PHYSICS

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**Faculty Early Retirement Program*

Programs Offered

Bachelor of Science in Physics

Bachelor of Arts in Physics

Minor in Physics

Teaching Credential Preparation

Physics is the most basic of all the scientific disciplines. Ranging from the applied to the abstract, from the infinitesimal to the infinite, and from quarks to the cosmos, the study of physics seeks to explain all the complicated phenomena in the natural world by providing a description of these phenomena in terms of a few basic principles and laws.

In their most abstract work, physicists seek a unified mathematical description of the four known forces of nature (gravitation, electricity, and magnetism, and the weak and strong nuclear forces). This quest for the "Theory of Everything" eluded Einstein, and is continued today by many physicists, including those who study superstring theory. A successful "Theory of Everything" will correctly predict the fundamental forces and the masses and interactions of the elementary particles from which all matter is formed.

Physicists also use their knowledge of fundamental principles to solve more concrete problems. Problems in understanding and utilizing the properties of semiconductors and other materials; in designing and building lasers, photonics, and telecommunications devices; in nuclear physics and biophysics; and in designing and using instrumentation for astrophysics and cosmology are typically solved using the techniques of physics. Such applied physics problems often have a significant overlap with topics and techniques in engineering and computational physics. Indeed, many of the department's graduates are currently employed in engineering or computationally oriented positions.

The department offers a traditional, mathematically rigorous program leading to a B.S. in physics; a more applied curriculum leading to a B.S. in physics with a concentration in applied physics; and a flexible B.A. program with two advisory plans (algebra and trigonometry or calculus). All programs stress fundamental concepts and techniques, offer an unusually rich laboratory experience and intensive use of computers, and require a "capstone" course as a culminating experience. Capstone projects may include experimental design, instructional design, or undergraduate research—personalized and unique opportunities to demonstrate the skills and knowledge acquired in the major.

In 2006, the department returned to the newly remodeled Darwin Hall, equipped with new lower-division teaching laboratories and facilities for intermediate and advanced laboratory courses, undergraduate research, design projects, and special studies. These facilities include an x-ray diffractometer, sputtering, chemical vapor deposition and e-beam evaporation thin film deposition equipment, and a nuclear low-level counting laboratory.

Physics majors also use multidisciplinary facilities in the Cerent Engineering Science Complex in Salazar Hall. These state-of-the-art laboratories include a scanning electron microscope, atomic force microscopes, a confocal microscope, and extensive instrumentation to support experiments in photonics and laser science, including experiments in laser-induced breakdown spectroscopy, laser-induced fluorescence spectroscopy, interferometry, holography, laser material processing, and micro-machining.

A substantial program in undergraduate astronomy includes many courses, listed in this catalog under Astronomy, which may be included in the B.A. or B.S. degree programs in physics. The department operates a teaching observatory on the SSU campus and a NASA-funded research observatory at a darker site in northern Sonoma County.

Careers in Physics

For information on what you can do with a bachelor's degree in physics, follow links from: http://phys-astro.sonoma.edu

Bachelor of Science in Physics

The B.S. program is a thorough introduction to the principles of physics, providing a strong foundation for graduate study or industrial research. It is also intended for those students who wish to prepare for interdisciplinary studies on the graduate level in fields such as astronomy, atmospheric science, biophysics, environmental science, geophysics, materials science, and physical oceanography.

Degree Requirements	**Units**
General education	51
Major requirements (may include 5 units in GE)	46
Supporting courses (may include 4 units in GE)	26
Electives	1-10
Total units needed for graduation	**124**

Major Core Requirements

PHYS 114 Introduction to Physics I (may be applied to GE)	4
PHYS 116 Introductory Laboratory Experience (may be applied to GE)	1
PHYS 214 Introduction to Physics II	4
PHYS 216 Introductory Laboratory	1
PHYS 230 Electronics I	3
PHYS 231 Electronics I Laboratory	1
PHYS 314 Introduction to Physics III	4
PHYS 320 Analytical Mechanics	3
PHYS 325 Introduction to Mathematical Physics	3
PHYS 340 Light and Optics	3
PHYS 366 Intermediate Experimental Physics	3
PHYS 381 Computer Applications for Scientists	2
PHYS 430 Electricity and Magnetism	3
PHYS 450 Statistical Physics	2
PHYS 460 Quantum Physics	3
Total units in the major core	40

Major Electives (Advanced)

To complete the major, select 6 units from the list below. At least one of the courses chosen must be a *capstone course.

