Physics

In the College of Sciences

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Faculty

Emeritus: Burnett, Cottrell, Day, Feher, Garrison, Lilly, Moe, Nichols, Piserchio, Shore, Smith, Teasdale, Templin, Wallace, Wolter
Chair: Papin
Professors: Davis, Goldberg, Morris, Oseroff, Papin, Rehfuss, Roeder, Sweedler, Torikachvili
Assistant Professors: Anderson, Baljon, Johnson
Lecturers: Ferguson, Shackelford
Adjunct: Bendall, Mueller

Offered by the Department

Master of Arts degree in physics.
Master of Science degree in physics.
Master of Science degree in radiological health physics.
Major in chemical physics with the B.S. degree in applied arts and sciences.
Major in physics with the B.A. degree in liberal arts and sciences.
Major in physics with the B.S. degree in applied arts and sciences.
Minor in physics.

The Major

The study of physics is considered the foundation of modern science. It has fascinated the finest minds of every age – from Newton to Maxwell, Einstein, Bohr, Schroedinger, Oppenheimer and Schwinger. The study of this diverse field encompasses such areas as optics, electricity, magnetism, the properties of the solid state, atomic structure, nuclear structure, motion, relativity, space and time. Physics also plays a significant role in chemistry, biology, astronomy, and geology, and in the applied sciences of engineering and technology.

Students who become physics majors will be selecting a rewarding and vital career. The great burst of activity during the last 20 years has instilled a new excitement in physics. For example, the invention of the laser in the late 1950s revolutionized the field of optics. These advances stimulated whole new areas in physics applications. Superconductivity has led to the search for a high-temperature superconductor so that electrical power might be transmitted without loss; quantum mechanical tunneling has led to the tunnel diode; and solid state physics brought about the transistor and its successors.

The career opportunities for physics graduates are as diverse as the field itself. They include research and development; management or administration in industrial laboratories or government agencies; technical sales; electronic design; laser instrument research; and secondary teaching.

Chemical Physics Major

With the B.S. Degree in Applied Arts and Sciences
(Major Code: 19081)

All candidates for a degree in applied arts and sciences must complete the graduation requirements listed in the section of this catalog on "Graduation Requirements." Individual master plans for each student are filed with the physics and chemistry undergraduate advisers and the Office of Advising and Evaluations.

A minor is not required with this major.

Preparation for the Major. Physics 195, 195L, 196, 196L, 197, 197L; Chemistry 200, 201, 231, 251; Mathematics 150, 151, and 252. (44 units)

Recommended: A course in computer programming.

Upper Division Writing Requirement. Passing the University Writing Examination or completing one of the approved writing courses with a grade of C (2.0) or better.

Major. A minimum of 48 upper division units to include Physics 311, 340A, 340B, 350, 354, 357, 400A-400B, 410; Chemistry 410A-410B, 431, 457, 520A, 550.

Physics Major

With the B.A. Degree in Liberal Arts and Sciences
(Major Code: 19021)

All candidates for a degree in liberal arts and sciences must complete the graduation requirements listed in the section of this catalog on "Graduation Requirements." Individual master plans for each student are filed with both the physics undergraduate adviser and the Office of Advising and Evaluations. No more than 48 units in physics courses can apply to the degree.

A minor is not required with this major.

Preparation for the Major. Physics 195, 195L, 196, 196L, 197, 197L; Chemistry 200; Mathematics 150, 151, 252. (30 units)

Foreign Language Requirement. Competency (successfully completing the third college semester or fifth college quarter) is required in one foreign language as part of the preparation for the major. Refer to the section of this catalog on "Graduation Requirements."

Upper Division Writing Requirement. Passing the University Writing Examination or completing one of the approved writing courses with a grade of C (2.0) or better.

Major. A minimum of 33 upper division units to include Physics 311, 340A, 340B, 350, 354, 357, 360, 400A-400B, 410.

Physics Major

With the B.S. Degree in Applied Arts and Sciences
(Major Code: 19021)

All candidates for a degree in applied arts and sciences must complete the graduation requirements listed in the section of this catalog on "Graduation Requirements." Individual master plans for each student are filed with both the physics undergraduate adviser and the Office of Advising and Evaluations.

A minor is not required with this major.

Basic Requirements for all Students

Preparation for the Major. Physics 195, 195L, 196, 196L, 197, 197L; Chemistry 200; Mathematics 150, 151, 252. (30 units)

Upper Division Writing Requirement. Passing the University Writing Examination or completing one of the approved writing courses with a grade of C (2.0) or better.

Major. A minimum of 45 upper division units to include Physics 311, 340A, 340B, 350, 354, 357, 360, 400A-400B, 410, 498A, 498B. In addition, the student must complete the requirements for either one of the following areas:

(a) General Physics

Nine units of elective coursework in physics or related areas. Electives must be approved by the Physics Department undergraduate adviser.

