Department of Physics and Astronomy

Physical Sciences Building, Room 119
(909) 537-5397

Traditionally, physics majors have gone on to graduate work in physics, high school teaching, or employment in industrial or government laboratories. Other opportunities which have recently become interesting for physics graduates include atmospheric physics (including air pollution studies), geophysics, radiation safety, oceanography, astrophysics, technical administration, biophysics, computer science, and medical instrumentation development.

The program for a bachelor of arts degree in physics provides basic knowledge in the main subject areas of physics as well as an opportunity for students to elect a considerable number of courses in other disciplines. This is a good choice for students planning careers in high school teaching. The bachelor of science program includes additional coursework in physics and related fields which further prepares a student for employment or graduate work.

The Department of Physics and Astronomy offers a minor in physics, a minor in applied physics, and a minor in astronomy. providing students with the opportunity to concentrate on a specialized area in physics, The minor in physics provides science students with the opportunity to take an additional course in physics and complement their primary major by selecting physics courses in a related area or courses of their interest.

The minor in applied physics is designed to prepare students for direct employment in high-technology firms upon graduation. For traditional design tasks, high-technology firms typically hire applied physicists with flexible and creative technical abilities who can address a wide range of technical problems and develop an experimental system to attack problems.

The minor in astronomy is designed for any interested student with a background in calculus. Combined with a physics, geology, chemistry, or biology degree, it can give students the background needed to pursue a career or graduate degree in an astronomy-related field including astrophysics, planetary science, cosmology, and more.

Pre-engineering

The department provides a pre-engineering program that enables students to complete the first two years of courses generic to engineering. Students may then transfer to an accredited engineering program of their choice. The following courses have been recommended as appropriate transfer courses:

Students considering a physics or pre-engineering major should call the department office for advising.

Departmental Honors

To be awarded departmental honors in physics a student must:

1. Achieve at least a 3.5 minimum grade point average in courses required for the major taken at California State University, San Bernardino, and at least a 3.0-grade point average overall;
2. Conduct advanced research on a topic approved by a faculty member who will serve as project director;
3. Obtain written approval upon successful completion of the project from the project director and the chair, present the results of the research to the department or at a research conference, and/or publish the results in a peer-reviewed scientific journal.

Current Faculty

Sara Callori, Associate Professor
B.A. 2007, New York University
M.A. 2009, Ph.D. 2013, Suny at Stony Brook

Paul K. Dixon, Professor, Professor
B.S. 1983, University of Michigan
M.A. 1985, Ph.D. 1990, University of Chicago

Carol Hood, Professor
B.S. 2004, Virginia Polytechnic Institute
M.S. 2007, Ph.D. 2011, University of California, Irvine

Karen Kolehmainen, Professor
B.S. 1977, Michigan State University
Ph.D. 1983, State University of New York at Stony Brook

Paul A. Renteln, Professor
B.A. 1981, University of California, Berkeley
Ph.D. 1988, Harvard University

Timothy D. Usher, Professor
B.S. 1981, Appalachian State University
Ph.D. 1990, University of South Carolina

Laura M. Woodney, Professor
B.A. 1993, John Hopkins University
M.S. 1997, Ph.D. 2000, University of Maryland

Emeriti

Leo P. Connolly, Professor

Javier Torner, Professor, Chair
B.S. 1978, I.P.N. Mexico
M.S. 1982, Ph.D. 1985, Illinois Institute of Technology

Undergraduate Degrees

Bachelor of Arts

- Physics (https://catalog.csusb.edu/colleges-schools-departments/natural-sciences/physics/physics-ba/)

Bachelor of Science

- Physics (https://catalog.csusb.edu/colleges-schools-departments/natural-sciences/physics/physics-bs/)

Minors

- Applied Physics (https://catalog.csusb.edu/colleges-schools-departments/natural-sciences/physics/applied-physics-minor/)
- Astronomy (https://catalog.csusb.edu/colleges-schools-departments/natural-sciences/physics/astronomy-minor/)
- Physics (https://catalog.csusb.edu/colleges-schools-departments/natural-sciences/physics/physics-minor/)

Astronomy Courses

ASTR 1000. Introduction to Planetary Astronomy. Units: 3

Semester Prerequisite: Satisfactory completion of GE mathematics requirement, area B4

A brief history of the development of astronomy followed by modern descriptions of our planetary system, extrasolar systems, and the possibilities of life in the universe. Discussions of methods of extending knowledge of the universe. No previous background in natural sciences is required. Satisfies GE Category B1. Formerly offered as ASTR 103.

