\[ d \sin \theta_m = m \lambda \]

find \( \lambda = ? \)

Neutral Density, \( \text{OD} = 3 \Rightarrow \frac{I}{I_0} = 10^{-3} \)

Note: The dial on Newport photodiode

5145 \( \Rightarrow \) 5145 Å
Program

BS in Physics
  Option in General Physics
  Option in Professional Physics
    Advanced Study Pattern
    Applied Optics Pattern
Minor in Physics
  Single Subject Teaching
    Credential in Science

“We know very little, and yet it is astonishing that we know so much, and still more astonishing that so little knowledge can give so much power.” Bertrand Russell (1872-1970)

The Physics Department offers the Bachelor of Science Degree in Physics with the choice of two options. The department also offers a minor in physics.

The Option in Professional Physics has two advising patterns. The Advanced Study pattern is the traditional B.S. program designed to prepare students for graduate study or for professional careers in government or industry. The Applied Optics pattern is designed to prepare students for careers in optics and telecommunications.

The Option in General Physics is designed to prepare students for teaching secondary school physics, with additional subject matter breadth across all sciences. This option fulfills all requirements for the Single Subject Teaching Credential in Science with a Concentration in Physics and a supplementary authorization in a second science. This option is also for students who are interested in physics-related interdisciplinary fields such as biophysics, geophysics, atmospheric sciences, physical oceanography, health physics, or environmental science.

The physics minor greatly strengthens the preparation of students majoring in mathematics, engineering, computer science, chemistry, geosciences, biology, and other fields of science or technology. It is particularly important for students who intend to pursue graduate studies in physical chemistry, geophysics, biophysics, or medical physics.

Students in such fields as mathematics, chemistry, engineering, or computer science may wish to consider physics as a second major. These fields are very compatible with physics, and some course work will satisfy the requirements for both majors.

Facilities

Special facilities available include laboratories for modern optics, X-ray diffraction and fluorescence, gamma ray spectroscopy, superconductivity, and nuclear physics.

Career Outlook

While graduate work is necessary for entry into some physics-related careers, physicists with the baccalaureate enjoy excellent employment opportunities in a wide variety of areas including optics and telecommunications, space, defense, energy, and environmental science.

Physicists are also employed in research and development projects involving electronic systems and devices, optics, computers, nuclear reactors, microwaves, and vacuum systems. Others find employment in such diverse fields as criminal investigation or public health.

At the present time there is a huge demand for high school science teachers. The Option in General Physics is the ideal preparation for such a career.

In addition to consulting faculty, students with career-related questions are encouraged to visit the Offices of Advising and Orientation and Counseling and Career Planning. These offices provide assistance with exploration of life goals, academic and career planning, and information on occupations related to majors as well as job market and placement trends.
THE BACHELOR OF SCIENCE IN PHYSICS

Total Course Requirements for the Bachelor's Degree: 128 units

See “Requirements for the Bachelor’s Degree” in The University Catalog for complete details on general degree requirements. A minimum of 40 units, including those required for the major, must be upper division.

The department has prepared a suggested Four Year Advising Plan to help students meet all graduation requirements within four years. Please request a plan from your major adviser or view it and other current advising information on the CSU, Chico Web.

General Education Requirements: 48 units

See “General Education Requirements” in The University Catalog and The Class Schedule for the designated WP courses for the semester in which you take the course. Students who earn below WP credit. See “Mathematics and Writing Requirements” in The University Catalog. Most courses used to satisfy these requirements may also apply to General Education.

Literacy Requirement:

See “Mathematics and Writing Requirements” in The University Catalog. Writing proficiency in the major is a graduation requirement and may be demonstrated through satisfaction of a waiver or completion of a course in your major which has been designated as the Writing Proficiency (WP) course for the semester in which you take the course. Students who earn below a C- are required to repeat the course and earn a C- or better to receive WP credit. See “Cultural Diversity” in The University Catalog. Most courses used to satisfy these requirements may also apply to General Education.

