Physics (PHYSICS)

Courses

PHYSICS 5A Introductory Mechanics and Relativity 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Kinematics, dynamics, work and energy, rotational motion, oscillations, fluids and relativity. Use of calculus and vector algebra will be emphasized. Intended for students with an interest in pursuing a major in physics, astrophysics, engineering physics, or related disciplines. Successor to the Physics H7 series. Start of three semester 5A-5B-5C sequence.
Rules & Requirements

Prerequisites: Prerequisites: Math 51; Math 52 (which may be taken concurrently)

Repeat rules: Course may be repeated for credit under special circumstances: Only repeatable to replace deficient grade.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 5B Introductory Electromagnetism, Waves, and Optics 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Electric fields and potential, circuits, magnetism and induction. Introduction to optics including light propagation, reflection, refraction and interference. Intended for students with an interest in pursuing a major in physics, astrophysics, engineering physics, or related disciplines. Successor to the Physics H7 series. Continuation of 5A-5B-5C sequence.
Rules & Requirements

Prerequisites: Prerequisites: Physics 5A or 7A; Math 53 (which may be taken concurrently)

Repeat rules: Course may be repeated for credit under special circumstances: Only repeatable to replace deficient grade.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 5BL Introduction to Experimental Physics I 2 Units

Terms offered: Fall 2025, Summer 2025 First 6 Week Session, Spring 2025
Part one of a two-semester laboratory sequence to introduce students to experimental physics and prepare them for research. Covers a variety of modern and historical experiments, emphasizing data analysis, clear scientific communication, and development of skills on modern equipment. Successor to the Physics H7 series.
Rules & Requirements

Prerequisites: Prerequisites: Physics 5A or 7A; 5B or 7B (which may be taken concurrently)

Repeat rules: Course may be repeated for credit under special circumstances: Only repeatable to replace deficient grade.

Hours & Format

Fall and/or spring: 15 weeks - 5 hours of laboratory per week

Summer: 6 weeks - 12.5 hours of laboratory per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

PHYSICS 5C Introductory Thermodynamics and Quantum Mechanics 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Temperature, kinetic theory, entropy; particle/wave nature of matter, Schrodinger equation, hydrogen atom, applications of quantum physics. Intended for students with an interest in pursuing a major in physics, astrophysics, engineering physics or related disciplines. Continuation of 5A-5B-5C sequence. Successor to the Physics H7 series.
Rules & Requirements

Prerequisites: Prerequisites: Physics 5B or 7B; Physics 89 or Math 54 (which may be taken concurrently)

Repeat rules: Course may be repeated for credit under special circumstances: Only repeatable to replace deficient grade.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 5CL Introduction to Experimental Physics II 2 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Part two of a two-semester laboratory sequence to introduce students to experimental physics and prepare them for research. Covers a variety of modern and historical experiments, emphasizing iterative experimental design, clear scientific communication, and development of skills on modern equipment. Successor to the Physics H7 series.
Rules & Requirements

Prerequisites: Physics 5B & 5BL or 7B; Physics 5C or 7C (which may be taken concurrently)

Repeat rules: Course may be repeated for credit under special circumstances: Only repeatable to replace deficient grade.

Hours & Format

Fall and/or spring: 15 weeks - 5 hours of laboratory per week

Summer: 6 weeks - 12.5 hours of laboratory per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

PHYSICS 7A Physics for Scientists and Engineers 4 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025
Mechanics and wave motion.
Rules & Requirements

Prerequisites: High school physics; Math 51; Math 52 (which may be taken concurrently)

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 2 hours of discussion, and 2 hours of laboratory per week

Summer: 8 weeks - 6 hours of lecture, 4 hours of discussion, and 4 hours of laboratory per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 7B Physics for Scientists and Engineers 4 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025
Heat, electricity, and magnetism.
Rules & Requirements

Prerequisites: 7A, Math 51-52, Math 53 (may be taken concurrently)

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 2 hours of discussion, and 2 hours of laboratory per week

Summer: 8 weeks - 6 hours of lecture, 4 hours of discussion, and 4 hours of laboratory per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 7C Physics for Scientists and Engineers 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Electromagnetic waves, optics, relativity, and quantum physics.
Rules & Requirements

Prerequisites: 7A-7B, Math 51-52, Math 53, Physics 89 (Physics 89 may be taken concurrently)

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 3 hours of laboratory per week

Summer: 8 weeks - 6 hours of lecture, 2 hours of discussion, and 6 hours of laboratory per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS H7A Physics for Scientists and Engineers 4 Units

Terms offered: Fall 2015, Fall 2014, Fall 2013
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 on the high school level 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.

Rules & Requirements

Prerequisites: High school physics; Math 1A; Math 1B (may be taken concurrently)

Credit Restrictions: Students will received no credit for H7A after taking 7A.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS H7B Physics for Scientists and Engineers 4 Units

Terms offered: Fall 2016, Spring 2016, Fall 2015
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 on the high school level 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.

Rules & Requirements

Prerequisites: 7A, Math 1A-1B, Math 53 (may be taken concurrently)

Credit Restrictions: Students will receive no credit H7B after taking 7B.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS H7C Physics for Scientists and Engineers 4 Units

Terms offered: Fall 2016, Spring 2016, Fall 2015
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 on the high school level 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.

Rules & Requirements

Prerequisites: 7A-7B, Math 1A-1B, Math 53, 54 (Math 54 may be taken concurrently)

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 8A Introductory Physics 4 Units

Terms offered: Fall 2025, Summer 2025 10 Week Session, Spring 2025
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.