ASTR 380 Astrophysics: Stars (3)
ASTR 482 Advanced Observational Astronomy (2)
*ASTR 492 Instructional Design Project (2)
ASTR 495 Special Studies (1-4)
*ASTR 497 Undergraduate Research in Astronomy (2)
PHYS 413 Microprocessor Applications (3)
PHYS 413L Microprocessor Applications Laboratory (1)
PHYS 445 Photonics (3)
PHYS 466 Advanced Experimental Physics (3)
PHYS 475 Physics of Semiconductor Devices (3)
*PHYS 492 Instructional Design Project (2)
*PHYS 493 Senior Design Project (2)
PHYS 494 Physics Seminar (1)
PHYS 495 Special Studies (1-4)
*PHYS 497 Undergraduate Research in Physics (2)

Certain selected-topics courses, ASTR or PHYS 396, may be approved by the advisor.

Total units in the advanced electives	6
Total units in the major	46

Required Supporting Courses

MATH 161 Calculus I (3 units may be applied in GE)	4
MATH 211 Calculus II	4
MATH 241 Calculus III	4
MATH 261 Calculus IV	4
CHEM 115AB General Chemistry (1 unit may be applied in GE)	10
Total units in supporting courses	26
Total units in the major and supporting courses (9 may be applied in GE)	72

Sample Four-year Program for Bachelor of Science in Physics

The sequential nature of the physics curriculum necessitates an early start with major requirements and the distribution of general education courses over four years.

FRESHMAN YEAR:: 31 Units

Fall Semester (15 Units)	*Spring Semester (16 Units)*
CHEM 115A (5)	CHEM 115B (5)
MATH 161 (4)	MATH 211 (4)
ENGL 101 (3) (GE A2)	PHYS 114 (4)
Elective (2)	PHYS 116 (1)
PHYS 494 (1) (Recommended)	Elective (2)

SOPHOMORE YEAR:: 31 Units

Fall Semester (15 Units)	*Spring Semester (16 Units)*
MATH 261 (4)	MATH 241 (4)
PHYS 214 (4)	PHYS 230 (3)
PHYS 216 (1)	PHYS 231 (1)
GE (3)	GE (3)
GE (3)	GE (3)
	Elective (2)

JUNIOR YEAR:: 30 Units

Fall Semester (15 Units)	*Spring Semester (15 Units)*
PHYS 325 (3)	PHYS 320 (3)
PHYS 314 (4)	PHYS 340 (3)
PHYS 381 (2)	PHYS 366 (3)
GE (3)	GE (3)
GE (3)	GE (3)

SENIOR YEAR:: 32 Units

Fall Semester (16 Units)	*Spring Semester (16 Units)*
PHYS 450 (2)	PHYS 430 (3)
PHYS 460 (3)	PHYS Elective (2)
PHYS Elective (3)	GE (3)
GE (3)	GE (3)
GE (3)	GE (3)
Elective (2)	Elective (2)

TOTAL UNITS:: 124

See your advisor to discuss acceptable physics electives and when they will be offered. Twelve of the 51 units of GE are met by required courses listed here (3 each in areas A2, B1, B3, and B4).

Applied Physics Concentration

Students may earn a B.S. in physics with a concentration in applied physics. This program is intended for those students who desire an emphasis on laboratory work. It provides a rigorous, yet slightly less theoretical course of study, and a greater selection of hands-on electives. It is a good choice for students who wish to continue their studies in graduate engineering programs, or who wish to work in industry in engineering or computationally oriented positions.

Degree Requirements	Units
General education	51
Major requirements (may include 5 in GE)	48
Supporting courses (may include 4 in GE)	17
Electives	8-17
Total units needed for graduation	**124**

Major Core Requirements

PHYS 114 Introduction to Physics I (may be applied to GE)	4
PHYS 116 Introductory Laboratory Experience (may be applied to GE)	1
PHYS 214 Introduction to Physics II	4
PHYS 216 Introductory Laboratory	1
PHYS 230 Electronics I	3
PHYS 231 Electronics I Laboratory	1
PHYS 314 Introduction to Physics III	4
PHYS 325 Introduction to Mathematical Physics	3
PHYS 340 Light and Optics	3
PHYS 366 Intermediate Experimental Physics	3
PHYS 381 Computer Applications for Scientists	2
PHYS 430 Electricity and Magnetism	3
PHYS 450 Statistical Physics	2
PHYS 460 Quantum Physics	3
PHYS 475 Physics of Semiconductor Devices	3
Total units in the major core	40