American Institutions Requirement: 6 units

See the “American Institutions Requirement” under “Bachelor’s Degree Requirements.” This requirement is normally fulfilled by completing HIST 050 and POLS 055. Courses used to satisfy this requirement do not apply to General Education.

Course Requirements for the Major: 70-81 units

The following courses, or their approved transfer equivalents, are required of all candidates for this degree.

DEGREE CORE PROGRAM: 46 units

Lower-Division Requirements: 36 units

9 courses required:
- CHEM 037 General Chemistry 4.0 FS*
- CHEM 038 General Chemistry 4.0 FS
- MATH 007A Analytical Geometry and Calculus 4.0 FS*
- MATH 007B Analytical Geometry and Calculus 4.0 FS
- MATH 007D Elem Diff Equation/Vector Calc 4.0 FS
- PHYS 004A Mechanics 4.0 FS*
- PHYS 004B Electricity and Magnetism 4.0 FS
- PHYS 004C Heat/Wave Motion/Sound/Light 4.0 FS
- PHYS 230 Optics 4.0 FS

Upper-Division Requirements: 10 units

4 courses required:
- PHYS 200A Modern Physics I 3.0 FA
- PHYS 200B Modern Physics II 3.0 SP
- PHYS 227 Advanced Laboratory 3.0 FA
- PHYS 291 Physics Seminar 1.0 SP

THE OPTION IN PROFESSIONAL PHYSICS: 24 units

This option is for students who intend to pursue graduate study in physics or related fields or who plan to enter careers in technical fields.

Option Core: 9 units

4 courses required:
- MATH 110 Boundary Value/Partial Diff Eqns 3.0 SP
- PHYS 201A Analytical Mechanics 3.0 FA
- PHYS 202A Electricity and Magnetism 3.0 FA
- PHYS 235A Quantum Mechanics 3.0 FA

Advising Pattern Course Requirements: 15 units

This option pattern is for students intending to pursue graduate study in physics or related fields. This is also suited to many technical careers.

5 courses required:
- MATH 007D, PHYS 004A, PHYS 004B, PHYS 004C.
- This course is the same as ECE 230 which may be substituted.
- PHYS 201B Analytical Mechanics 3.0 SP
- PHYS 231 Fiber Optics/Telecommunications 3.0 SP

Applied Optics Pattern: 15 units

This option pattern is for students intending to pursue careers in optics, telecommunications, or related fields.

4 courses required:
- M E 045 Materials Engineering 3.0 FS
- PHYS 230 Optics 3.0 SP
- PHYS 231 Fiber Optics/Telecommunications 3.0 SP

1 course selected from:
- PHYS 202B Electricity and Magnetism 3.0 SP
- PHYS 235A Quantum Mechanics 3.0 FA
- ECE 232 Fourier Optics 3.0 Inq

Upper-Division Requirements: 10 units

4 courses required:
- PHYS 200A Modern Physics I 3.0 FA
- PHYS 200B Modern Physics II 3.0 SP
- PHYS 227 Advanced Laboratory 3.0 FA
- PHYS 291 Physics Seminar 1.0 SP

Prerequisites: Upper-division standing in physics.

Major Option Course Requirements: 24-35 units

The following courses, or their approved transfer equivalents, are required dependent upon the major chosen. Students must select one of the following options for completion of the major course requirements.
THE OPTION IN GENERAL PHYSICS: 35 units

This option fulfills all requirements for the Single Subject Teaching Credential in Science with a Concentration in Physics and a supplementary authorization in a second science. This option is also excellent preparation for students considering physics-related interdisciplinary fields. Students who choose this option should consult with their major adviser.

5 courses required:
- BIOL 006A Biological Principles 4.0 FS
- BIOL 006B Biological Principles 4.0 FS
- PHYS 002 Physical Geology 3.0 FS
- GEOS 002 Physical Geology 3.0 FS
- PHYS 289T Internship in Physics Teaching 3.0 FS

6 units required:
Any upper-division course in physics (except PHYS 289P and PHYS 289T) with approval of the credential adviser.

Breadth Requirements: 12 units

Any non-General Education courses in Chemistry (CHEM), Biology (BIOL), or Geoscience (GEOS). All 12 units must be selected from one department.