Rules & Requirements

Prerequisites: Mathematics 51, 10A, 16A, or equivalent, or consent of instructor

Credit Restrictions: Students with credit for 7A will not receive credit for 8A.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 2 hours of discussion, and 2 hours of laboratory per week

Summer:
8 weeks - 6 hours of lecture, 4 hours of discussion, and 4 hours of laboratory per week
10 weeks - 6 hours of lecture, 4 hours of discussion, and 4 hours of laboratory per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 8B Introductory Physics 4 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025
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.
Rules & Requirements

Prerequisites: 8A or equivalent

Credit Restrictions: Students with credit for 7B or 7C will not receive credit for Physics 8B.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 2 hours of discussion, and 2 hours of laboratory per week

Summer: 8 weeks - 6 hours of lecture, 4 hours of discussion, and 4 hours of laboratory per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 10 Descriptive Introduction to Physics 3 Units

Terms offered: Fall 2025, Spring 2025, Spring 2024
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.
Rules & Requirements

Prerequisites: Open to students with or without high school physics

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS C10 Descriptive Introduction to Physics 3 Units

Terms offered: Spring 2024, Fall 2023, Spring 2023, Fall 2022, Spring 2022
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.
Rules & Requirements

Prerequisites: Open to students with or without high school physics

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Also listed as: L & S C70V

PHYSICS 21 Physics of Music 3 Units

Terms offered: Spring 2003, Spring 2002, Spring 2000
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.
Rules & Requirements

Prerequisites: No previous courses in Physics are assumed, although Physics 10 is recommended

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS C21 Physics and Music 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
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.

Rules & Requirements

Prerequisites: No previous courses in Physics are assumed, although Physics 10 is recommended

Credit Restrictions: Students will receive no credit for Physics C21/ Letters and Science C70W after completing Physics 21. A deficient grade in Physics 21 may be removed by taking Physics C21/Letters and Science C70W.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Also listed as: L & S C70W

PHYSICS 24 Freshman Seminars 1 Unit

Terms offered: Fall 2025, Fall 2024, Fall 2023
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.

Rules & Requirements

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of seminar per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

PHYSICS 39 Lower Division Physics Seminar 1.5 - 4 Units

Terms offered: Spring 2010, Spring 2009, Fall 2008
Enrollment limited to 20 students per section. Physics seminar course designed for both non major students and students considering a major in physics. Topics vary from semester to semester.

Rules & Requirements

Prerequisites: Enrollment by consent of instructor during the week of pre-enrollment. Consult bulletin boards outside 366 Le Conte for more information

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1.5-4 hours of seminar per week

Summer: 6 weeks - 3.5-10 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

PHYSICS 49 Supplementary Work in Lower Division Physics 1 - 3 Units

Terms offered: Spring 2021, Fall 2018, Spring 2018
Students with partial credit in lower division physics courses may, with consent of instructor, complete the credit under this heading.

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Summer: 8 weeks - 1-3 hours of independent study per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

PHYSICS 77 Introduction to Computational Techniques in Physics 3 Units

Terms offered: Fall 2025, Summer 2025 10 Week Session, Spring 2025
Introductory scientific programming in Python with examples from physics. Topics include: visualization, statistics and probability, regression, numerical integration, simulation, data modeling, function approximation, and algebraic systems. Recommended for freshman physics majors.

Rules & Requirements

Prerequisites: Math 51, Math 52 (can be taken concurrently); Physics 5A or 7A (which may be taken concurrently) or permission of instructor

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 2 hours of workshop per week

Summer: 10 weeks - 3 hours of lecture and 3 hours of workshop per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

PHYSICS 88 Data Science Applications in Physics 2 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Introduction to data science with applications to physics. Topics include: statistics and probability in physics, modeling of the physical systems and data, numerical integration and differentiation, function approximation. Connector course for Data Science 8, room-shared with Physics 77. Recommended for freshmen intended to major in physics or engineering with emphasis on data science.

Objectives & Outcomes

Student Learning Outcomes: Learning goals for Physics 88
The following learning goals will guide the presentation of material as well as development of HWs, rubrics for assessment, and practice problems for use in discussion section: 1) Use of representations, 2) Communication, 3) Tools, 4) Problem-Solving, 5) Making connections, 6) Intellectual maturity and metacognition, 7) Resourcefulness.

Rules & Requirements

Prerequisites: Math 51, 52 (52 can be taken concurrently), Physics 5A or 7A (may be taken concurrently), Data Science 8 (may be taken concurrently), or permission of instructor

Hours & Format

Fall and/or spring: 9 weeks - 2 hours of lecture and 2 hours of workshop per week

Summer: 6 weeks - 3 hours of lecture and 3 hours of workshop per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

PHYSICS 89 Introduction to Mathematical Physics 4 Units

Terms offered: Fall 2025, Summer 2025 10 Week Session, Spring 2025
Complex numbers, linear algebra, ordinary differential equations, Fourier series and transform methods, introduction to partial differential equations, introduction to tensors. Applications to physics will be emphasized. This course or an equivalent course required for physics major.

Rules & Requirements

Prerequisites: Math 53; Physics 5A or 7A (can be taken concurrently) or instructor's consent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of discussion per week

Summer:
10 weeks - 4 hours of lecture and 3 hours of discussion per week
10 weeks - 4 hours of lecture and 3 hours of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS W89 Introduction to Mathematical Physics 4 Units

Terms offered: Summer 2023 10 Week Session, Summer 2022 10 Week Session, Summer 2021 10 Week Session
Math is the natural language of physics. Of central importance to nearly all areas of physics are the fields of linear algebra and differential equations. A solid understanding of the structure and techniques of these fields will allow you to dig deeper into all of your physics courses and give you a greater appreciation of the beauty of physical theory. In this course we will develop and explore a collection of tools including complex numbers, linear algebra, differential equations, Fourier series and transform methods, and tensors. Along the way this course will explore many example systems you were exposed to in your introductory physics classes including waves, circuits, rotations, and oscillations.

Rules & Requirements

Prerequisites: Math 53; Physics 5A or 7A (can be taken concurrently) or Instructor's Consent

Credit Restrictions: Students will receive no credit for PHYSICS W89 after completing PHYSICS 89. A deficient grade in PHYSICS W89 may be removed by taking PHYSICS 89, or PHYSICS 89.

Hours & Format

Summer: 10 weeks - 6 hours of web-based lecture and 2 hours of web-based discussion per week

Online: This is an online course.