Major Electives (Advanced)

8 units selected from the following (must include at least one *capstone course)

ASTR 482 Advanced Observational Astronomy (2)
*ASTR 492 Instructional Design Project (2)
ASTR 495 Special Studies (1-4)
*ASTR 497 Undergraduate Research in Astronomy (2)
PHYS 320 Analytical Mechanics (3)
PHYS 413 Microprocessor Applications (3)
PHYS 413L Microprocessor Applications Laboratory (1)
PHYS 445 Photonics (3)
PHYS 466 Advanced Experimental Physics (3)
*PHYS 492 Instructional Design Project (2)
*PHYS 493 Senior Design Project (2)
PHYS 494 Physics Seminar (1)
PHYS 495 Special Studies (1-4)
*PHYS 497 Undergraduate Research in Physics (2)
Certain selected topics courses, ASTR or PHYS 396, may be approved by the advisor.

Total units in the major electives 8

Total units in the major 48

Required Supporting Courses

MATH 161 Calculus I (3 units may be applied in GE)	4
MATH 211 Calculus II	4
MATH 261 Calculus IV	4
CHEM 115A General Chemistry (1 unit may be applied in GE)	5
Total units in supporting courses	17
Total units in the major and supporting courses (9 may be applied in GE)	65

Sample Four-year Program for Bachelor of Science in Physics with Concentration in Applied Physics

The sequential nature of the physics curriculum necessitates an early start with major requirements and the distribution of general education courses over four years.

FRESHMAN YEAR:: 30 Units

Fall Semester (15 Units)	*Spring Semester (15 Units)*
CHEM 115A (5)	MATH 211 (4)
MATH 161 (4)	PHYS 114 (4)
ENGL 101 (3) (GE A2)	PHYS 116 (1)
Elective (2)	GE (3)
PHYS 494 (1) (recommended)	GE (3)

SOPHOMORE YEAR:: 31 Units

Fall Semester (15 Units)	*Spring Semester (16 Units)*
MATH 261 (4)	PHYS 230 (3)
PHYS 214 (4)	PHYS 231 (1)
PHYS 216 (1)	GE (3)
GE (3)	GE (3)
GE (3)	GE (3)
	GE (3)

JUNIOR YEAR:: 31 Units

Fall Semester (15 Units)	*Spring Semester (16 Units)*
PHYS 325 (3)	PHYS 340 (3)
PHYS 314 (4)	PHYS 366 (3)
PHYS 381 (2)	PHYS Elective (3)
GE (3)	GE (3)
Elective (3)	Elective (4)

SENIOR YEAR:: 32 Units

Fall Semester (16 Units)	*Spring Semester (16 Units)*
PHYS 450 (2)	PHYS 430 (3)
PHYS 460 (3)	PHYS 475 (3)
PHYS Elective (2)	PHYS Elective (2)
GE (3)	GE (3)
Elective (3)	GE (3)
Elective (3)	Elective (2)

TOTAL UNITS:: 124

See your advisor to discuss acceptable physics electives and when they will be offered. Twelve of the 51 units of GE are met by required courses listed here, (3 each in areas A2, B1, B3, and B4).

Bachelor of Arts in Physics

The B.A. program allows considerable flexibility for the student who wishes to study physics as part of a liberal arts education. Two advisory plans are offered:

Bachelor of Arts in Physics with Advisory Plan C

This plan uses calculus. Students who choose this, the more popular B.A. advisory plan, have the prerequisites to take nearly all of the courses in the department. They find employment in scientific and engineering fields. Some go on to graduate school in interdisciplinary sciences. This degree program is appropriate for those who wish to earn a California Science Teaching Credential with a concentration in Physics.