(b) Modern Optics

Required: Physics 406, 552, 553.
Recommended: Physics 516, 532, 554.

Physics Minor

The following courses are prerequisites to the physics minor and do not count toward the 16 units required for the minor. Physics 195, 195L, 196, 196L, 197, 197L; Mathematics 150, 151, 252.

The minor in physics consists of a minimum of 16 units to include Physics 340A, 350, 354, 360, 400A.

Courses in the minor may not be counted toward the major, but may be used to satisfy preparation for the major and general education requirements, if applicable. A minimum of six upper division units must be completed in residence at San Diego State University.

Courses (PHYS)

LOWER DIVISION COURSES

Maximum credit 12 units for any combination of Physics 107, 170, 180A-180B, 182A-182B, 195, 195L, 196, 196L, 197, 197L, 201.

107. Introductory Physics with Laboratory (4) I, II
Three lectures and three hours of laboratory.
How physics concepts describe everyday events, and frontier phenomena. Classical mechanics, thermodynamics, electromagnetism, and selected topics from atomic, relativistic, and radioactivity physics. Not open to students with credit in Physics 180A or 195.

149. Special Study (1-2) Cr/NC I, II
Prerequisite: Consent of supervising instructor.
Individual study and laboratory work in area of student's major interest. Students will be assigned a member of the staff who will supervise their work. Maximum credit two units.

170. Preparation for Physics (3)
Prerequisite: Two years of high school algebra.
Elemental principles of physics approached from problem-solving and critical thinking perspectives necessary for success in Physics 180A and Physics 195. Not open to students with credit in Physics 107, 180A, or 195.

180A-180B. Fundamentals of Physics (3-3) I, II
Prerequisite: Satisfaction of the Entry-Level Mathematics requirement and qualification on the Mathematics Departmental Placement Examination, Part IA. Physics 180A is prerequisite to 180B.
Recommended: For Physics 180A, concurrent registration in Physics 182A; for Physics 180B, concurrent registration in Physics 182B.
Semester I: Mechanics, wave motion, sound, and fluids. Semester II: Electricity, magnetism, optics, and modern physics. Presented in a two-semester algebra/trigonometry based sequence. Physics 180A not open to students with credit in Physics 195. Physics 180B not open to students with credit in Physics 196.

182A-182B. Physical Measurements (1-1) I, II
Three hours of laboratory.
Prerequisite for 182A: Credit or concurrent registration in Physics 180A.
Prerequisite for 182B: Credit or concurrent registration in Physics 180B.
A laboratory course to accompany Physics 180A-180B. Semester I: Properties of matter, mechanics, sound, and wave motion. Semester II: Electricity, DC circuits, oscilloscope measurement techniques, electric and magnetic fields, and optics. 182A: Not open to students with credit in Physics 195L. 182B: Not open to students with credit in Physics 196L.

195. Principles of Physics (3) I, II
(195 + 195L: CAN PHYS 8)
(195 + 195L +196 + 196L + 197 +197L: CAN PHYS SEQ B)
Prerequisites: High school physics or Physics 107 or 170. Mathematics 150.
Fundamental principles of physics in areas of mechanics and oscillatory motion. Designed for students requiring calculus-based physics.

195L. Principles of Physics Laboratory (1) I, II
(195 + 195L: CAN PHYS 8)
(195 + 195L +196 + 196L + 197 +197L: CAN PHYS SEQ B)
Three hours of laboratory.
Prerequisite: Credit or concurrent registration in Physics 195.
Experiments in mechanics, wave motion, resonance phenomena using precision air tracks. Not open to students with credit in Physics 182A.

196. Principles of Physics (3) I, II
(196 + 196L: CAN PHYS 12)
(195 + 195L +196 + 196L + 197 +197L: CAN PHYS SEQ B)
Prerequisites: Physics 195 and Mathematics 151.
Fundamental principles of physics in areas of electricity and magnetism. Designed for students requiring calculus-based physics.

196L. Principles of Physics Laboratory (1) I, II
(196 + 196L: CAN PHYS 12)
(195 + 195L +196 + 196L + 197 +197L: CAN PHYS SEQ B)
Three hours of laboratory.
Prerequisite: Credit or concurrent registration in Physics 196.
Experiments in DC circuits, AC circuits, electrical resonance, oscilloscope measurement techniques, and electric and magnetic fields. Not open to students with credit in Physics 182B.

197. Principles of Physics (3) I, II
(197 + 197L: CAN PHYS 14)
(195 + 195L +196 + 196L + 197 +197L: CAN PHYS SEQ B)
Prerequisites: Physics 196 and Mathematics 252.
Fundamental principles of physics in areas of wave motion, sound, electromagnetic waves, optics, relativity, and modern physics. Designed for students requiring calculus-based physics.