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

PHYSICS 98 Directed Group Study 1 - 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

Rules & Requirements

Prerequisites: Restricted to freshman and sophomores only; consent of instructor

Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of directed group study per week

Summer: 8 weeks - 1.5-7.5 hours of directed group study per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

PHYSICS 98BC Berkeley Connect 1 Unit

Terms offered: Fall 2025, Spring 2025, Fall 2024

Berkeley Connect is a mentoring program, offered through various academic departments, that helps students build intellectual community. Over the course of a semester, enrolled students participate in regular small-group discussions facilitated by a graduate student mentor (following a faculty-directed curriculum), meet with their graduate student mentor for one-on-one academic advising, attend lectures and panel discussions featuring department faculty and alumni, and go on field trips to campus resources. Students are not required to be declared majors in order to participate.

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of directed group study per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

PHYSICS 99 Supervised Independent Study 1 - 3 Units

Terms offered: Spring 2017, Spring 2016, Fall 2015

Rules & Requirements

Prerequisites: Restricted to freshmen and sophomores only; consent of instructor

Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of independent study per week

Summer: 8 weeks - 1.5-7.5 hours of independent study per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

PHYSICS 100 Communicating Physics and Physical Science 2 Units

Terms offered: Spring 2010, Spring 2009, Spring 2008

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.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 105 Analytic Mechanics 4 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025
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. Some knowledge of Python required for homework assignments. Students who have not taken Physics 77 or Data Science 8 are encouraged to complete the Python tutorials provided by the Physics Department.

Rules & Requirements

Prerequisites: Physics 5A, 5B, 5C or 7A, 7B, 7C

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 110A Electromagnetism and Optics 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Part I. 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.

Rules & Requirements

Prerequisites: Physics 5A, 5B, 5C or 7A, 7B, 7C

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 110B Electromagnetism and Optics 4 Units

Terms offered: Spring 2025, Spring 2024, Fall 2023
Part II. 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.

Rules & Requirements

Prerequisites: Physics 5A, 5B, 5C or 7A, 7B, 7C and 110A

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 111A Instrumentation Laboratory 4 Units

Terms offered: Fall 2025, Summer 2025 10 Week Session, Spring 2025
The instrumentation lab (formerly Basic Semiconductor Circuits) is an introductory course in basic design, analysis and modeling of circuits, and data analysis and control. Topics include but not limited to:
linear circuits, semiconductor diodes, JFETS, Op-Amps, Labview programming, ADC and DAC converters, signal processing, and feedback control.

Rules & Requirements

Prerequisites: Consent of Instructor

Hours & Format

Fall and/or spring: 15 weeks - 8 hours of laboratory and 1.5 hours of lecture per week

Summer: 10 weeks - 12 hours of laboratory and 4.5 hours of lecture per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

PHYSICS 111B Advanced Experimentation Laboratory 1 - 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
In the advanced experimentation lab students complete four of 20+ advanced experiments. These include many experiments in atomic, nuclear, particle physics, biophysics, and solid-state physics, among others.

Rules & Requirements

Prerequisites: Physics 111A and 137A or consent of instructor

Credit Restrictions: Three units of the Advanced Experimentation lab required for physics major; After the first three units, lab may be repeated for additional credit. No more than three units may be completed in one semester.

Repeat rules: Course may be repeated for credit with instructor consent.

Hours & Format

Fall and/or spring: 15 weeks - 3-9 hours of laboratory per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

Formerly known as: Physics 111

PHYSICS 112 Introduction to Statistical and Thermal Physics 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
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. Some knowledge of Python required for homework assignments. Students who have not taken Physics 77 or Data Science 8 are encouraged to complete the Python tutorials provided by the Physics Department.

Rules & Requirements

Prerequisites: Physics 5A, 5B, 5C or 7A, 7B, 7C

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 129 Particle Physics 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
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. Some knowledge of Python required. Students who have not taken Physics 77 or Data Science 8 are encouraged to complete the Python tutorials provided by the Physics Department.

Rules & Requirements

Prerequisites: 137A, 137B (may be taken concurrently), or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Formerly known as: 129A

PHYSICS 130 Quantum and Nonlinear Optics 3 Units

Terms offered: Spring 2024, Spring 2022, Spring 2020
The detailed theory and experimental basis of quantum and nonlinear optics is presented and used to exhibit basic concepts of quantum measurements and noise, stochastic processes and dissipative quantum systems. Topics covered may include the second-quantization treatment of electromagnetic fields, photodetection, coherence properties of quantum-optical fields, light-atom interactions, cavity quantum electrodynamics, several non-linear optical systems, squeezed light and its applications, aspects of quantum information science, and selected topics at the forefront of modern optics research.

Rules & Requirements

Prerequisites: 110A and 137A-137B, or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 137A Quantum Mechanics 4 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025
Postulates and principles of quantum mechanics. Basic concepts including Hilbert space and superposition, Dirac notation and wavefunctions, operators and observables, measurements, time evolution and Schroedinger's equation, Hamiltonians and energy, uncertainty principle, symmetries and conserved quantities. Analysis of two-state systems (qubits), spin-½ particles, Stern-Gerlach experiment. Other basic systems including a free particle, finite and infinite potential wells, the harmonic oscillator, 3D quantum mechanics, angular momentum, and the hydrogen atom. Bipartite systems, density matrix and introduction to quantum entanglement, and interpretation of quantum mechanics.

Rules & Requirements

Prerequisites: Physics 5A, 5B, 5C or 7A, 7B, 7C

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 137B Quantum Mechanics 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Complex and dynamical quantum systems with applications to atomic, molecular, and particle physics. Multiparticle systems, bosons and fermions, Pauli exclusion principle. Approximation techniques including time-independent, degenerate and time-dependent perturbation theory, Fermi golden rule, WKB approximation, Born-Oppenheimer approximation, and the variational principle. The Helium atom, Spin-Orbit interaction, fine and hyperfine structure, higher Z atoms, molecules and the Linear Combination of Atomic Orbitals approximation. Atoms in electric and magnetic fields (Stark and Zeeman effects), and radiation (absorption, spontaneous and stimulated emissions). Exchange forces and van der Waals interaction. Introduction to scattering theory.

