

University of California, Berkeley

UNDERGRADUATE COURSE DESCRIPTIONS

Lower Division Courses

**7A. Physics for Scientist and Engineers. (4)** Three hours of lecture and four hours of laboratory / workshop per week. *Prerequisites: High School physics, Math 1A or Math1AS; Math 1B or Math 1BS (may be taken concurrently).* Mechanics and wave motion. (F, SP) Staff

**7B. Physics for Scientist and Engineers. (4)** Three hours of lecture and four hours of laboratory / workshop per week. *Prerequisites: 7A; Math 1A-1B, Math 53 (may be taken concurrently).* Heat, electricity and magnetism. (F, SP) Staff

**7C. Physics for Scientist and Engineers. (4)** Three hours of lecture, one hour of discussion and three hours of laboratory per week. *Prerequisites: Prerequisites: 7A-7B; Math 1A-1B, Math 53-54 (Math 54 must be taken concurrently, if it has not been completed).* Electromagnetic waves, physical optics, relativity and quantum physics. (F, SP) Staff

**H7A-C. Honors Physics for Scientist and Engineers. (4; 4; 4)** Students will receive no credit for H7A after taking 7A. Three hours of lecture, one hour of discussion and three hours of laboratory per week. *Prerequisites: High School physics, Math 1A-1B, Math 53 and Math 54 (Please see Math requirements for the regular 7 sequence).* Honors sequence corresponding to 7A-7B-7C, but with a greater emphasis on theory as opposed to problem solving. Recommended for those students who have had advanced physics at the high school and who are intending to declare a major in physics. Entrance into H7A is decided on the basis of performance on an examination given during the first week of class or the consent of the instructor, and into H7B-H7C on performance in previous courses in a standard sequence. (F, SP) Staff

**8A. Introductory Physics. (4)** Students with credit for 7A will not receive credit for 8A. Three hours of lecture and four hours of discussion / laboratory week. *Prerequisites: Mathematics 16A or equivalent or consent of instructor.* Introduction to forces, kinetics, equilibria, fluids, waves, and heat. This course presents concepts and methodologies for understanding physical phenomena, and is particularly useful preparation for upper division study in biology and architecture. (F,SP) Staff.

**8B. Introductory Physics. (4)** Students with credit for 7B or 7C will not receive credit for Physics 8B. Three hours of lecture and four hours of discussion / laboratory section per week. *Prerequisites: 8A or equivalent.* Introduction to electricity, magnetism, electromagnetic waves, optics, and modern physics. The course presents concepts and methodologies for understanding physical phenomena, and is particularly useful preparation for upper division study in biology and architecture. (F,SP) Staff.

**10. Descriptive Introduction to Physics. (3)** Three hours of lecture and one hour of discussion per week. *Prerequisites: Open to students with or without high school physics.* The most interesting and important topics in physics, stressing conceptual understanding rather than math, with applications to current events. Topics covered may vary and may include energy and conservation, radioactivity, nuclear physics, the Theory of Relativity, lasers, explosions, earthquakes, superconductors, and quantum physics. (F,SP) Staff

**C10. Descriptive Introduction to Physics. (3)** Students will receive no credit for C10 after taking 10. Three hours of lecture and one hour of discussion per week. Prerequisites: Open to students with or without high school physics. The most interesting and important topics in physics, stressing conceptual understanding rather than math, with applications to current events. Topics covered may vary and may include energy and conservation, radioactivity, nuclear physics, the Theory of Relativity, lasers, explosions, earthquakes, superconductors, and quantum physics. Also listed as Letters and Science C70V. (F,SP) Staff

**21. Physics of Music. (2)** Two hours of lecture and one hour of discussion per week. Prerequisites: No previous courses in Physics are assumed, although Physics 10 is recommended. Physical principles encountered in the study of music. The applicable laws of mechanics, fundamentals of sound, harmonic content, principles of sound production in musical instruments, musical scales. Numerous illustrative lecture demonstrations will be given. Only the basics of high school algebra and geometry will be used. (SP) Staff