Electives Requirement:
To complete the total units required for the bachelor's degree, select additional elective courses from the total university offerings. You should consult with an adviser regarding the selection of courses which will provide breadth to your university experience and apply to a supportive second major or minor.

Grading Requirement:
All courses taken to fulfill major course requirements must be taken for a letter grade, except those courses specified by the department as Credit/No Credit grading only.

Advising Requirement:
Advising is mandatory for all majors in this degree program. Consult your undergraduate adviser for specific information.

THE MINOR IN PHYSICS

Course Requirements for the Minor: 29 units

The following courses, or their approved transfer equivalents, are required of all candidates for this minor.

6 courses required:
- MATH 007A Analytic Geometry and Calculus 4.0 FS
- PHYS 004B Electricity and Magnetism 4.0 FS
- PHYS 004C Heat and Wave Motion/Sound/Light 4.0 FS
- PHYS 004A Modern Physics I 3.0 FA
- PHYS 004D Modern Physics II 3.0 FA
- PHYS 004E Modern Physics III 3.0 FA

6 units selected from:
Any Physics (PHYS) courses numbered 199 or above (except PHYS 289P and PHYS 289T).

THE SINGLE SUBJECT CREDENTIAL IN PHYSICS

Course Requirements for the Single Subject Teaching Credential: 81 units

In most majors, candidates for this credential will normally fulfill the single subject matter preparation program by completing the appropriate education option in the major. Any exceptions to this procedure are noted at the end of this section. In addition to the single subject matter preparation program, completion of an additional professional education program is required to qualify for a California teaching credential. Professional education (credential) programs are available through the School of Education. For prerequisites and other admission requirements to professional education programs, see the "Education" chapter of this catalog. All credential candidates are required to qualify for a California teaching credential. Professional education (credential) programs are available through the School of Education. Please consult with your departmental credential adviser for current information.

Your departmental credential adviser is responsible for verifying that the subject matter preparation program has been completed. If you are interested in obtaining a teaching credential, confer with the appropriate credential adviser early in your university career. Department credential advisers can assist you in planning an educational program that meets both major and credential requirements.

Subject matter preparation requirements are governed by legislative action and approval of the California Commission on Teacher Credentialing. Requirements may change between catalogs. Please consult with your departmental credential adviser for current information.

The General Physics Option described above fulfills all requirements for the Single Subject Teaching Credential Program in Science with a Concentration in Physics.

The Faculty

Irving F. Boekelheide, 1953, Professor Emeritus, PhD, UIowa.
Fred L. Boos Jr., 1957, Professor Emeritus, MS, Macalester.
Louis J. Buchholz, 1986, Professor, PhD, Stanford U.
Cheuk-Kin Chau, 1975, Professor, PhD, U Illinois.
Eric R. Dietz, 1983, Professor, PhD, UC Berkeley.
Christopher A. Gaffney, 1987, Professor, PhD, Notre Dame.
Philip W. Gash, 1986, Professor, PhD, UC CT.
David T. Kagan, 1981, Chair, Professor, PhD, UC Berkeley.
Michael R. McGie, 1966, Professor Emeritus, PhD, UC Davis.
L. Edward Millet, 1967, Professor Emeritus, PhD, BYU.
Robert L. Paulson, 1973, Professor, PhD, UC Davis.
John C. Young, 1970, Professor, PhD, UC Davis.
Xueli Zou, 2000, Assistant Professor, PhD, Ohio St U.

Physics Course Offerings

Please see the section on “Course Description Symbols and Terms” in The University Catalog for an explanation of course description terminology and symbols, the course numbering system, and course credit units. All courses are lecture and discussion and employ letter grading unless otherwise stated. Some prerequisites may be waived with faculty permission. Many syllabi are available on the Chico Web.

PHYS 001 Concepts in Physics 3.0 Fa/Spr
A non-mathematical General Education lecture, laboratory-activity course with opportunities for discussion. Topics include Newtonian Mechanics, properties of matter, heat, wave motion, sound, electricity, and light. Not intended for students who have completed high school physics. 2.0 hours discussion, 2.0 hours activity. This is an approved General Education course.