Rules & Requirements

Prerequisites: Physics 7A, 7B, 7C and 137A

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 138 Modern Atomic Physics 3 Units

Terms offered: Spring 2025, Spring 2023, Spring 2021
Atomic, molecular, and optical physics is at once a precise and quantitative description of atoms, molecules and light; a generalized toolbox for manipulating and probing quantum systems; and an active field of contemporary research. This course exposes students to all these aspects. Lectures will cover topics such as atomic structure and spectra, the interaction of atoms with static and time-varying electromagnetic fields, some topics in quantum electrodynamics, methods of resonant manipulation of quantum systems, and resonance optics. Through lectures, discussion sessions, and homework assignments, students encounter contemporary research foci.

Rules & Requirements

Prerequisites: 137A-137B

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 139 Special Relativity and General Relativity 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
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.

Rules & Requirements

Prerequisites: 105, 110A or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 141A Solid State Physics 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Part I. 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.

Rules & Requirements

Prerequisites: 137A-137B; 137B may be taken concurrently

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 141B Solid State Physics 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
Part II. 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.

Rules & Requirements

Prerequisites: 137A-137B and 141A

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 142 Introduction to Plasma Physics 4 Units

Terms offered: Spring 2024, Spring 2022, Spring 2021
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.

Rules & Requirements

Prerequisites: 105, 110A-110B (110B may be taken concurrently)

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 151 Elective Physics: Special Topics 3 Units

Terms offered: Spring 2025, Fall 2023, Spring 2023
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.

Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS 153 Foundational Course for Physical Science Transfer Students 1 Unit

Terms offered: Fall 2025, Fall 2024, Fall 2023
This course is designed to assist physics and other physical sciences transfer students in their transition to UC Berkeley. Over the course of a semester, students will learn about campus resources, how to navigate the campus, establish connections with other students in their cohorts, receive physics transfer peer mentorship and advising. Students will work in small-groups to solve challenging mathematical and physics concepts to assist with academic success.
Rules & Requirements

Prerequisites: Open only to physics and other physical sciences transfer students

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

PHYSICS C161 Relativistic Astrophysics and Cosmology 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
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.
Rules & Requirements

Prerequisites: Astro 7B recommended; Physics 7A-7B-7C (7C may be taken concurrently) or Physics 5A-5B-5C (5C may be taken concurrently)

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Lee, Ma, Kasen

Also listed as: ASTRON C161

PHYSICS 177 Principles of Molecular Biophysics 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
We will describe how concepts of free energy and entropy help us understand cooperative folding, conformational switching, and phase separation of proteins and explain the dynamics of biological molecules in a viscous and crowded cellular environment. We will then develop analytical approaches to a wide range of collective biophysical phenomena, including bacterial chemotaxis, swimming of sperm, stepping of molecular motors, neuronal firing, vision, photosynthesis, biological networks, pattern formation, and evolution. The course will also introduce advanced biophysical methods, such as single-molecule imaging and manipulation, and electrophysiology.
Rules & Requirements

Prerequisites: 112 or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

PHYSICS C180 Order-Of-Magnitude Physics 4 Units

Terms offered: Fall 2025, Fall 2024
Learn how to understand the world around you to within a factor of 10, how to solve real-life problems from physical first principles, how to make ill-posed questions well-posed, and how to sketch solutions quickly and avoid long and formal derivations. These skills build physical intuition and are crucial for all lines of work, especially research. You will learn how to guess intelligently, how to follow your hunches while guided by the laws of physics, and how to maximize understanding from just a modicum of information --- how to reason inductively and quantitatively. All of undergraduate physics --- mechanics, E&M, quantum mechanics, statistical mechanics --- will be covered in useful, memorable, and entertaining ways.
Rules & Requirements

Prerequisites: Physics 7A, 7B, 7C (or 5 equivalent) + preferably at least 1 upper-division course in the physical sciences. Suitable also for graduate students

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Final exam required, with common exam group.

Formerly known as: Physics C101/Astronomy C101

Also listed as: ASTRON C180

PHYSICS 188 Bayesian Data Analysis and Machine Learning for Physical Sciences 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
The course design covers data analysis and machine learning, highlighting their importance to the physical sciences. It covers data analysis with linear and nonlinear regression, logistic regression, and gaussian processes. It covers concepts in machine learning such as unsupervised and supervised regression and classification learning. It develops Bayesian statistics and information theory, covering concepts such as information, entropy, posteriors, MCMC, latent variables, graphical models and hierarchical Bayesian modeling. It covers numerical analysis topics such as integration and ODE, linear algebra, multi-dimensional optimization, and Fourier transforms.
Rules & Requirements

Prerequisites: Physics 77 or Data Science 8 or Computer Science 61A or an introductory Python course, or equivalent, or permission from instructor; Physics 89 or Mathematics 54 or Electrical Engineering 16A/B

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

PHYSICS H190 Physics Honors Course 2 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
A seminar which includes study and reports on current theoretical and experimental problems. Open only to students officially in the physics honors program or with consent of instructor.
Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

PHYSICS C191 Introduction to Quantum Computing 4 Units

Terms offered: Spring 2025, Spring 2024, Fall 2023
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.
Rules & Requirements

Prerequisites: Linear Algebra (EECS 16A or PHYSICS 89 or MATH 54) AND either discrete mathematics (COMPSCI 70 or MATH 55), or quantum mechanics (PHYSICS 7C or PHYSICS 137A or CHEM 120A)

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Also listed as: CHEM C191/COMPSCI C191

PHYSICS C191A Introduction to Quantum Computing I 4 Units

Terms offered: Fall 2025
This is the first semester of a multidisciplinary two-semester sequence in Quantum Computing. This semester provides an introduction to fundamental conceptual aspects of quantum mechanics in the language of qubits and quantum gates, and a first introduction to quantum computation. Topics in part one include basic concepts and results in quantum information, quantum algorithms, and an introduction to quantum error correction.
Rules & Requirements

Prerequisites: Linear Algebra: Either EECS 16A, Physics 89, Math 54, or equivalent. Some background in either quantum mechanics (Physics 137A, Chemistry 120A, or equivalent) or discrete mathematics (CS 70, Math 55, or equivalent) is expected

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Also listed as: CHEM C191A/EECS C191A

PHYSICS C191B Introduction to Quantum Computing II 4 Units

Terms offered: Not yet offered
This is the second semester of a multidisciplinary two-semester sequence in Quantum Computing. This second semester covers fundamentals of control of qubits, methods of quantum error mitigation, quantum benchmarking, quantum supremacy and tests of quantumness, advanced quantum error correction including fault-tolerant quantum computing and error thresholds, theory/practice of near-term fault fault tolerance, discussions of different physical platforms for quantum computing, and alternative paradigms for quantum computing.
Rules & Requirements

Prerequisites: C191A or equivalent (with permission of instructor)

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Also listed as: CHEM C191B/EECS C191B

PHYSICS H195A Senior Honors Thesis Research 2 Units

Terms offered: Fall 2022, Fall 2019, Spring 2016
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.
Rules & Requirements

Prerequisites: Open only to students in the honors program

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. This is part one of a year long series course. A provisional grade of IP (in progress) will be applied and later replaced with the final grade after completing part two of the series. Final exam not required.