ASTR 1000L. Introduction to Planetary Astronomy Lab. Unit: 1

Semester Prerequisite: Satisfactory completion of GE mathematics requirement, area B4

Semester Corequisite: ASTR 1000

Laboratory associated with Introduction to Planetary Astronomy (ASTR 1000). Satisfies GE Category B3. Materials fee required.

ASTR 1010. Introduction to Galaxies and Cosmology. Units: 3

Semester Prerequisite: Satisfactory completion of GE mathematics requirement, area B4

A brief history of the development of astronomy followed by modern descriptions of stars, galaxies, and structure, evolution, and eventual fate of the universe. Discussions of methods of extending knowledge of the universe. No previous background in natural sciences is required. Satisfies GE Category B1. Formerly offered as ASTR 103.

ASTR 1010L. Introduction to Galaxies and Cosmology Lab. Unit: 1

Semester Prerequisite: Satisfactory completion of GE mathematics requirement, area B4

Semester Corequisite: ASTR 1010

Laboratory associated with Introduction to Galaxies and Cosmology (ASTR 1010). Satisfies GE Category B3. Materials fee required.

ASTR 2300. Introduction to Astronomy for Scientists. Units: 4

Semester Prerequisite: PHYS 2510, 2510L. Prerequisite: PHYS 223, MATH 213

A brief history of the development of astronomy followed by modern physical descriptions of our planetary system, extrasolar systems, stars, galaxies, and models of the universe. Discussions of methods of extending knowledge of the universe. Three hours lecture and three hours laboratory. Materials fee required.

ASTR 3000. Life in the Cosmos. Units: 3

Semester Prerequisite: junior or senior standing, completion of the B1, B2, and B4 general education requirements. Quarter Prerequisite: junior or senior standing

Life in the cosmos is discussed using the findings of astronomy, biology, chemistry and physics. Topics include the development of life and its environment, the search for life, interstellar communications and travel, and the effects of contact. Satisfies GE Category B5. Formerly NSCI 314, students may not receive credit for both.

ASTR 3300. Astrophysics of Planetary Systems. Units: 3

Semester Prerequisite: ASTR 2300

Physical principles of planetary systems and their formation, stellar structure and evolution. Formerly PHYS 370; students may not earn credit for both courses.

ASTR 3310. Astrophysics of Galaxies and Cosmology. Units: 3

Semester Prerequisite: ASTR 2300

Physical principles of stellar evolution, galactic structure, extragalactic astrophysics, and cosmology.

ASTR 4000. Observational Astronomy. Units: 3

Semester Prerequisite: ASTR 2300, PHYS 3300 or other computer programming course. Prerequisite: CSE 201 or other computer programming course

Introduction to the operation of telescopes to image astronomical targets, primarily in the optical range. Topics include night sky motion and coordinate systems; digital imaging, reduction, and analysis; proposal design and review; and observation run planning. Projects include observation and analysis of both pre-determined objects and objects of the students' choosing. Presentations throughout the course using multiple methods of written and oral communication. Counts towards the General Education Writing Intensive (WI) requirement. One hour lecture, three hours lab and three hours supervision. Night-time observing required. Formally a topic under PHYS 485. Students may not earn credit for both courses.