PHYS 002A General Physics 4.0 Fa/Spr
Prerequisites: High school physics or faculty permission. High school trigonometry and second-year high school algebra or equivalent (MATH 003 and MATH 004 at CSU, Chico). Mechanics, properties of matter, wave motion, sound, heat. Science majors are encouraged to take PHYS 004A instead of this course. 3.0 hours discussion, 3.0 hours laboratory. This is an approved General Education course. CAN PHYS 2.
PHYS 002B General Physics 4.0 Fa/Spr
Prerequisites: PHYS 002A.
Light, electricity, magnetism, selected topics in modern physics. Science majors are encouraged to take PHYS 004B instead of this course. Algebra and trigonometry are used. 3.0 hours discussion, 3.0 hours laboratory. CAN PHYS 4.

PHYS 002X Physics Problem Session 1.0 Fa/Spr
Prerequisites: Concurrent enrollment in PHYS 002A.
Designed to supplement PHYS 002X with additional applications of introductory physics. Provides the student with the opportunity for additional assistance in developing problem-solving abilities. 2.0 hours activity. Credit/no credit grading only. You may take this course more than once for a maximum of 6.0 units.

PHYS 002Y Physics Problem Session 1.0 Fa/Spr
Prerequisites: PHYS 002A. Concurrent enrollment in PHYS 002B.
Designed to supplement PHYS 002B with additional applications of introductory physics. Provides the student with the opportunity for additional assistance in developing problem-solving abilities. 2.0 hours activity. Credit/no credit grading only. You may take this course more than once for a maximum of 6.0 units.

PHYS 004A Physics for Students of Science and Engineering: Mechanics 4.0 Fa/Spr
Prerequisites: High school physics or faculty permission. Concurrent enrollment in or prior completion of MATH 007B (second semester of calculus or equivalent). Vectors, kinematics, particle dynamics, friction, work, energy, power, momentum, dynamics and statics of rigid bodies, oscillations, gravitation, fluids. Calculus used. 3.0 hours discussion, 3.0 hours laboratory. This is an approved General Education course. CAN PHYS 8.

PHYS 004B Physics for Students of Science and Engineering: Electricity and Magnetism 4.0 Fa/Spr
Prerequisites: MATH 007B, PHYS 004A.
Charge and matter, electric field, Gauss' law, electric potential, capacitors and dielectrics, current and resistance, magnetic field, Ampere's law, Faraday's law of induction, magnetic properties of matter, electromagnetic oscillations and waves. Calculus used. 3.0 hours discussion, 3.0 hours laboratory. CAN PHYS 10.

PHYS 004C Physics for Students of Science and Engineering: Heat, Wave Motion, Sound, Light, and Modern Topics 4.0 Fa/Spr
Prerequisites: MATH 007B, PHYS 004A.
Temperature, first and second law of thermodynamics, and kinetic theory. Waves in elastic media, standing waves and resonance, and sound. Ray and wave optics, reflection, refraction, lenses, mirrors, diffraction, and polarization. Selected topics in modern physics. Calculus used. 3.0 hours discussion, 3.0 hours laboratory. CAN PHYS 14.

PHYS 004X Physics Problem Session 1.0 Fa/Spr
Prerequisites: Concurrent enrollment in PHYS 004A.
Designed to supplement PHYS 004A with additional applications of introductory physics. Provides the student with the opportunity for additional assistance in developing problem-solving abilities. 2.0 hours activity. Credit/no credit grading only. You may take this course more than once for a maximum of 6.0 units.

PHYS 004Y Physics Problem Session 1.0 Fa/Spr
Prerequisites: PHYS 004A. Concurrent enrollment in PHYS 004B.
Designed to supplement PHYS 004B with additional applications of introductory physics. Provides the student with the opportunity for additional assistance in developing problem-solving abilities. 2.0 hours activity. Credit/no credit grading only. You may take this course more than once for a maximum of 6.0 units.