PHYSICS H195B Senior Honors Thesis Research 2 Units

Terms offered: Spring 2025, Spring 2016, Fall 2015
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.
Rules & Requirements

Prerequisites: Open only to students in the honors program

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Letter grade. This is part two of a year long series course. Upon completion, the final grade will be applied to both parts of the series. Final exam not required.

PHYSICS 198 Directed Group Study 1 - 4 Units

Terms offered: Fall 2025, Summer 2025 Second 6 Week Session, Fall 2024
Enrollment restrictions apply; see the Introduction to Courses and Curricula section in this catalog.
Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of directed group study per week

Summer:
6 weeks - 2.5-10 hours of directed group study per week
8 weeks - 1.5-7.5 hours of directed group study per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

PHYSICS 198BC Berkeley Connect 1 Unit

Terms offered: Fall 2025, Spring 2025, Fall 2024
Berkeley Connect is a mentoring program, offered through various academic departments, that helps students build intellectual community. Over the course of a semester, enrolled students participate in regular small-group discussions facilitated by a graduate student mentor (following a faculty-directed curriculum), meet with their graduate student mentor for one-on-one academic advising, attend lectures and panel discussions featuring department faculty and alumni, and go on field trips to campus resources. Students are not required to be declared majors in order to participate.

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of directed group study per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

PHYSICS 198F Frontiers of Physics 2 Units

Terms offered: Prior to 2007
Discussion-based introduction to contemporary research in physics for advanced undergraduates. Presentation of different weekly topics in physics research led by graduate students, postdocs, or professors in a particular field to connect upper division physics majors with contemporary research and to increase dialogue between upper division undergraduates and researchers in the department.

Objectives & Outcomes

Course Objectives: -- To connect upper division physics majors with contemporary research in a way that traditional coursework does not.
-- To connect upper division physics majors with contemporary research in a way that traditional coursework does not.
-- To increase dialogue between upper division undergraduates and researchers in the department.
-- To help undergraduates make more informed career choices.

Student Learning Outcomes: -- Students left the course with a more broadened and more concrete understanding of what “pursuing research in physics” consists of. They also found themselves interested in areas of physics they didn’t expect or hadn’t known existed.
-- Students gained connections in the department. This has resulted in research projects for several students
-- Students received mentoring from the graduate student on many career path issues.
-- Small class size and discussion format strengthened the physics community both laterally and vertically.

Rules & Requirements

Prerequisites: Physics 7A, 7B, 7C or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of directed group study per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Alternative to final exam.

PHYSICS 199 Supervised Independent Study 1 - 3 Units

Terms offered: Summer 2025 10 Week Session, Spring 2025, Summer 2024 10 Week Session
Enrollment restrictions apply; see the Introduction to Courses and Curricula section in this catalog.

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2-6 hours of independent study per week

Summer:
3 weeks - 10-25 hours of independent study per week
6 weeks - 2.5-7.5 hours of independent study per week
8 weeks - 1.5-5.5 hours of independent study per week
10 weeks - 1.5-4.5 hours of independent study per week

Additional Details

Subject/Course Level: Physics/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

PHYSICS C201 Introduction to Nano-Science and Engineering 3 Units

Terms offered: Spring 2015, Spring 2013, Spring 2012
A three-module introduction to the fundamental topics of Nano-Science and Engineering (NSE) theory and research within chemistry, physics, biology, and engineering. This course includes quantum and solid-state physics; chemical synthesis, growth fabrication, and characterization techniques; structures and properties of semiconductors, polymer, and biomedical materials on nanoscales; and devices based on nanostructures. Students must take this course to satisfy the NSE Designated Emphasis core requirement.

Rules & Requirements

Prerequisites: Major in physical science such as chemistry, physics, etc., or engineering; consent of advisor or instructor

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

Instructors: Gronsky, S.W. Lee, Wu

Also listed as: BIO ENG C280/MAT SCI C261/NSE C201

PHYSICS C202 Astrophysical Fluid Dynamics 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Principles of gas dynamics, self-gravitating fluids, magnetohydrodynamics and elementary kinetic theory. Aspects of convection, fluid oscillations, linear instabilities, spiral density waves, shock waves, turbulence, accretion disks, stellar winds, and jets.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

Instructors: Chiang, Kasen, Ma, Quataert, White

Also listed as: ASTRON C202

PHYSICS C203 Computational Nanoscience 3 Units

Terms offered: Spring 2009, Spring 2008, Spring 2006
A multidisciplinary overview of computational nanoscience for both theorists and experimentalists. This course teaches the main ideas behind different simulation methods; how to decompose a problem into "simulatable" constituents; how to simulate the same thing two different ways; knowing what you are doing and why thinking is still important; the importance of talking to experimentalists; what to do with your data and how to judge its validity; why multiscale modeling is both important and nonsense.

Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

Also listed as: NSE C242

PHYSICS 205A Advanced Dynamics 4 Units

Terms offered: Spring 2022, Spring 2021, Spring 2019
Lagrange and Hamiltonian dynamics, variational methods, symmetry, kinematics and dynamics of rotation, canonical variables and transformations, perturbation theory, nonlinear dynamics, KAM theory, solitons and integrable pdes.

Rules & Requirements

Prerequisites: 105 or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 205B Advanced Dynamics 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
Nonlinear dynamics of dissipative systems, attractors, perturbation theory, bifurcation theory, pattern formation. Emphasis on recent developments, including turbulence.