Physics Courses

PHYS 1000. Physics in the Modern World. Units: 3

Semester Prerequisite: MATH 1101, or MATH 1103, or MATH 1201, or MATH 1203, or MATH 1301, or MATH 1303, or MATH 1401, or MATH 1402, or MATH 1403, or MATH 1601, or MATH 2210. Quarter Prerequisite: completion of the general education requirement in mathematics, category B1

Introduction to the physical world, including Newtonian mechanics, electromagnetism, relativity, quantum theory, and nuclear and particle physics. Implications of physics for society. Intended for students with little background in science. Satisfies Category B1. Formerly PHYS 100.

PHYS 1000L. Physics in the Modern World Lab. Unit: 1

Semester Prerequisite: completion of the general education requirement in mathematics, category B4. Prerequisite: completion of the general education requirement in mathematics, category B1

Semester Corequisite: PHYS 1000

Laboratory associated with Physics in the Modern World (PHYS 1000). Satisfies GE Category B3. Materials fee required.

PHYS 1500. Tools for Physicists. Units: 3

Introduction to tools and techniques necessary to prepare students for the physics curriculum. Topics include problem solving techniques, basic programming, data analysis, and discussions of careers and research in physics. Intended for students majoring in physics. Two hours lecture and three hours lab. Materials fee required.

PHYS 2000. Introduction to Physics I. Units: 4

Semester Prerequisite: MATH 1601 or 2210, with a grade of C or better. Quarter Prerequisite: MATH 192 or 211, with a grade of C- or better
First course of a year long sequence surveying the basic concepts of physics, primarily for natural science students. Student majoring in physics, computer science or engineering, or closely related fields should enroll in PHYS 2500. This course will cover the basic principles of mechanics, oscillations, thermodynamics and fluids. Satisfies GE Category B1. Formerly part of the PHYS 121, 122, and 123 sequences.

PHYS 2000L. Introduction to Physics I Lab. Unit: 1

Semester Prerequisite: MATH 1601 or 2210, with a grade of C or better. Prerequisite: MATH 192 or 211, with a grade of C- or better
Semester Corequisite: PHYS 2000
Laboratory associated with Introduction to Physics I (PHYS 2000). Student majoring in physics, computer science or engineering, or closely related fields should enroll in PHYS 2500 and PHYS 2500L. Formerly part of the PHYS 121, 122, and 123 sequences. Satisfies GE Category B3. Materials fee required.

PHYS 2010. Introduction to Physics II. Units: 4

Semester Prerequisite: PHYS 2000. Quarter Prerequisite: PHYS 121
Second course of a year long sequence surveying the basic concepts of physics, primarily for natural science students. Students majoring in physics, computer science or engineering, or closely related fields should instead enroll in PHYS 2510. This course will cover the basic principles of electricity, magnetism, waves, optics, and modern physics. Formerly part of the PHYS 121, 122, and 123 sequence.

PHYS 2010L. Introduction to Physics II Lab. Unit: 1

Semester Prerequisite: PHYS 2000 and 2000L. Prerequisite: PHYS 121
Semester Corequisite: PHYS 2010
Laboratory associated with Introduction to Physics II (PHYS 2010). Students majoring in physics, computer science or engineering, or closely related fields should instead enroll in PHYS 2510 and PHYS 2510L. Formerly part of the PHYS 121, 122, and 123 sequence. Materials fee required.

PHYS 2500. General Physics I. Units: 4

Semester Prerequisite: Math 2210. Quarter Corequisite: MATH 212. Quarter Prerequisite: MATH 211
Semester Corequisite: Math 2220
First course of a two-course sequence in introductory calculus-based physics for scientists and engineers. This sequence is intended for students with a strong background in mathematics and the sciences. Topics include mechanics and oscillations. Satisfies GE Category B1. Formerly part of the PHYS 221, 222, and 223 sequences.

PHYS 2500L. General Physics I Lab. Unit: 1

Semester Prerequisite: Math 2210. Prerequisite: MATH 211
Semester Corequisite: Math 2220 and PHYS 2500
Laboratory for General Physics I (PHYS 2500). This sequence is intended for students with a strong background in mathematics and the sciences. Formerly part of the PHYS 221, 222, and 223 sequence. Satisfies GE Category B3. Materials fee required.