PHYS 004Z Physics Problem Session 1.0 Fa/Spr
Prerequisites: PHYS 004A. Concurrent enrollment in PHYS 004C.
Designed to supplement PHYS 004C with additional applications of introductory physics. Provides the student with the opportunity for additional assistance in developing problem-solving abilities. 2.0 hours activity. Credit/no credit grading only. You may take this course more than once for a maximum of 6.0 units.

PHYS 050 Computer-Assisted Physics Problem-Solving 3.0 OddSpr
Prerequisites: PHYS 004A, PHYS 004B. No previous computer experience necessary. This course prepares physics majors to be self-sufficient in personal computer use to solve experimental and theoretical physics problems. Topics include, but are not limited to, analysis of experimental data, projectile motion, random processes, vector fields and potentials, vibrating systems, and electric circuits. 2.0 hours discussion, 3.0 hours laboratory.

PHYS 101 Relativity and Albert Einstein 3.0 Fa/Spr
Prerequisites: Upper-division standing.
An upper-division General Education thematic course giving an appreciation of Einstein's theory of relativity and his other contributions, including his impact on history, philosophy, politics, art, religion, etc. A 3-unit lecture/discussion course at the conceptual level, with emphasis on writing and critical thinking.

PHYS 110 Sound in the Environment 3.0 Fa/Spr
Application of basic principles of physics to a study of acoustics. Topics include measurement of sound, acoustics of musical instruments, electric productoustics, of sound, room acoustics, and environmental noise pollution. Especially recommended for music and speech pathology majors. This is an approved General Education course.

PHYS 120 Concepts in Modern Physics 3.0 Fall
Prerequisites: Completion of lower-division Area B General Education.
An upper-division General Education Thematic course that explores concepts in relativity, quantum physics, and chaos. The course will emphasize both the conceptual essentials of these theories and the philosophical implications arising from them. Topics will include the nature of space and time, the interplay of measurement and our conception of reality, the difference between predictability and determinism, and the tension between human understanding and mathematical description. This is an approved General Education course.

PHYS 131 Science and Modern Culture 3.0 Fa/Spr
An appreciation of Darwin's theory of evolution, Einstein's theory of relativity, and quantum theory as basic intellectual sources of Modernism, along with an understanding of their relationship to other foundational themes of Modernism, such as Marx's socialism, Nietzsche's perspectivism, and Freud's theory of the unconscious. This is an approved General Education course. This course is the same as PHIL 131 which may be substituted.

PHYS 176 Nuclear Science 3.0 Fa/Spr
Prerequisites: PHYS 004A; PHYS 004B; PHYS 004C; or PHYS 002A and PHYS 002B and calculus with faculty permission. Special relativity, quantum properties of radiation, wave properties of matter, the Bohr theory of the hydrogen atom, characteristic x-ray spectra, electron spin.

PHYS 199 Special Problems 1.0-3.0 Spring
This course is for special topics offered as 199A-C for 1.0 to 3.0 units respectively. Typically the topic is offered on a one-time-only basis and may vary from term to term and be different for different sections. See The Class Schedule for the specific topic being offered.

PHYS 200A Special Topics (Modern Physics I) 3.0 Fall
Prerequisites: PHYS 004A, PHYS 004B, PHYS 004C, or PHYS 002A and PHYS 002B and calculus with faculty permission. Special relativity, quantum properties of radiation, wave properties of matter, the Bohr theory of the hydrogen atom, characteristic x-ray spectra, electron spin.

PHYS 200B Atomic and Nuclear Physics (Modern Physics II) 3.0 Spring
Prerequisites: PHYS 200A.
Introduction to atomic, nuclear, molecular, and solid state physics, including single electron and many electron atoms; nuclear structure, nuclear reactions, nuclear instruments, and elementary particles; statistical mechanics, the laser, theory of solids, semiconductors.

PHYS 201A Analytical Mechanics 3.0 Fall
Prerequisites: PHYS 007D, PHYS 004A, PHYS 004B, PHYS 004C. Newton's laws of motion, particle dynamics, accelerated reference systems, central force problems, conservation laws, and celestial mechanics.