Rules & Requirements

Prerequisites: 205A

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS C207 Radiation Processes in Astronomy 4 Units

Terms offered: Spring 2025, Fall 2023, Fall 2022
An introduction to the basic physics of astronomy and astrophysics at the graduate level. Principles of energy transfer by radiation. Elements of classical and quantum theory of photon emission; bremsstrahlung, cyclotron and synchrotron radiation. Compton scattering, atomic, molecular and nuclear electromagnetic transitions. Collisional excitation of atoms, molecules and nuclei.

Rules & Requirements

Prerequisites: Physics 105, 110A; 110B concurrently; open to advanced undergraduates with GPA of 3.70

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

Instructors: Chiang, Kasen, Quataert

Also listed as: ASTRON C207

PHYSICS 209 Classical Electromagnetism 5 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Maxwell's equations, gauge transformations and tensors. Complete development of special relativity, with applications. Plane waves in material media, polarization, Fresnel equations, attenuation, and dispersion. Wave equation with sources, retarded solution for potentials, and fields. Cartesian and spherical multipole expansions, vector spherical harmonics, examples of radiating systems, diffraction, and optical theorem. Fields of charges in arbitrary motion, radiated power, relativistic (synchrotron) radiation, and radiation in collisions.

Rules & Requirements

Prerequisites: 110A-110B or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 211 Equilibrium Statistical Physics 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
Foundations of statistical physics. Ensemble theory. Degenerate systems. Systems of interacting particles.
Rules & Requirements

Prerequisites: 112 or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 212 Nonequilibrium Statistical Physics 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Time dependent processes. Kinetic equations. Transport processes. Irreversibility. Theory of many-particle systems. Critical phenomena and renormalization group. Theory of phase transitions.
Rules & Requirements

Prerequisites: 112 and 221A-221B, or equivalents

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 216 Special Topics in Many-Body Physics 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
Quantum theory of many-particle systems. Applications of theory and technique to physical systems. Pairing phenomena, superfluidity, equation of state, critical phenomena, phase transitions, nuclear matter.
Rules & Requirements

Prerequisites: 221A-221B or equivalent recommended

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS C218 Modern Optical Microscopy for the Modern Biologist 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024, Fall 2023
This course is intended for graduate students in the early stages of their thesis research who are contemplating using modern microscopy tools as part of their work. It endeavors to cut through the confusion of the wide array of new imaging methods, with a practical description of the pros and cons of each. In addition to providing an intuitive physical understanding how these microscopes work, the course will offer hands on experience with cutting-edge microscopes where students will be able to see firsthand how different imaging modalities perform on their own samples, and where they will be able to access computational tools for the visualization and analysis of their data.
Rules & Requirements

Credit Restrictions: Students will receive no credit for MCELLBI 205 after completing MCELLBI 205, or MCELLBI 205. A deficient grade in MCELLBI 205 may be removed by taking MCELLBI 205, or MCELLBI 205.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

Instructors: Betzig, Ji

Formerly known as: Molecular and Cell Biology 205

Also listed as: MCELLBI C205/NEU C272

PHYSICS 221A Quantum Mechanics 5 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Basic assumptions of quantum mechanics; quantum theory of measurement; matrix mechanics; Schroedinger theory; symmetry and invariance principles; theory of angular momentum; stationary state problems; variational principles; time independent perturbation theory; time dependent perturbation theory; theory of scattering.
Rules & Requirements

Prerequisites: 137A-137B or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 221B Quantum Mechanics 5 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
Many-body methods, radiation field quantization, relativistic quantum mechanics, applications.
Rules & Requirements

Prerequisites: 221A

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 226 Particle Physics Phenomenology 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Introduction to particle physics phenomena. Emphasis is placed on experimental tests of particle physics models. Topics include Quark model spectroscopy; weak decays; overview of detectors and accelerators; e+e- annihilation; parton model; electron-proton and neutrino-proton scattering; special topics of current interest.
Rules & Requirements

Prerequisites: 221A-221B or equivalent or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS C228 Extragalactic Astronomy and Cosmology 3 Units

Terms offered: Spring 2025, Fall 2022, Spring 2021
A survey of physical cosmology - the study of the origin, evolution, and fate of the universe. Topics include the Friedmann-Robertson-Walker model, thermal history and big bang nucleosynthesis, evidence and nature of dark matter and dark energy, the formation and growth of galaxies and large scale structure, the anisotropy of the cosmic microwave radiation, inflation in the early universe, tests of cosmological models, and current research areas. The course complements the material of Astronomy 218.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

Instructors: Holzapfel, Lee, Ma, Seljak, White

Also listed as: ASTRON C228

PHYSICS 229 Advanced Cosmology 3 Units

Terms offered: Spring 2025, Spring 2023, Spring 2021
Advanced topics in physical and early-universe cosmology. Topics include the expanding Universe, evidence and nature of dark matter and dark energy, relativistic perturbation theory, models of cosmological inflation, the formation and growth of large scale structure and the anisotropy of the cosmic microwave background, and current research areas. The course extends the material of C228.
Rules & Requirements

Prerequisites: Physics/Astronomy C228 or equivalent or consent of instructor

Hours & Format

Fall and/or spring:
15 weeks - 3 hours of lecture per week
15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 230 Quantum and Nonlinear Optics 3 Units

Terms offered: Spring 2024
The detailed theory and experimental basis of quantum and nonlinear optics is presented and used to exhibit basic concepts of quantum measurements and noise, stochastic processes and dissipative quantum systems. Topics covered may include the second-quantization treatment of electromagnetic fields, photodetection, coherence properties of quantum-optical fields, light-atom interactions, cavity quantum electrodynamics, several non-linear optical systems, squeezed light and its applications, aspects of quantum information science, and selected topics at the forefront of modern optics research.
Rules & Requirements

Prerequisites: Physics 110A, Physics 137A, Physics 137B, or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 231 General Relativity 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
An introduction to Einstein's theory of gravitation. Tensor analysis, general relativistic models for matter and electromagnetism, Einstein's field equations. Applications, for example, to the solar system, dense stars, black holes, and cosmology.
Rules & Requirements