PHYS 2510. General Physics II. Units: 4

Semester Prerequisite: MATH 2220, PHYS 2500. Quarter Prerequisite: PHYS 221 and MATH 213
Second course of a two-course sequence in introductory calculus-based physics for scientists and engineers. This sequence is intended for students with a strong background in mathematics. Topics include electromagnetism and optics. Formerly part of the PHYS 221, 222, and 223 sequence.

PHYS 2510L. General Physics II Lab. Unit: 1

Semester Prerequisite: MATH 2220, PHYS 2500, PHYS 2500L. Prerequisite: MATH 213, PHYS 221
Semester Corequisite: PHYS 2510
Laboratory for General Physics II (PHYS 2510). This sequence is intended for students with a strong background in mathematics. Formerly part of the PHYS 221, 222, and 223 sequence. Materials fee required.

PHYS 2512. General Physics - Supplement. Units: 2

Semester Prerequisite: MATH 2220
An additional course for students who transfer in credit for parts of PHYS 2500 and PHYS 2510, the introductory calculus-based physics sequence for scientists and engineers. This sequence is intended for students with a strong background in mathematics. Intended for transfer students only. Department consent required.

PHYS 2600L. Introduction to Electronics. Unit: 1

Semester Prerequisite: PHYS 2510, MATH 2310. Quarter Prerequisite: PHYS 222, MATH 331
Introduces electronics for the sciences and engineering. Focus is on analog electronics, practical circuits, troubleshooting, passive and active circuit elements, signal conditioning, and test and measurement skills. Formerly PHYS 150; students may not earn credit for both courses. Materials fee required.

PHYS 2700. Modern Physics. Units: 3

Semester Prerequisite: MATH 2310, PHYS 1500, PHYS 2510 and PHYS 2510L. Quarter Corequisite: MATH 252. Quarter Prerequisite: PHYS 223, MATH 331
Semester Corequisite: MATH 2320
An introduction to special relativity, wave-particle duality, quantum mechanics, atomic physics, nuclear physics, and elementary particle physics. Formerly PHYS 225; students may not earn credit for both courses.

PHYS 2951. Special Projects in Physics. Unit: 1

Quarter Prerequisite: consent of instructor
Individual investigation, research, study, or survey of selected problems. May be repeated for credit. Department consent required. Formerly PHYS 295A.

PHYS 2952. Special Projects in Physics. Units: 2

Quarter Prerequisite: consent of instructor
Individual investigation, research, study, or survey of selected problems. May be repeated for credit. Department consent required. Formerly PHYS 295B.

PHYS 2953. Special Projects in Physics. Units: 3

Individual investigation, research, study, or survey of selected problems. May be repeated for credit. Department consent required.

PHYS 3000. Pop Culture Physics. Units: 3

Semester Prerequisite: junior or senior standing, completion of the B4 general education requirements

Introduction to the concepts of physics through popular media such as movies, television, books, and video games. Intended for students having little background in science but who wish to understand what is possible in this universe and what is not. Satisfies GE Category B5.

PHYS 3010. The Science of Digital Sound and Music. Units: 3

Semester Prerequisite: junior or senior standing, completion of the B1 and B4 general education requirements

This course will use the physics and mathematics of waves and sound in order to understand how digital sound and music can be created, shaped, and used to express creative ideas. Topics will include sound and waves, the study of electronics and programs that can be used to shape and filter waveforms, and how these applications can be used to create different types of sound and music. Satisfies GE Category B5. Digital Life GE Pathway.

PHYS 3050. Physics and Astronomy in the Classroom. Units: 3

Semester Prerequisite: MATH 3012. Quarter Prerequisite: MATH 301C

Semester Corequisite: PHYS 3050L; MATH 3013

Basic concepts of physics and astronomy as related to the elementary and middle school classroom. Topics include mechanics, electricity and magnetism, optics, thermodynamics, and astronomy. Course content and practices are aligned with the Next Generation Science Standards (NGSS) and specially designed for students interested in teaching grades K through 8. Formerly a combination of PHYS 100 and ASTR 311 or part of PHYS 3040; credit may not be earned for this course and both PHYS 100 and ASTR 311 or PHYS 3040.