**C21. Physics and Music. (2)** Two hours of lecture and one hour of discussion per week. Prerequisites: Open to students with or without high school physics. What can we learn about the nature of reality and the ways that we humans have invented to discover how the world works? An exploration of these questions through the physical principles encountered in the study of music. The applicable laws of mechanics, fundamentals of sound, harmonic content, principles of sound production in musical instruments, musical scales. Numerous illustrative lecture demonstrations will be given. Only the basics of high school algebra and geometry will be used. Also listed as Letters and Science C70W. (SP) Staff

**24. Freshman Seminars. (1)** Course may be repeated for credit as topic varies. One hour of seminar per week. The Berkeley Seminar Program has been designed to provide new students with the opportunity to explore an intellectual topic with a faculty member in a small-seminar setting. Berkeley Seminars are offered in all campus departments, and topics vary from department to department and semester to semester. (F, SP) Staff

**39. Lower Division Physics Seminar. (1.5)** Course may be repeated for credit. Two hours of lecture per week. Must be taken on a *passed/not passed* basis. Prerequisites: Enrollment by consent of instructor. Consult bulletin boards outside of 366 LeConte for more information. Enrollment limited to 20 students per section. Seminar course designed for both non-major students and those students considering a major in physics. Topics will vary from semester to semester. (F, SP) Staff

**49. Supplementary Work in Lower Division Physics. (1-3)** Course may be repeated for credit. Meetings to be arranged. Students with partial credit in lower division physics courses may, with consent of instructor, complete the credit under this heading. (F, SP) Staff

**84. Sophomore Seminar. (1)** One hour of seminar per week. Sections 1-2 to be graded on a passed/not passed basis. Sections 3-4 to be graded on a letter-grade basis. Sophomore seminars are designed for students considering a major in the sponsoring department. They are small, interactive courses in which students will encounter a topic typical of the discipline and become acquainted with the approaches and methods of scholars in that field. Sophomore seminar instructors will become faculty mentors for the students from the time they declare the major until the time they graduate. (F, SP) Staff

**98. Directed Group Study. (1-4)** Course may be repeated for credit as topic varies. Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog. One to four hours of directed group study per week. Must be taken on a passed/not passed basis. Prerequisites: Restricted to freshman and sophomores only; consent of instructor. (F, SP) Staff

**99. Supervised Independent Study. (1-4)** Course may be repeated for credit as topic varies. Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog. One to four hours of independent study per week. Must be taken on a passed/not passed basis. Prerequisites: Restricted to freshmen and sophomores only; consent of instructor. (F, SP) Staff

### Upper Division Courses

*Physics 7A-7C (regular or honors), Math 1A-1B, 53-54, or their equivalents are prerequisite to all upper division courses except Physics 132.*

**100. Communicating Physics and Physical Science. (2)** Two hours of lecture/fieldwork per week. For undergraduate and graduate students interested in improving their ability to communicate scientific knowledge by teaching science in K-12 schools. The course will combine instruction in inquiry-based science teaching methods and learning pedagogy with 10 weeks of supervised teaching experience in a local school. Students will practice, with support and mentoring, communicating scientific knowledge through presentations and hands-on activities. Approximately three hours per week including time spent in school classrooms. (SP) Staff

**105. Analytic Mechanics. (4)** Three hours of lecture and one hour of discussion per week. Newtonian mechanics, motion of a particle in one, two, and three dimensions, Lagrange's equations, Hamilton's equations, central force motion, moving coordinate systems, mechanics of continuous media, oscillations, normal modes, rigid body dynamics, tensor analysis techniques. (F,SP) Staff

**110A-110B. Electromagnetism and Optics. (4;4)** Three hours of lecture and one hour of discussion per week. A course emphasizing electromagnetic theory and applications; charges and currents; electric and magnetic fields; dielectric, conducting, and magnetic media; relativity, Maxwell equations. Wave propagation in media, radiation and scattering, Fourier optics, interference and diffraction, ray optics and applications. (F,SP) Staff