197L. Principles of Physics Laboratory (1) I,II
(197 + 197L: CAN PHYS 14)
(195 + 195L +196 + 196L + 197 +197L: CAN PHYS SEQ B)
Three hours of laboratory.
Prerequisite: Credit or concurrent registration in Physics 197.
Experiments in optics, lasers, holography, and nuclear counting.

201. Physics of Sound, Hearing, and Speech (4)
Three lectures and three hours of laboratory.
Prerequisite: Qualification on the Mathematics Departmental Placement Examination, Part IA.
Fundamental nature of sound and applications to hearing and speech.

296. Experimental Topics (1-4)
Selected topics. May be repeated with new content. See Class Schedule for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree.

UPPER DIVISION COURSES
(Intended for Undergraduates)

301. Energy and the Environment (3)
Prerequisite: Completion of the General Education requirements in Communication and Critical Thinking and Foundations II.A., Natural Sciences and Quantitative Reasoning.
Fundamental physical concepts underlying energy, its conversion, and impact on the environment.

311. Electronics for Scientists (4)
Three lectures and three hours of laboratory.
Prerequisites: Physics 180B and 182B, or 196 and 196L.
AC and DC circuits, diodes, transistors, conventional and operational amplifiers, analog to digital conversion, pulse and digital electronics. Introduce science majors to modern electronic devices and their utilization in scientific instrumentation.

333. Physics Perspectives (3)
Prerequisite: Physics 180B or 197.
Theoretical physics emphasizing basic themes cutting across separate traditional subject divisions. Visualize three-dimensional vector fields, forces and torques. Balance between derivations, conceptual understanding, numerical problem-solving, estimations, and proportional reasoning.

340A-340B. Mathematical Methods in Physics (4-4)
Three lectures and three hours of laboratory.
Prerequisite: Physics 197. Physics 340A is prerequisite to 340B. Recommended: A course in computer programming.
Linear algebra, scalar and vector fields. Complex numbers and analytic functions. Fourier series and integral transforms. Ordinary and partial differential equations. Probability and group theory. Applications to physical theory employing analytical, numerical and computation techniques. Not open to students with credit in Mathematics 342A-342B.

350. Classical Mechanics (3)
Prerequisites: Physics 195 with a minimum grade of C and Physics 197. Credit or concurrent registration in Physics 340A.
Newtonian mechanics, gravitation, small oscillations, collisions, motion of rigid bodies, Lagrangian mechanics.

354. Modern Physics (3)
Prerequisites: Physics 197 with a minimum grade of C. Credit or concurrent registration in Physics 340A.
Special theory of relativity. Particle properties of electromagnetic radiation, and wave properties of particles. Introduction to quantum theory with applications to atomic structure. Not open to students with credit in Physics 354A or 354B.

357. Advanced Physical Measurements (3)
One lecture and six hours of laboratory.
Prerequisites: Physics 311 and 354.
Stresses both laboratory experiments and techniques of data and error analysis. Experiments are taken from major areas of physics.

360. Thermal Physics (3)
Prerequisites: Physics 340A, 350, 354.
Classical thermodynamics and statistical mechanics. Applications of equilibrium thermodynamics. Statistical mechanics, including concepts from probability and statistics. Maxwell-Boltzmann, Fermi-Dirac, and Bose-Einstein statistics. Applications of statistical mechanics in calculating macroscopic properties of simple systems. (Formerly numbered Physics 460.)

400A-400B. Classical Electromagnetism (3-3)
Prerequisites for Physics 400A: Physics 196 with a minimum grade of C; Physics 197 and 340A. Physics 400A is prerequisite to Physics 400B.
Electrostatics, magnetostatics, electromagnetic induction, Maxwell's equations, radiation and wave propagation.

406. Optics (3)
Prerequisites: Physics 197, 197L, 340B.
Reflection, refraction, matrix methods, dispersion, polarization, double refraction, interference, diffraction, Fourier optics, coherence theory, lasers, and holography with applications to optical instruments, wave propagation, and the nature of light.

410. Quantum Mechanics (3)
Prerequisites: Physics 340B, 350, 354.
Mathematical and physical foundations of quantum theory in terms of wave and matrix mechanics. Applications to properties of atoms and solids. (Formerly numbered Physics 510.)

496. Selected Topics in Physics (1-4)
Prerequisite: Consent of instructor.
Selected topics in classical and modern physics. May be repeated with consent of instructor. See Class Schedule for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree. Maximum credit six units.