Prerequisites: Physics 110B or Physics 139 (or equivalent) or consent of instructor/department

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 232A Quantum Field Theory I 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Introduction to quantum field theory: canonical quantization of scalar, electromagnetic, and Dirac fields; derivation of Feynman rules; regularization and renormalization; introduction to the renormalization group; elements of the path integral.
Rules & Requirements

Prerequisites: Concurrent enrollment in 221A or 221B or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 232B Quantum Field Theory II 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
Renormalization of Yang-Mills gauge theories: BRST quantization of gauge theories; nonperturbative dynamics; renormalization group; basics of effective field theory; large N; solitons; instantons; dualities. Selected current topics.
Rules & Requirements

Prerequisites: 232A or equivalent or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 233A Standard Model and Beyond I 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
Introduction to the Standard Model of particle physics and its applications: construction of the Standard Model; Higgs mechanism; phenomenology of weak interactions; QCD and the chiral Lagrangian; quark mixing and flavor physics.

Rules & Requirements

Prerequisites: 232A or equivalent or consent of instructor (concurrent enrollment in 232B is recommended)

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 233B Standard Model and Beyond II 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2021
Advanced topics in the Standard Model and beyond, selected from: open problems in the Standard Model; supersymmetric models; grand unification; neutrino physics; flat and warped extra dimensions; axions; inflation; baryogenesis; dark matter; the multiverse; other current topics.

Rules & Requirements

Prerequisites: 233A or equivalent or consent of instructor

Repeat rules: Course may be repeated for credit with instructor consent.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 234A String Theory I 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Perturbative theory of the bosonic strings, superstrings, and heterotic strings: NSR and GS formulations; 2d CFT; strings in background fields; T-duality; effective spacetime supergravity; perturbative description of D-branes; elements of compactifications and string phenomemology; perturbative mirror symmetry.

Rules & Requirements

Prerequisites: 232A or equivalent or consent of instructor. 232B is recommended

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 234B String Theory II 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
Nonperturbative apsects of string theory. Topics selected from black holes; black branes; Bekenstein-Hawking entropy; D-branes; string dualities; M-theory; holographic principle and its realizations; AdS/CFT correspondence; gauge theory/gravity dualities; flux compactifications; cosmology in string theory; topological string theories. Selected current topics.

Rules & Requirements

Prerequisites: 234A or equivalent or consent of instructor

Repeat rules: Course may be repeated for credit with instructor consent.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 238A Modern Atomic Physics 3 Units

Terms offered: Spring 2025, Spring 2023
Atomic, molecular, and optical physics is at once a precise and quantitative description of atoms, molecules and light; a generalized toolbox for manipulating and probing quantum systems; and an active field of contemporary research. This course exposes students to all these aspects. Lectures will cover topics such as atomic structure and spectra, the interaction of atoms with static and time-varying electromagnetic fields, some topics in quantum electrodynamics, methods of resonant manipulation of quantum systems, and resonance optics. Through lectures, discussion sessions, and homework assignments, students encounter contemporary research foci.
Rules & Requirements

Prerequisites: Physics 110A, Physics 137A, Physics 137B, or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 238B Advanced Atomic, Molecular, and Optical Physics 4 Units

Terms offered: Fall 2023
Contemporary topics in atomic, molecular, and optical physics are presented at an advanced level. These topics may include one or several of the following, at the discretion of the instructor: mechanical effects of light-atom interactions, ultra-cold atomic physics, molecular physics, resonance optics of multi-level atoms, and probing particle physics with atoms and molecules.
Rules & Requirements

Prerequisites: Physics 110A; Physics 137A; Physics 137B; Physics 130 or 230; Physics 138 or 238A

Credit Restrictions: Students will receive no credit for PHYSICS 238B after completing PHYSICS 238. A deficient grade in PHYSICS 238B may be removed by taking PHYSICS 238.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 240A Quantum Theory of Solids 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Excitations and interactions in solids; crystal structures, symmetries, Bloch's theorem; energy bands; electron dynamics; impurity states; lattice dynamics, phonons; many-electron interactions; density functional theory; dielectric functions, conductivity and optical properties.
Rules & Requirements

Prerequisites: 141A-141B and 221A-221B or equivalents, or consent of instructor; 240A is prerequisite to 240B

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 240B Quantum Theory of Solids 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
Optical properties, excitons; electron-phonon interactions, polarons; quantum oscillations, Fermi surfaces; magnetoresistance; quantum Hall effect; transport processes, Boltzmann equation; superconductivity, BCS theory; many-body perturbation theory, Green's functions.
Rules & Requirements

Prerequisites: 141A-141B and 221A-221B or equivalents, or consent of instructor; 240A is prerequisite to 240B

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 242A Theoretical Plasma Physics 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Analysis of plasma behavior according to the Vlasov, Fokker-Planck equations, guiding center and hydromagnetic descriptions. Study of equilibria, stability, linear and nonlinear waves, transport, and laser-plasma interactions.

Rules & Requirements

Prerequisites: Physics 142, or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 242B Theoretical Plasma Physics 4 Units

Terms offered: Spring 2024, Spring 2020, Spring 2016
Analysis of plasma behavior according to the Vlasov, Fokker-Planck equations, guiding center and hydromagnetic descriptions. Study of equilibria, stability, linear and nonlinear waves, transport, and laser-plasma interactions.

Rules & Requirements

Prerequisites: Physics 142, or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 250 Special Topics in Physics 2 - 4 Units

Terms offered: Spring 2024, Fall 2021, Fall 2019
Topics will vary from semester to semester. See Department of Physics announcements.

Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit with instructor consent.

Hours & Format

Fall and/or spring: 15 weeks - 2-4 hours of lecture per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 251 Introduction to Graduate Research in Physics 1 Unit

Terms offered: Fall 2025, Fall 2024, Fall 2023
A survey of experimental and theoretical research in the Department of Physics, designed for first-year graduate students. One regular meeting each week with supplementary visits to experimental laboratories. Meetings include discussions with research staff.