**111. Modern Physics and Advanced Electrical Laboratory. (1-3)** Course may be repeated for a maximum of 9 units. Six units required for physics major; nine units may be taken for credit. No more than 3 units may be completed in one semester. Eight hours of laboratory per week. Prerequisites: 137A or consent of instructor. The first semester (3 units), on Basic Semiconductor Circuits (BSC), covers introductory analog and digital circuits. The class meets for two 4-hour afternoon lab sessions, and a 1-1/2 hour weekly lecture. In the second semester, Advanced Lab (3 units), students complete 4 of 20+ advanced experiments. These include many in atomic, nuclear, classical, and solid-state physics, among others. Students may, with approval, enroll in an optional third semester for variable units. (F,SP) Staff

**112. Introduction to Statistical and Thermal Physics. (4)** Three hours of lecture and one hour of discussion per week. Basic concepts of statistical mechanics, microscopic basis of thermodynamics and applications to macroscopic systems, condensed states, phase transformations, quantum distributions, elementary kinetic theory of transport processes, fluctuation phenomena. (F,SP) Staff

**129. Particle Physics. (4)** Three hours of lecture and one hour of discussion per week. Prerequisites: 137A, 137B (may be taken concurrently), or consent of instructor. Formerly 129A. Tools of particle and nuclear physics. Properties, classification, and interaction of particles including the quark-gluon constituents of hadrons. High energy phenomena analyzed by quantum mechanical methods. Course will survey the field including some related topics in nuclear physics. (F) Staff

**130. Quantum and Nonlinear Optics. (3)** Three hours of lecture and one hour of discussion per week. Prerequisites: 110A and 137A-137B, or consent of instructor. Detailed theory and experimental basis of quantum and nonlinear optics, exhibiting concepts of quantum measurement, noise, stochastic processes and dissipative quantum systems. Topics include second-quantization of electromagnetic fields, photodetection, coherence properties, light-atom interactions, cavity quantum electrodynamics, nonlinear optical systems, squeezed light, aspects of quantum information science, and contemporary research. (F,SP) Staff

**132. Contemporary Physics. (3)** Not open for credit to students who have completed 137A. Three hours of lecture and one hour of discussion per week. Prerequisites: 8A-8B or equivalent or consent of instructor. A general descriptive course of selected topics in contemporary physics. Subject matter will vary and may include topics from special and general relativity, atomic and nuclear physics, radiation, fundamental particles and their symmetries, superconductivity and superfluidity, solid state physics, astrophysics, and cosmology. (SP) Staff

**137A-137B. Quantum Mechanics. (4;4)** Three hours of lecture and one hour of discussion per week. Introduction to the methods of quantum mechanics with applications to atomic, molecular, solid state, nuclear and elementary particle physics. (F,SP) Staff

**138. Modern Atomic Physics. (3)** Three hours of lecture and one hour of discussion per week. Prerequisites: 137A-137B. This course covers atomic, molecular, and optical physics as a quantitative description of atoms and fields, a generalized toolbox for controlling quantum systems, and a vibrant research area. Topics covered include atomic structure and spectra, atom-field interactions, topics in quantum electrodynamics, methods of resonant manipulation of quantum systems, resonance optics, and experimental techniques. (F,SP) Staff

**139. Special Relativity and General Relativity. (3)** Three hours of lecture and one hour of discussion per week. Prerequisites: 105, 110A or consent of instructor. Historical and experimental foundations of Einstein's special theory of relativity; spatial and temporal measurements, particle dynamics, electrodynamics, Lorentz invariants. Introduction to general relativity. Selected applications. Designed for advanced undergraduates in physics and astronomy. (SP) Staff

