanics and Classical Mechanics

PHYSICS 112A- 112B	Electromagnetic Theory and Electromagnetic Theory
PHYSICS 113A	Quantum Mechanics
PHYSICS 115A	Statistical Physics
PHYSICS 121W	Advanced Laboratory
PHYSICS 125A	Mathematical Physics
PHYSICS 194	Research Communication for Physics Majors
And select five additional coherently related four-unit courses. (This requirement is normally satisfied by concentrations, specializations, and tracks, as listed below.)	

Upper-Division Writing Requirement: Physics majors are required to satisfy the upper-division writing requirement by completing PHYSICS 194 with a grade of C- or better, followed by PHYSICS 121W with a grade of C- or better.

Sample Program — Physics Core Curriculum

Freshman		
Fall	**Winter**	**Spring**
MATH 2B	MATH 2D	MATH 2E
PHYSICS 7C- 7LC	PHYSICS 7D- 7LD	PHYSICS 7E
(PHYSICS 99)		
Sophomore		
Fall	**Winter**	**Spring**
MATH 3A	MATH 3D	PHYSICS 52C
PHYSICS 52A	PHYSICS 52B	PHYSICS 53
PHYSICS 60	PHYSICS 61A	PHYSICS 61B or 61C
Junior		
Fall	**Winter**	**Spring**
PHYSICS 111A	PHYSICS 111B	PHYSICS 112B
PHYSICS 50	PHYSICS 112A	PHYSICS 113A
Senior		
Fall	**Winter**	
PHYSICS 115A	PHYSICS 121W	
PHYSICS 194	PHYSICS 125A	

For a student planning graduate study in physics, additional courses in advanced physics are strongly recommended.

Concentration in Computational Physics

The **Computational Physics concentration** provides training for positions in software development in a wide variety of high-technology fields. For example, consider medical imaging software for magnetic resonance imaging. To write a first-rate program, one must understand the apparatus and analysis techniques (physics), use appropriate numerical techniques (numerical analysis), and employ a convenient object-oriented interface (computer science). The concentration develops this unique set of skills: physical and mathematical insight through the Physics curriculum, knowledge of modern computer programming techniques, and knowledge of numerical analysis.

Requirements:	
Three courses in computer science:	
I&C SCI 31	Introduction to Programming
I&C SCI 32	Programming with Software Libraries
I&C SCI 33	Intermediate Programming
Two courses in numerical analysis plus the accompanying laboratories:	
MATH 105A- 105B	Numerical Analysis I and Numerical Analysis II
MATH 105LA- 105LB	Numerical Analysis Laboratory and Numerical Analysis Laboratory
One advanced computational course and accompanying laboratory:	

MATH 107- 107L	Numerical Differential Equations and Numerical Differential Equations Laboratory

Sample Program — Computational Physics Concentration

Junior		
Fall	**Winter**	**Spring**
I&C SCI 31	I&C SCI 32	I&C SCI 33
Senior		
Fall	**Winter**	**Spring**
MATH 105A- 105LA	MATH 105B- 105LB	MATH 107- 107L

Concentration in Philosophy of Physics

The **Philosophy of Physics concentration** is concerned with the study of the conceptual history of physics, the method of inquiry that has led to our best physical theories, and the structure and interpretation of the theories themselves. Students take courses in deductive and inductive logic, the philosophy and history of physics, and quantum mechanics. The emphasis on careful argument makes this concentration useful for anyone who wishes to pursue a graduate degree in philosophy or law, or for other careers that employ both verbal and quantitative analysis.

Requirements:	
Select one from the following:	
LPS 40	The Nature of Scientific Inquiry
LPS 60	The Making of Modern Science
SOC SCI H1G	Honors: Critical Issues on the Social Sciences
LPS H125	What Is Time?
or another approved Campuswide Honors course	
Select one of the following:	
LPS 30	Introduction to Symbolic Logic
LPS 104	Introduction to Logic
LPS 105A- 105B- 105C	Introduction to Set Theory and Mathematical Reasoning and Metalogic and Undecidability and Incompleteness
MATH 150	Introduction to Mathematical Logic
Complete:	
LPS 31	Introduction to Inductive Logic
Select one from the following:	
LPS 104	Introduction to Logic
LPS 105A- 105B- 105C	Introduction to Set Theory and Mathematical Reasoning and Metalogic and Undecidability and Incompleteness
LPS 140	Topics in Philosophy of Science
MATH 150	Introduction to Mathematical Logic
Complete:	
PHYSICS 113B	Quantum Mechanics
Select three from the following:	
LPS 141B	Geometry and Spacetime
LPS 141D	Probability and Determinism
or other approved Philosophy of Physics course	