PHYS 3050L. Physics and Astronomy in the Classroom Laboratory. Unit: 1

Semester Prerequisite: MATH 3012. Quarter Prerequisite: MATH 301C

Semester Corequisite: PHYS 1000 or PHYS 3040

Basic concepts of astronomy and physics as related to the elementary and middle school classroom in a hands-on laboratory environment. Course content and practices are aligned with the Next Generation Science Standards (NGSS) and specially designed for students interested in teaching grades K through 8. Topics will include, but are not limited to, all space science NGSS standards. Materials fee required. Formerly a combination of PHYS 100 and part of ASTR 311; credit may not be earned for this course and both PHYS 100 and ASTR 311.

PHYS 3060. Physics and Astronomy in the Classroom. Units: 2

Basic concepts of physics and astronomy as related to the elementary and middle school classroom taught with in-class activities and experiments. Topics include mechanics, electricity and magnetism, optics, thermodynamics, and astronomy. Course content and practices are aligned with the Next Generation Science Standards (NGSS) and specially designed for students interested in teaching grades K through 8. Formerly a combination of PHYS 100 and ASTR 311 or part of PHYS 3040 or PHYS 3050 and PHYS 3050L; credit may not be earned for this course and both PHYS 100 and ASTR 311 or PHYS 3040 or PHYS 3050.

PHYS 3100. Mathematical Methods of Physics. Units: 4

Semester Prerequisite: MATH 2310, MATH 2320 with a grade of C or better, PHYS 1500, PHYS 2510, Combined 2 GPA in 2000-level PHYS courses. Quarter Prerequisite: Math 331 and Math 252 with a grade of C or better, PHYS 223, Combined 2 GPA in 200-level PHYS courses

Vector calculus, ordinary and partial differential equations, special functions, and integral transform techniques including Fourier and Laplace. Emphasis on techniques applicable to the problems of physics and engineering. Formerly PHYS 373, students may not earn credit for both courses.

PHYS 3200. Classical Mechanics. Units: 4

Semester Prerequisite: PHYS 2510 and 2510L. Quarter Prerequisite: PHYS 223

Semester Corequisite: PHYS 3100

A study of translational and rotational dynamics including Newtonian, Lagrangian, and Hamiltonian formulations in inertial and non-inertial reference frames. Applications include oscillations, central-force motion, and systems of particles. Formerly PHYS 306; students may not earn credit for both courses.

PHYS 3300. Computational Physics. Units: 3

Semester Prerequisite: PHYS 2510, PHYS 2510L. Prerequisite: PHYS 223

Semester Corequisite: PHYS 3100

Numerical methods in Python. Topics include numerical integration, applications of computational techniques to differential equations, modeling, Monte Carlo techniques, and non-linear systems. Materials fee required. Formerly a topic under PHYS 485; students may not earn credit for both courses. One hour lecture and six hours laboratory.

PHYS 3400. Electricity & Magnetism. Units: 3

Semester Prerequisite: PHYS 2700 and PHYS 3100 with a grade of C- or better in each course. Quarter Prerequisite: PHYS 225 and 373 with a grade of C- or better in each course

Semester Corequisite: PHYS 2700

A study of classical electromagnetic fields and applications of Maxwell's equations. Topics include electrostatics, magnetostatics, and electrodynamics. Formerly PHYS 313, students may not earn credit for both courses.

PHYS 3500. Statistical and Thermal Physics. Units: 4

Semester Prerequisite: PHYS 2700 and PHYS 3100 with grades of C- or better in each course. Quarter Prerequisite: PHYS 225 and PHYS 373 with a grade of C- or better in each course

Basics of equilibrium thermodynamics and statistical mechanics. Topics include entropy and temperature, partition functions and free energies, classical and quantum statistical ensembles, phase transitions, and selected applications. Formerly PHYS 324, students may not earn credit for both courses.