Degree Requirements	Units
Major requirements (may include 5-6 in GE)	34-38
Required area of concentration	12
Supporting courses (may include 3 in GE)	12
General education	51
General electives	7-19
Total units needed for graduation	**120**

Major Core Requirements

PHYS 114 Introduction to Physics I (may be applied to GE)	4
PHYS 116 Introductory Laboratory Experience (may be applied to GE)	1
PHYS 214 Introduction to Physics II	4
PHYS 216 Introductory Laboratory	1
PHYS 314 Introduction to Physics III	4
PHYS 340 Light and Optics	3
Choose one of the following two programming courses:	*2-4*
PHYS 381 Computer Applications for Scientists (2)	
CS 115 Programming I (4)	
Capstone course: One of the following	*2*
ASTR 492 Instructional Design Project (2)	
ASTR 497 Undergraduate Research in Astronomy (2)	
PHYS 492 Instructional Design Project (2)	
PHYS 493 Senior Design Project (2)	
PHYS 497 Undergraduate Research in Physics (2)	
The major must include a minimum of 24 upper-division units in physics and astronomy, so, with an advisor, choose 13-15 units in additional upper-division physics and astronomy courses. Physics 230 and 231, although lower-division, may be used to meet part of this requirement.	*13-15*
Total units in the major core	34-38

Required Area of Concentration

Courses in one other field, chosen in consultation with an advisor.

Total units in area of concentration	12

Supporting Courses

MATH 161 Calculus I (3 units may be applied in GE)	4
MATH 211 Calculus II	4
MATH 261 Calculus IV	4
Total units in supporting courses	12
Total units in the major and supporting courses (8-9 may be applied in GE)	58 - 62

Sample Four-year Program for Bachelor of Arts in Physics with Advisory Plan C

The sequential nature of the physics curriculum necessitates an early start with major requirements and the distribution of general education courses over four years.

FRESHMAN YEAR:: 31 Units

Fall Semester (16 Units)	*Spring Semester (15 Units)*
MATH 161 (4)	MATH 211 (4)
ENGL 101 (3) (GE A2)	PHYS 114 (4)
GE (3)	PHYS 116 (1)
GE (3)	GE (3)
GE (3)	GE (3)

SOPHOMORE YEAR:: 30 Units

Fall Semester (15 Units)	*Spring Semester (15 Units)*
MATH 261 (4)	PHYS Elective (3)
PHYS 214 (4)	Elective (3)
PHYS 216 (1)	GE (3)
GE (3)	GE (3)
GE (3)	Elective (3)

JUNIOR YEAR:: 30 Units

Fall Semester (15 Units)	*Spring Semester (15 Units)*
PHYS 314 (4)	PHYS 340 (3)
PHYS 381 (2)	PHYS Elective (3)
Area of Concentration* (3)	Area of Concentration* (3)
GE (3)	GE (3)
GE (3)	Elective (3)

SENIOR YEAR:: 29 Units

Fall Semester (15 Units)	*Spring Semester (14 Units)*
PHYS Elective (3)	Capstone Course (2)
Area of Concentration* (3)	Area of Concentration* (3)
GE (4)	PHYS Elective (4)
Electives (5)	Electives (5)

TOTAL UNITS:: 120

**Area of Concentration = 12 units in one other subject. Eleven of the 51 units of GE are met by required courses listed here (in areas A2, B1, B3, and B4). (One more can be met with a physics elective.)*

Bachelor of Arts in Physics with Advisory Plan T

This plan uses algebra and trigonometry. Students may select from upper-division courses, appropriate to careers as science or technical writers, scientific sales personnel, technicians, programmers, or other technical specialists. There is opportunity to take courses that lead to careers in the health sciences or environmental fields. This degree program is appropriate for those who wish to earn a California Multiple Subject Teaching Credential. Advisory Plan T is often taken as part of a double major.

Degree Requirements	Units
Major requirements (may include 6 in GE)	32-36
Required area of concentration	12
Supporting course (may include 3 in GE)	4
General education	51
General electives	17-30
Total units needed for the degree	**120**

Major Core Requirements

PHYS 209AB General Physics Laboratory	2
PHYS 210AB General Physics	6
Choose one of the following two courses in modern physics or astronomy:	*3-4*
ASTR 305 Frontiers in Astronomy (3)	
PHYS 314 Introduction to Physics III (4)	
Choose one of the following two courses in optics:	*3*
PHYS 340 Light and Optics (3)	
PHYS 342 Light and Color (3)	
An approved course in computer applications, e.g., PHYS 381 (2):	*2-4*
Capstone course: One of the following:	*2*
ASTR 492 Instructional Design Project (2)	
ASTR 497 Undergraduate Research in Astronomy (2)	
PHYS 492 Instructional Design Project (2)	
PHYS 493 Senior Design Project (2)	
PHYS 497 Undergraduate Research in Physics (2)	
The major must include a minimum of 24 upper-division units in physics and astronomy, so, with an advisor, choose 13-16 units in additional upper-division physics and astronomy courses. Physics 230 and 231, although lower-division, may be used to meet part of this requirement.	*13-16*
Total units in the major core	**32-36**

Required Area of Concentration

Courses in one other field chosen in consultation with an advisor.