498A. Senior Research (1) Cr/NC
One discussion period and two additional hours per week to be arranged.
Prerequisites: Physics 357 and consent of instructor.
Selection and design of individual research project. Oral and written progress reports.

498B. Senior Research (2)
Two discussion periods and four additional hours per week to be arranged.
Prerequisite: Physics 498A.
Laboratory work, progress reports, oral and written final reports.

499. Special Study (1-3)
Individual study or laboratory work on a special problem in physics selected by the student. Each student will be assigned a member of the staff who will supervise his/her work. Credit, hours and topics to be arranged in each case. Maximum credit six units.

UPPER DIVISION COURSES
(Also Acceptable for Advanced Degrees)

516. Theory of Scientific Instrumentation (3)
Prerequisites: Physics 311 and 340B.
Fourier analysis with applications to scientific instrumentation, spectroscopy, and image processing; Z transforms and digital filtering; detection systems and their optimization of the signal-to-noise ratio.

532. Condensed Matter Physics (3)
Prerequisite: Physics 410.
Elastic, thermal, electric, magnetic and optical properties of solids. Introduction to the energy band theory of solids, with applications to semiconductors and metals.

533. Experimental Techniques in Condensed Matter Physics (3)
One lecture and six hours of laboratory.
Prerequisites: Physics 357 and credit or concurrent registration in Physics 532.
Experiments in various fields of condensed matter such as x-ray diffraction, Hall effect, superconductivity, and electron paramagnetic resonance.

534. Colloquium in Condensed Matter Physics (1) Cr/NC
Prerequisite: Credit or concurrent registration in Physics 532.
Student and faculty research project presentations. Maximum credit three units.

552. Modern Optics and Lasers (3)
Prerequisites: Physics 406 with minimum grade of C; credit or concurrent registration in Physics 400B.
Electromagnetic theory, matrix methods of optics, propagation of Gaussian beams, optical resonators, interaction of radiation and atomic systems, theory of laser oscillation, nonlinear optics, specific laser systems, optical detectors, applications of lasers in physics.

553. Modern Optics Laboratory (3)
One lecture and six hours of laboratory.
Prerequisites: Physics 357 with minimum grade of C; Physics 406 with minimum grade of C; credit or concurrent registration in Physics 552.
Experiments in various fields of modern optics such as holography, physics of lasers, Fourier transform spectroscopy, Raman spectroscopy, light modulation techniques, fiber optics, spatial filtering, diffraction grating spectroscopy, radiometry, and nonlinear optics.

554. Colloquium in Optics Research (1) Cr/NC
Prerequisites: Concurrent registration in Physics 498A or 498B or 797 and consent of instructor.
Student and faculty research project presentations. Maximum credit three units.

560. Radiological Physics and Dosimetry (3)
Prerequisite: Credit or concurrent registration in Physics 354.
Ionizing radiation fields, interactions of radiation with matter, cavity theory, external radiation dosimetry.

561. Nuclear Instrumentation (3)
One lecture and six hours of laboratory.
Prerequisites: Physics 311 and 560.
Radiation detection, measurement, and spectroscopy. Ionization chambers, GM and proportional counters, scintillation and semiconductor detectors, and thermoluminescent dosimetry.

564. Nuclear Physics (3)
Prerequisites: Physics 340B and 354.
Nuclear and elementary particle phenomena including nuclear structure, decay, and radioactivity. Nuclear reactions and devices. Experimental methods and applications.

570. Relativity (3)
Prerequisites: Physics 354 and 400B.
Relative coordinates, Lorentz transformation, covariant formation of the laws of physics, applications of special relativity, introduction to curved space time, cosmology.

580. Computational Physics (3)
Prerequisites: Physics 354; Computer Engineering 160 or Computer Science 106; and credit or concurrent registration in Physics 400A.
Computer programming for numerical solution of problems in classical mechanics, electromagnetism, optics, and quantum mechanics. Use of Fortran and C programming languages and the UNIX operating system. Incorporation of standard subroutines for linear algebra and differential equations into student written programs.

585. Computer Simulation in Physical Sciences (3)
Prerequisites: Physics 340B, 350, and 360.
Complex physical systems such as solids, liquids, and macromolecules, by means of computer simulation. Prediction of experimentally measurable physical quantities. Mathematical models. Molecular dynamics and Monte Carlo methods. Interpretation of numerical results. Statistical errors.

596. Special Topics in Physics (1-4)
Prerequisite: Consent of instructor.
Selected topics in classical and modern physics. May be repeated with the consent of the instructor. See Class Schedule for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree. Maximum credit of six units of 596 applicable to a bachelor's degree. Maximum combined credit of six units of 596 and 696 applicable to a 30-unit master's degree.

GRADUATE COURSES
Refer to Bulletin of the Graduate Division.