PHYS 3600. Data Acquisition and Control. Units: 2

Semester Prerequisite: PHYS 2600L, PHYS 3100, PHYS 3300. Quarter Prerequisite: CSE 201, PHYS 150, PHYS 222, and PHYS 373
An introduction to computer-based data acquisition, control, and analysis. Topics include instrument control, graphical programming, algorithm development, feedback control algorithms, and computer-based data analysis. One hour lecture and three hours laboratory. Materials fee required. Formerly PHYS 350; students may not earn credit for both courses.

PHYS 3800. Intermediate Physics Laboratory. Units: 2

Semester Prerequisite: PHYS 3300, PHYS 2700, PHYS 2600L. Prerequisite: CSE 201, PHYS 225, PHYS 150
Semester Corequisite: PHYS 2700, PHYS 2600L
Seminal experiments in physics. Topics include modern scientific instrumentation, probability and statistics, and data and error analysis techniques. Development of written and oral communication skills. One hour lecture and three hours laboratory. Materials fee required.

PHYS 4400. Electricity & Magnetism II. Units: 3

Semester Prerequisite: PHYS 3400 with grade of C- or better. Quarter Prerequisite: PHYS 313 with grade of C- or better
A continuing study of classical electromagnetic fields and applications of Maxwell's equations. Topics may include electrodynamics in media, gauge invariance, electromagnetic waves, radiation, and special relativity. Formerly PHYS 314; students may not earn credit for both courses.

PHYS 4600. Electronics. Units: 3

Semester Prerequisite: PHYS 3600. Quarter Prerequisite: PHYS 350 and PHYS 373
Electronics for science and engineering. Topics may include modular circuit design, linear systems theory, electronic design software, high frequency techniques, communication theory, and control theory. Two hours lecture and three hours laboratory. Materials fee required. Formerly PHYS 352; students may not earn credit for both courses.

PHYS 4700. Quantum Mechanics. Units: 4

Semester Prerequisite: PHYS 2700, PHYS 3100, PHYS 3200, and PHYS 3400 with grades of C- or better in each course. Quarter Prerequisite: MATH 331, PHYS 225, PHYS 373, PHYS 313, and PHYS 306 with a grade of C- or better in each course
Quantum mechanics presented in the Dirac formalism. Topics include spin and orbital angular momentum, two-level systems, time evolution, the harmonic oscillator, and the hydrogen atom. Formerly PHYS 421, students may not earn credit for both courses.

PHYS 4800. Senior Thesis. Units: 2

Semester Prerequisite: PHYS 3800, PHYS 3200, and PHYS 3400. Quarter Prerequisite: PHYS 306 and PHYS 313
Culminating laboratory experience in physics includes working in groups to select, design, perform, and analyze an experiment. Presentations throughout the course using multiple methods of written and oral communication. Counts towards the General Education Writing Intensive (WI) requirement. One hour lecture and three hours laboratory.

PHYS 4851. Special Topics in Physics. Unit: 1

A lecture course on a specialized topic in physics. May be repeated for credit as topics change. Department consent required. Formerly PHYS 485A.

PHYS 4851L. Special Topics in Physics Laboratory. Unit: 1

A laboratory course to coincide with a special topics lecture course. May be repeated for credit as topics change. Department consent required. Materials fee required.

PHYS 4852. Special Topics in Physics. Units: 2

A lecture course on a specialized topic in physics. May be repeated for credit as topics change. Department consent required. Formerly PHYS 485B.

PHYS 4852L. Special Topics in Physics Laboratory. Units: 2

A laboratory course to coincide with a special topics lecture course. May be repeated for credit as topics change. Department consent required. Materials fee required.

PHYS 4853. Special Topics in Physics. Units: 3

A lecture course on a specialized topic in physics. May be repeated for credit as topics change. Department consent required. Formerly PHYS 485C.