PHYS 201B Analytical Mechanics 3.0 Spring
Prerequisites: PHYS 201A. Many body systems, rotational motion, rigid body dynamics, Euler's equations, Lagrange's and Hamilton's formulations, oscillating systems and waves.

PHYS 202A Electricity and Magnetism 3.0 Fall
Prerequisites: MATH 007D, PHYS 004A, PHYS 004B, PHYS 004C.
Electrostatics, dielectrics, magnetostatics, electromagnetic induction, magnetic materials.

PHYS 202B Electricity and Magnetism 3.0 Spring
Prerequisites: PHYS 202A or faculty permission.
Maxwell's equations and the propagation of electromagnetic waves, propagation of radiation in materials, production and detection of radiation, and the application of special relativity to electrodynamics.
PHYS 208A Physics Associates Program 1.0 Fa/Spr
Prerequisites: Faculty permission. See description below. Credit/no credit grading only. You may take this course more than once for a maximum of 6.0 units.

PHYS 208B Physics Associates Program 2.0 Fa/Spr
Prerequisites: Faculty permission. See description below. Credit/no credit grading only. You may take this course more than once for a maximum of 6.0 units.

PHYS 208C Physics Associates Program 3.0 Fa/Spr
Prerequisites: PHYS 004A; PHYS 004B; PHYS 004C; or PHYS 002A and PHYS 002B, with grade of C- or higher and faculty permission.

PHYS 280A-PHYS 280C: Student participation in the instructional and professional activities of the Physics Department, particularly related to personalized modes of instruction. Responsibility for some assignments, consultation with students, preparation and conduction of demonstrations, tutoring and evaluation of student learning. Not a research-oriented activity. Credit/no credit grading only. You may take this course more than once for a maximum of 6.0 units.

PHYS 215 Thermal Physics 3.0 EvnSpr
Prerequisites: MATH 110, PHYS 200A. Statistical mechanics, the laws of thermodynamics, kinetic theory, states of matter.

PHYS 224 Nuclear Physics 3.0 Inquire
Prerequisites: PHYS 200A. Nuclear forces, two-nucleon system, nuclear models, nuclear reactions, radioactive decay, nuclear spin, and magnetism.

PHYS 225 Solid State Physics 3.0 OddFall
Prerequisites: PHYS 004B; PHYS 004C. Crystal structure, x-ray diffraction, constants of crystals, lattice vibrations, domains, free electron models, band theory of solids, semi-conductors, transistors, superconductivity, and dislocations.

PHYS 227 Advanced Laboratory 3.0 Fall
Prerequisites: ENGL 001 (or its equivalent) with a grade of C- or higher, PHYS 200B. Experiments involving x-rays, radioactivity, Compton effect, photoelectric effect, velocity of light, lasers, nuclear magnetic resonance, electron spin resonance, Mössbauer effect, including data analysis by high speed computer. 2.0 hours discussion, 3.0 hours laboratory. This is a writing proficiency, WP, course; a grade of C- or better certifies writing proficiency for majors.

PHYS 230 Optics 3.0 Spring
Prerequisites: PHYS 004A, PHYS 004B, PHYS 004C. Geometrical and physical optics, interference, diffraction, reflection, dispersion, resolution, polarization, fiber optics, laser optics, and holography. 2.0 hours discussion, 3.0 hours laboratory. This course is the same as ECE 230 which may be substituted.

PHYS 231 Lasers and Their Applications 3.0 Fall
Prerequisites: PHYS 004C. Recommended: PHYS 230. The theory and mechanism of laser action, various types of lasers and their applications and future use. Laboratory involves measurements with lasers, fiber optics, data transmission, and holography. 2.0 hours discussion, 3.0 hours laboratory. This course is the same as ECE 231 which may be substituted.

PHYS 233 Fiber Optics/Telecommunications 3.0 Spring
Prerequisites: PHYS 230 or PHYS 231. Review light wave transmission in dielectric media; study the components of fiber optic communication, investigate analog and digital, and multiplexing techniques; examine the system performance criteria, measurements, and design. 2.0 hours discussion, 3.0 hours laboratory.