Concentration in Physics Education

The **Physics Education concentration** is for students who plan a career in secondary education. An Education course, four general science courses, a research methods course, and two quarters of classroom experience complete the requirements for the concentration. Students are encouraged to take PHYSICS 191 (outreach).

Requirements:	
EDUC 55	Knowing and Learning in Mathematics and Science
PHY SCI 5	California Teach 1: Introduction to Science and Mathematics Teaching

PHY SCI 105	California Teach 2: Middle School Science and Mathematics Teaching
PHYSICS 193	Research Methods
Select four courses from the following:	
BIO SCI 93	From DNA to Organisms
BIO SCI 94	From Organisms to Ecosystems
CHEM 1A- 1B- 1C	General Chemistry and General Chemistry and General Chemistry
EARTHSS 1	Introduction to Earth System Science
EARTHSS 7	Physical Geology
PHYSICS 20A- 20B	Introduction to Astronomy and Cosmology: Humanity's Place in the Universe

NOTE: With this concentration, a Secondary Teaching Certification option is available.

Secondary Teaching Certification Option: With *additional* course work and field experience offered through the UCI Cal Teach program, students who complete the concentration in Physics Education can also earn a California Preliminary Single Subject Teaching Credential. Completing the bachelor's degree, concentration, and teacher certification in four years is possible with careful, early planning. Additional courses required for teacher certification are:

LPS 60	The Making of Modern Science
EDUC 109	Reading and Writing in Mathematics and Science
EDUC 143AW	Classroom Interactions I
EDUC 143BW	Classroom Interactions II
EDUC 148	Complex Pedagogical Design [1]
EDUC 158	Student Teaching Mathematics and Science in Middle/High School (two quarters)

1 Successful completion of EDUC 143AW-EDUC 143BW and EDUC 148 will be accepted in lieu of PHYSICS 125A and PHYSICS 194 for Cal Teach students.

For additional information about teacher certification requirements and enrollment procedures, see Preparation for Teaching Science and Mathematics (http://catalogue.uci.edu/schoolofphysicalsciences/#undergraduateprogramstext). Interested students are strongly encouraged to contact the Cal Teach Resource and Advising Center or the Physical Sciences Student Affairs Office.

Sample Program — Concentration in Physics Education with Secondary Teaching Certification Option

Freshman		
Fall	**Winter**	**Spring**
MATH 2B	MATH 2D	MATH 2E
PHYSICS 7C- 7LC	PHYSICS 7D- 7LD	PHYSICS 7E
General Education	General Education	General Education
(PHYSICS 99)	PHY SCI 5	General Education
Sophomore		
Fall	**Winter**	**Spring**
MATH 3A	MATH 3D	PHYSICS 60
PHYSICS 52A	PHYSICS 61A	PHYSICS 61B
PHY SCI 105	PHYSICS 52B	PHYSICS 52C
	PHYSICS 193	LPS 60
Junior		
Fall	**Winter**	**Spring**
PHYSICS 50	PHYSICS 111B	PHYSICS 53
PHYSICS 111A	PHYSICS 112A	PHYSICS 112B
General Science	General Science	PHYSICS 113A
General Science	EDUC 143AW	EDUC 148
EDUC 55		
Senior		
Fall	**Winter**	**Spring**
PHYSICS 115A	General Education	PHYSICS 121W

General Science	EDUC 109	General Education
EDUC 143BW	EDUC 158	EDUC 158

Specialization in Astrophysics

The Astrophysics specialization is primarily taken by two types of students, those planning on going on to graduate school in astronomy or astrophysics and those planning to work in aeronautics or astrophysics-related industries or government research laboratories after receiving their bachelor's degree. It also is an excellent focus for students who anticipate careers in science journalism, teaching, science administration, or public relations. The course work includes:

A. Complete:	
PHYSICS 61C	Introduction to Astrophysics
PHYSICS 139	Observational Astrophysics
B. Select three courses from the following:	
PHYSICS 137	Introduction to Cosmology
PHYSICS 138	Astrophysics of Galaxies
PHYSICS 144	Stellar Astrophysics
PHYSICS 145	High-Energy Astrophysics
C. Two or more upper-division Physics courses. Of the Physics electives, students bound for graduate school are strongly advised to include:	
PHYSICS 113B	Quantum Mechanics
PHYSICS 125B	Mathematical Physics
Other recommended electives include:	
PHYSICS 116	Relativity and Black Holes
PHYSICS 134A	Physical and Geometrical Optics
PHYSICS 135	Plasma Physics
PHYSICS 136	Introduction to Particle Physics

Sample Program — Astrophysics Specialization

Junior		
Fall	**Winter**	**Spring**
PHYSICS 137	PHYSICS 116	PHYSICS 144 or 145
Senior		
Fall	**Winter**	**Spring**
PHYSICS 113B	PHYSICS 138	PHYSICS 135
PHYSICS 139		PHYSICS 125B
		PHYSICS 144 or 145

The Honors Program in Physics encourages all students majoring in Physics or Applied Physics to consider advanced work in one of the research areas of the Department. To qualify for Honors in Physics, students should begin a research project with a supervising faculty member no later than fall of their senior year and then complete three quarters of Honors Thesis in Physics (PHYSICS H196A-PHYSICS H196B-PHYSICS H196C). Students have to complete the H196 sequence and submit a final written thesis before graduation. If this work is deemed of honors quality by the program advisor, and the student's grade point average is at least 3.4 overall and 3.5 in physics courses, the student will graduate with Departmental Honors in Physics.

Physics 3 is a one-year course suitable for premedical students, students majoring in Biological Sciences, and nonscience majors. It surveys most of the important branches of physics. Laboratory work accompanies the course. Nonscience majors with some mathematical skill may wish to consider Physics 3 as an alternative to PHYSICS 12 through PHYSICS 21.

A student who decides to major in Physics after completing Physics 3 should meet with the Department Undergraduate Advisor for placement information.

Physics 7 is an intensive three-quarter course for students in Physical Sciences and Engineering who are interested in a more quantitative approach to introductory physics. Two units of laboratory work accompany the course.

Physics courses numbered between 12 and 21 are general education courses intended for nonscience majors. The content and format of PHYSICS 21 may vary from year to year.

The introduction to mathematical methods (MATH 2E, MATH 3A, MATH 3D, and PHYSICS 50), microscopic physics (PHYSICS 61A-PHYSICS 61B), and experimental physics (PHYSICS 52A-PHYSICS 52B-PHYSICS 52C) are normally taken in the sophomore year.

Courses numbered 100 and above are for Physics majors and other qualified students. Courses numbered between 111 and 115 emphasize the mathematical and theoretical structures that have unified our understanding of nature. It should be noted that multi-quarter courses such as 111A-B

must be taken and passed in sequential order. Any student who is so inclined may take more than the minimum one quarter of advanced laboratory work. Courses numbered between 133 and 149 introduce active subdisciplines in current research. Independent research (PHYSICS 195, PHYSICS 196) is strongly encouraged. In PHYSICS 194, students learn the basics of writing about science, proper use of references and background material, presentation of research proposals, and more.

Transfer students are specifically advised to seek individual consultation with the Department Undergraduate Advisor before deciding on a program of courses.

All Physics and Applied Physics majors must complete the core courses listed with the sample programs. By the end of the junior year, each student is encouraged to select a concentration or track.

Note that alternatives to Physics major requirements can be approved upon petition to the Department and the Office of the Associate Dean. Furthermore, exceptionally prepared students are allowed to enroll in graduate-level courses; to do so requires the approval of the Department Undergraduate Advisor.

Sample Program - Physics Graduate School Track

Junior		
Fall		
PHYSICS 115A or 116		
Senior		
Fall	**Winter**	**Spring**
PHYSICS 113B	PHYSICS 113C	PHYSICS 135
PHYSICS 115A or 116	Physics Elective	PHYSICS 125B
Physics Elective		Physics Elective

Students preparing for graduate school in atmospheric science or physical oceanography should complete the minor in Earth and Atmospheric Sciences.

- Applied Physics, B.S.
- Physics, Ph.D.