PHYS 5100. Mathematical Methods of Physics II. Units: 3

Semester Prerequisite: PHYS 3100. Quarter Prerequisite: PHYS 373
Topics may include functions of a complex variable, tensor analysis, Hilbert spaces, Bayesian statistics, and group theory. Emphasis on techniques applicable to the problems of physics and engineering. Formerly PHYS 473. Students may not earn credit for both courses.

PHYS 5400. Optics. Units: 3

Semester Prerequisite: PHYS 4400. Quarter Prerequisite: PHYS 314
Applications of propagating electromagnetic fields to optical systems. Topics may include physical optics, holography, adaptive optics, lasers, quantum optics, photonics, and non-linear optics. Formerly PHYS 315. Students may not earn credit for both courses.

PHYS 5500. Solid State Physics. Units: 3

Semester Prerequisite: Required: PHYS 2700 and PHYS 3100 or consent of instructor; Recommended: PHYS 3500 and PHYS 4700
An introduction to solid state physics, including structural, electrical, and thermal properties. Topics may include crystal structure, bonding, phonons, electronic states, band structure, and nanomaterials. Formerly PHYS 450. Students may not earn credit for both courses.

PHYS 5700. Quantum Mechanics II. Units: 3

Semester Prerequisite: PHYS 4700 with a grade of C or better. Quarter Prerequisite: PHYS 421 with a grade of C or better
Continued study of the principles of quantum mechanics introduced in PHYS 4700. Topics may include perturbation theory, density functional theory, exchange interactions, scattering, and path integrals. Formerly PHYS 422, students may not earn credit for both courses.

PHYS 5751. Internship. Unit: 1

Supervised work and study in private or public setting. May be repeated for credit. Department consent required. Graded credit/no credit. Only 3 units of PHYS 5751-5753 may be counted towards the Physics degree. Formerly PHYS 585D.

PHYS 5752. Internship. Units: 2

Supervised work and study in private or public setting. May be repeated for credit. Department consent required. Graded credit/no credit. Only 3 units of PHYS 5751-5753 may be counted towards the Physics degree. Formerly PHYS 585B.

PHYS 5753. Internship. Units: 3

Supervised work and study in private or public setting. May be repeated for credit. Department consent required. Graded credit/no credit. Only 3 units of PHYS 5751-5753 may be counted towards the Physics degree. Formerly PHYS 585C.

PHYS 5851. Special Topics in Physics. Unit: 1

A lecture course on a specialized topic in physics. May be repeated for credit as topics change. Department consent required.

PHYS 5851L. Special Topics in Physics Laboratory. Unit: 1

A laboratory course to coincide with a special topics lecture course. May be repeated for credit as topics change. Department consent required. Materials fee required.

PHYS 5852. Special Topics in Physics. Units: 2

A lecture course on a specialized topic in physics. May be repeated for credit as topics change. Department consent required.

PHYS 5852L. Special Topics in Physics Laboratory. Units: 2

A laboratory course to coincide with a special topics lecture course. May be repeated for credit as topics change. Department consent required. Materials fee required.

PHYS 5853. Special Topics in Physics. Units: 3

A lecture course on a specialized topic in physics. May be repeated for credit as topics change. Department consent required.

PHYS 5951. Independent Study. Unit: 1

Investigations conducted under the direction of a faculty member. PHYS 5951-5953 may be repeated for credit up to a total of 6 units. Department consent required. Only 3 units of PHYS 5951-5953 may be counted towards the Physics degree. Formerly PHYS 595A.

PHYS 5952. Independent Study. Units: 2

Investigations conducted under the direction of a faculty member. PHYS 5951-5953 may be repeated for credit up to a total of 6 units. Department consent required. Only 3 units of PHYS 5951-5953 may be counted towards the Physics degree. Formerly PHYS 595B.

PHYS 5953. Independent Study. Units: 3

Investigations conducted under the direction of a faculty member. PHYS 5951-5953 may be repeated for credit up to a total of 6 units. Department consent required. Only 3 units of PHYS 5951-5953 may be counted towards the Physics degree. Formerly PHYS 595C.