PHYS 235A Quantum Mechanics 3.0 Fall
Prerequisites: MATH 110, PHYS 200A. Plane waves, wave packets, de Broglie waves, Schroedinger's equation, probability, simple harmonic oscillator, angular momentum, and hydrogen atom.

PHYS 235B Quantum Mechanics 3.0 Spring
Prerequisites: PHYS 235A. Operator methods, matrix mechanics, approximation methods, multielectron atoms, and scattering theory.

PHYS 270 Electronic Physics 3.0 Inquire
Prerequisites: MATH 007D, PHYS 004B. Circuit review, solid state devices, charged particle dynamics, analog and digital integrated circuits, applications. 2.0 hours discussion, 3.0 hours laboratory.

PHYS 280 Theoretical Physics 3.0 Inquire
Prerequisites: MATH 007D, PHYS 004A, PHYS 004B, PHYS 004C, faculty permission. Advanced topics in theoretical physics appropriate to needs of students.

PHYS 289 Internship in Professional Physics 3.0 Fa/Spr
Prerequisites: PHYS 208B and faculty permission. This is a supervised internship in professional physics. This internship may take place at a university, government laboratory, or private sector company. This course may be taken more than once. It cannot be used for the minor in physics. Credit/no credit grading only.

PHYS 290T Internship in Physics Teaching 3.0 Fa/Spr
Prerequisites: PHYS 208B and faculty permission. This is a supervised internship in physics teaching which will take place in a local high school physics classroom. This course may be taken more than once, but a maximum of 3 units of any PHYS 289 may be counted toward the degree. Credit/no credit grading only.

PHYS 291 Physics Seminar 1.0 Spring
Prerequisites: Upper-division standing in physics. Presentation and discussion of reports based on current physics literature and/or special studies of students and faculty. You may take this course more than once for a maximum of 6.0 units.

PHYS 298 Special Topics 1.0-3.0 Fa/Spr
Prerequisites: Upper-division standing in physics; faculty permission. This course is for special topics offered as 298A-C for 1.0 to 3.0 units respectively. Typically the topic is offered on a one-time-only basis and may vary from term to term and be different for different sections. See The Class Schedule for the specific topic being offered.

PHYS 299 Independent Study 1.0-3.0 Fa/Spr
Prerequisites: Upper-division standing in physics; faculty permission. This course is an independent study of special problems and is offered as 299A-C for 1.0 to 3.0 units respectively. You must register directly with a supervising faculty member. Credit/no credit grading only. You may take this course more than once for a maximum of 6.0 units.

PHYS 301 Analytical Mechanics 3.0 Inquire
Prerequisites: PHYS 200B, faculty permission. System of particles, waves, rigid body dynamics, coordinate transformation, generalized coordinates, and relativistic mechanics.

PHYS 302 Electricity and Magnetism 3.0 Inquire
Prerequisites: PHYS 202B, faculty permission. Electromagnetic waves, refraction, plasma, waves guides, radiation, and relativistic formulation.

PHYS 335 Quantum Mechanics 3.0 Inquire
Prerequisites: PHYS 235B, faculty permission. Two-body problems, scattering. Born approximation, perturbation theory, addition of angular momentum, Dirac equation, and applications.

PHYS 380 Theoretical Physics 3.0 Inquire
Prerequisites: Faculty permission. Advanced topics in theoretic physics appropriate to needs of the students.

PHYS 398 Independent Study 1.0-4.0 Fa/Spr
This course is a graduate level independent study offered as 398A-D for 1.0 to 4.0 units respectively. You must register directly with a supervising faculty member.

PHYS 399 Master's Study 1.0-6.0 Fa/Spr
This course is a master's study offered as either a Master's Thesis, identified as 399A-F for 1.0 to 6.0 units respectively, or as a Master's Project, identified as 399G-L for 1.0 to 6.0 units respectively. You must register directly with a supervising faculty member. Credit/no credit grading only.