Rules & Requirements

Prerequisites: Graduate standing in Department of Physics or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS C254 High Energy Astrophysics 3 Units

Terms offered: Fall 2025, Spring 2025, Spring 2024, Spring 2023
Basic physics of high energy radiation processes in an astrophysics environment. Cosmic ray production and propagation. Applications selected from pulsars, x-ray sources, supernovae, interstellar medium, extragalactic radio sources, quasars, and big-bang cosmologies.

Rules & Requirements

Prerequisites: 201 or consent of instructor. 202 recommended

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

Instructors: Boggs, Quataert

Formerly known as: Physics C254, Astronomy C254

Also listed as: ASTRON C254

PHYSICS C285 Theoretical Astrophysics Seminar 1 Unit

Terms offered: Fall 2025, Spring 2025, Fall 2024, Fall 2023
The study of theoretical astrophysics.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

Instructor: Quataert

Also listed as: ASTRON C285

PHYSICS 288 Bayesian Data Analysis and Machine Learning for Physical Sciences 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

The course design covers data analysis and machine learning, highlighting their importance to the physical sciences. It covers data analysis with linear and nonlinear regression, logistic regression, and gaussian processes. It covers concepts in machine learning such as unsupervised and supervised regression and classification learning. It develops Bayesian statistics and information theory, covering concepts such as information, entropy, posteriors, MCMC, latent variables, graphical models and hierarchical Bayesian modeling. It covers numerical analysis topics such as integration and ODE, linear algebra, multi-dimensional optimization, and Fourier transforms.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Letter grade.

PHYSICS 290A Seminar 2 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 290B Seminar 2 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS C290C Cosmology 2 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024, Spring 2024, Spring 2023

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

Instructors: White, Cohn

Formerly known as: Physics C290C, Astronomy C290C

Also listed as: ASTRON C290C

PHYSICS 290D Seminar 2 Units

Terms offered: Fall 2005, Fall 2004, Fall 2003

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 290E Seminar 2 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 290F Seminar 2 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 290G Seminar 2 Units

Terms offered: Fall 2006, Spring 2006, Fall 2005

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 290H Seminar 2 Units

Terms offered: Spring 2017, Spring 2016, Spring 2015

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 290I Seminar 2 Units

Terms offered: Spring 2014, Spring 1999, Spring 1998

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 290J Seminar 2 Units

Terms offered: Prior to 2007

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 290K Seminar 2 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 290L Seminar 2 Units

Terms offered: Fall 2012, Fall 2000

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 290N Seminar in Non-Neutral Plasmas 2 Units

Terms offered: Spring 2007, Fall 2006, Spring 2006

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 290P Seminar 2 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 290Q Seminar in Quantum Optics 2 Units

Terms offered: Prior to 2007

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 290R Seminar 2 Units

Terms offered: Prior to 2007

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 290S Seminar 2 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 290T Seminar 2 Units

Terms offered: Spring 2000, Fall 1999, Spring 1999

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 290X Seminar 2 Units

Terms offered: Fall 2006, Spring 2006, Fall 2005

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 290Y Seminar 2 Units

Terms offered: Fall 2006, Spring 2006, Fall 2005

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 290Z Seminar 2 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 295 Special Study for Graduate Students 1 - 4 Units

Terms offered: Summer 2025 Second 6 Week Session, Fall 2024, Summer 2024 Second 6 Week Session
This course is arranged to allow qualified graduate students to investigate possible research fields or to pursue problems of interest through reading or non-laboratory study under the direction of faculty members who agree to give such supervision.
Rules & Requirements

Prerequisites: Graduate standing

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of independent study per week

Summer:
6 weeks - 1-4 hours of independent study per week
8 weeks - 1-4 hours of independent study per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 297 Careers for Physical Science PhDs 1 Unit

Terms offered: Spring 2018
This course exposes graduate students and postdocs in the physical sciences to non-academic careers. Each session hosts speakers who have transitioned from a PhD in the physical sciences to a variety of industries, including data science, quantitative finance, software/hardware engineering, consulting, and more.
Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of seminar per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 299 Research 1 - 12 Units

Terms offered: Fall 2025, Summer 2025, Summer 2025 8 Week Session
Rules & Requirements

Prerequisites: Graduate standing

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Summer:
6 weeks - 1-12 hours of independent study per week
8 weeks - 1-12 hours of independent study per week

Additional Details

Subject/Course Level: Physics/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 301 Advanced Professional Preparation: Supervised Teaching of Physics 1 - 2 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Discussion, problem review and development, guidance of physics laboratory experiments, course development.
Rules & Requirements

Prerequisites: 300

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of independent study per week

Additional Details

Subject/Course Level: Physics/Professional course for teachers or prospective teachers

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 375 Professional Preparation: Supervised Teaching of Physics 2 Units

Terms offered: Fall 2021, Fall 2020, Fall 2019
Mandatory for first time GSIs. Topics include teaching theory, effective teaching methods, educational objectives, alternatives to standard classroom methods, reciprocal classroom visitations, and guided group and self-analysis of videotapes.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor; may be taken concurrently with 301

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Physics/Professional course for teachers or prospective teachers

Grading: Offered for satisfactory/unsatisfactory grade only.

Formerly known as: Physics 300

PHYSICS 602 Individual Study for Doctoral Students 1 - 8 Units

Terms offered: Spring 2016, Fall 2015, Spring 2015
Individual study in consultation with the major field adviser intended to provide an opportunity for qualified students to prepare themselves for the various examinations required of candidates for the Ph.D.
Rules & Requirements

Prerequisites: For qualified graduate students

Credit Restrictions: Course does not satisfy unit or residence requirements for doctoral degree.

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-8 hours of independent study per week

Summer:
6 weeks - 1-8 hours of independent study per week
8 weeks - 1-8 hours of independent study per week

Additional Details

Subject/Course Level: Physics/Graduate examination preparation

Grading: Offered for satisfactory/unsatisfactory grade only.

PHYSICS 700 Departmental Colloquium 0.0 Units

Terms offered: Spring 2017, Fall 2016
Physics Department weekly colloquium.
Hours & Format

Fall and/or spring: 15 weeks - 2 hours of colloquium per week

Additional Details

Subject/Course Level: Physics/Graduate examination preparation

Grading: The grading option will be decided by the instructor when the class is offered.

Formerly known as: Physics 800