Total units in area of concentration 12

Supporting Course

MATH 107 Pre-calculus Mathematics (3 units may be applied in GE):	4
Total units in supporting course	**4**
Total units in the major	**48-52**

Sample Four-year Program for Bachelor of Arts in Physics with Advisory Plan T

The sequential nature of the physics curriculum necessitates an early start with major requirements and the distribution of general education courses over four years.

FRESHMAN YEAR:: 30 Units

Fall Semester (15 Units)	*Spring Semester (15 Units)*
MATH 107 (4)	PHYS 209A (1)
ENGL 101 (3) (GE A2)	PHYS 210A (3)
GE (3)	GE (3)
GE (3)	GE (3)
Elective (2)	GE (3)
	Elective (2)

SOPHOMORE YEAR:: 31 Units

Fall Semester (15 Units)	*Spring Semester (16 Units)*
PHYS 209B (1)	PHYS Elective (4)
PHYS 210B (3)	Elective (3)
GE (3)	GE (3)
GE (3)	GE (3)
GE (3)	GE (3)
Elective (2)	

JUNIOR YEAR:: 30 Units

Fall Semester (15 Units)	*Spring Semester (15 Units)*
ASTR 305 (3)	PHYS 342 (3)
PHYS Elective (3)	PHYS Elective (3)
Area of Concentration* (3)	Area of Concentration* (3)
GE (3)	GE (3)
Elective (3)	Elective (3)

SENIOR YEAR:: 29 Units

Fall Semester (15 Units)	*Spring Semester (14 Units)*
PHYS Elective (3)	PHYS Elective (2)
PHYS Elective (3)	Area of Concentration* (3)
Area of Concentration* (3)	Elective (3)
Elective (3)	Elective (3)
Elective (3)	Elective (3)

TOTAL UNITS:: 120

**Area of concentration = 12 units in one other subject. Twelve of the 51 units of GE are met by required courses listed here (in areas A2, B1, B3, and B4).*

Minor in Physics

Completion of a minimum of 20 units in physics courses, including not more than one first course or more than one second course, constitutes a minor in physics. (First courses are PHYS 100, 210A, and 114 and their equivalents taught elsewhere. Second courses are PHYS 210B, 214, and their equivalents.) Interested students should consult with the advisor in the Department of Physics and Astronomy.

Teaching Credential Preparation

See the Teaching Credential Preparation in Science Courses section of this catalog or contact the department advisor.

Physics Courses (PHYS)

Classes are offered in the semesters indicated. Please see the Schedule of Classes or the department website at www.phys-astro.sonoma.edu for the most current information and faculty teaching assignments.

Grading Policy: All courses submitted toward major requirements in the Physics and Astronomy Department must be taken for a letter grade (A-F). This policy does not apply to courses challenged or offered only on a Cr/NC basis.

100 Descriptive Physics (3) Fall, Spring
Lecture, 3 hours. A descriptive survey of the important principles of physics. Not recommended for B.S. students. Satisfies GE, category B1 or B3. Prerequisite for chemistry, physics, or mathematics majors: Physics and Astronomy Department approval.

102 Descriptive Physics Laboratory (1) Fall, Spring
Laboratory, 3 hours. Experimental demonstrations, exercises, and field trips illustrating the methods by which physicists have learned what they claim to know about the world. Instruction is at the PHYS 100 level. Satisfies GE, category B1 or B3, and GE laboratory requirements. Prerequisite: previous or concurrent enrollment in PHYS 100 or ASTR 100, or consent of instructor.

114 Introduction to Physics I (4) Fall, Spring
Lecture, 4 hours. The first of three basic sequential courses in physics for science and mathematics majors. Introduction to vectors; classical mechanics, including particle dynamics and fluid mechanics; simple harmonic motion; thermodynamics and kinetics. Satisfies GE, category B1 or B3. Prerequisite: MATH 161.

116 Introductory Laboratory Experience (1) Fall, Spring
Laboratory, 3 hours. Demonstrations and participatory experiments are used to increase the student's familiarity with gravitational, electromagnetic, and nuclear forces in nature. Applications include biological, geophysical, medical, and environmental phenomena. Satisfies GE, category B1 or B3, and GE laboratory requirements. Prerequisite: previous or concurrent enrollment in PHYS 114.