**141A-141B. Solid State Physics. (4;3)** Three hours of lecture and one hour of discussion per week. Prerequisites: 137A-137B; 137B may be taken concurrently. A thorough introductory course in modern solid state physics. Crystal symmetries; classification of solids and their bonding; electromagnetic, elastic, and particle waves in periodic lattices; thermal magnetic and dielectric properties of solids; energy bands of metals and semi-conductors; superconductivity; magnetism; ferroelectricity; magnetic resonances. (F,SP) Staff

**142. Introduction to Plasma Physics. (4)** Three hours of lecture and one hour of discussion per week. Prerequisites: 105, 110A-110B (110B may be taken concurrently). Motion of charged particles in electric and magnetic fields, dynamics of fully ionized plasma from both microscopic and macroscopic point of view, magnetohydrodynamics, small amplitude waves; examples from astrophysics, space sciences and controlled-fusion research. (SP) Staff

**151. Elective Physics: Special Topics. (3)** Course may be repeated for credit as topic varies. Three hours of lecture and one hour of discussion per week. Prerequisites: Consent of instructor. Topics vary from semester to semester. The subject matter level and scope of the course are such that it is acceptable as the required elective course in the Physics major. See Department of Physics course announcements. (F,SP) Staff

**C161. Relativistic Astrophysics and Cosmology. (4)** Three hours of lecture and one hour of discussion per week. Elements of general relativity. Physics of pulsars, cosmic rays, black holes. The cosmological distance scale, elementary cosmological models, properties of galaxies and quasars. The mass density and age of the universe. Evidence for dark matter and dark energy and concepts of the early universe and of galaxy formation. Reflections on astrophysics as a probe of the extrema of physics. Also listed as Astronomy C161. (SP) *Arons, Boggs, Davis, Holzapfel, A. Lee, Ma, Quataert*

**177. Principles of Molecular Biophysics. (3)** Three hours of lecture and one hour of discussion per week. Prerequisites: 112 or consent of instructor. We will review the structure of proteins, nucleic acids, carbohydrates, lipids, and the forces and interactions maintaining their structure in solution. We will describe the thermodynamics and kinetics of protein folding. The principles of polymer chain statistics and of helix-coil transitions in biopolymers will be reviewed next, together with biopolymer dynamics. We will then cover the main structural methods in biology: X-ray crystallography, MNR and fluorescence spectroscopy, electron and probe microscopy, and single molecular methods. (SP) Staff

**H190. Physics Honors Course. (2)** Course may be repeated for credit. Must be taken on a passed/not passed basis. A seminar which includes study and reports on current theoretical and experimental problems. Open to all students. (F) Staff

**C191. Quantum Information Science and Technology. (3)** Three hours of lecture/discussion per week. Prerequisites: Mathematics 54, Physics 7A-7B, and either Physics 7C, Mathematics 55, or Computer Science 170. This multidisciplinary course provides an introduction to fundamental conceptual aspects of quantum mechanics from a computational and informational theoretic perspective, as well as physical implementations and technological applications of quantum information science. Basic sections of quantum algorithms, complexity, and cryptography, will be touched upon, as well as pertinent physical realizations from nanoscale science and engineering. Also listed as Chemistry C191 and Computer Science C191. (F,SP) *Crommie, Vazirani, Whaley*

**H195A-H195B. Senior Honors Thesis Research. (2;2)** Credit and grade to be awarded on completion of sequence. Prerequisites: Open only to students in the honors program. Thesis work under the supervision of a faculty member. To obtain credit the student must, at the end of two semesters, submit a satisfactory thesis. A total of four units must be taken. The units may be distributed between one or two semesters in any way. (F,SP) Staff

**198. Directed Group Study. (1-4)** Course may be repeated for credit. Must be taken on a passed/not passed basis. Enrollment restrictions apply; see the Introduction to Courses and Curricula section in this catalog. (F,SP) Staff

**199. Supervised Independent Study. (1-3)** Must be taken on a passed/not passed basis. Enrollment restrictions apply; see the Introduction to Courses and Curricula section in this catalog. (F,SP) Staff