209AB General Physics Laboratory (1, 1) Fall, Spring
Laboratory, 3 hours. Laboratory experiments to accompany PHYS 210AB and develop students' ability to perform measurements of physical phenomena and increase their appreciation of the sense of the physical universe gained through experimentation. 209A satisfies GE, category B1 or B3, and GE laboratory requirements. Prerequisites: high school algebra and trigonometry and a course in high school physical science. For 209A: previous or concurrent enrollment in PHYS 210A. For 209B: 209A and previous or concurrent enrollment in 210B. CAN PHYS SEQ A.

210AB General Physics (3, 3) Fall, Spring
Lecture, 3 hours. A basic course in physics for students majoring in biology, geology, or pre-professional programs. Fundamentals of Newtonian mechanics, thermophysics, optics, electricity and magnetism, special relativity, and quantum physics. Registration by mathematics majors requires Physics and Astronomy Department approval. 210A satisfies GE, category B1 or B3 requirement. Prerequisites: high school algebra and trigonometry, or MATH 107. CAN PHYS SEQ A.

214 Introduction to Physics II (4) Fall, Spring
Lecture, 4 hours. The continuation of PHYS 114. Electrostatics, quasistatic fields and currents, magnetostatics; electromagnetic induction; waves; physical and geometric optics. Prerequisites: PHYS 114; previous or concurrent enrollment in MATH 211.

216 Introductory Laboratory (1) Fall, Spring
Laboratory, 3 hours. Selected experiments to increase the student's working physical knowledge of the natural world. Prerequisites: PHYS 114 and 116. Concurrent enrollment in PHYS 214 is strongly recommended.

230 Electronics I (3) Spring
An introduction to the basics of analog and digital electronics. Review of Kirchhoff's laws, Thevenin's and Norton's theorems. Electronic circuits modeling and analysis, diodes, transistors, filters, operational amplifiers, single and multi-stage amplifiers; analysis and design of combinational and sequential digital circuits. Cross-listed as ES 230. Prerequisites: ES 220 and 221, or PHYS 214 and 216, or 210B and 209B, or consent of instructor. Must be taken concurrently with Electronics I Lab.

231 Electronics I Laboratory (1) Spring
Laboratory, 3 hours. Laboratory work to accompany Electronics I. Computer assisted design of analog and digital circuits. Diodes, filters, transistors, oscillators, amplifiers, analog to digital and digital to analog conversion, combinational and sequential logic, programmable logic devices. Cross-listed as ES 231. Must be taken concurrently with Electronics I.

300 Physics of Music (3) Fall
Lecture, 3 hours. Introduction to physical principles encountered in the study of music, applicable laws of mechanics and acoustics, harmonic analysis, musical scales, sound production in musical instruments, and elements of electronic music. Satisfies GE, category B3. Prerequisite: one course in physical science or consent of instructor.

314 Introduction to Physics III (4) Fall
Lecture, 4 hours. The continuation of PHYS 214. Special relativity, elementary quantum mechanics, the Bohr atom and deBroglie waves, the Schrödinger wave equation with applications to simple one-dimensional problems and to atomic structure, elementary nuclear physics, introduction to equilibrium statistical mechanics, the partition function, and Boltzmann statistics. Prerequisites: PHYS 214; previous or concurrent enrollment in MATH 261.

320 Analytical Mechanics (3) Spring
Lecture, 3 hours. Principles of Newtonian mechanics. Relativistic dynamics. Introduction to Hamiltonian mechanics. Applications to central force problems and small vibrations. Prerequisites: PHYS 114, PHYS 325.

325 Introduction to Mathematical Physics (3) Fall
Lecture, 3 hours. Coordinate systems and vectors; vector calculus; series expansions; differential equations; orthonomal functions; matrices and tensors; eigenvalues, eigenvectors, and eigenfunctions; solutions of systems of linear equations; complex numbers, complex plane, polar forms; Fourier series and Fourier integrals; use of mathematical symbolic processing software. Prerequisites: PHYS 214 and MATH 261 or consent of instructor.

340 Light and Optics (3) Spring

Lecture, 3 hours. The quantum theory of light, coherence, interference, diffraction and polarization, masers, lasers, geometrical optics, spectroscopy. Prerequisite: PHYS 314 or 325.

342 Light and Color (3) Spring

Lecture, 3 hours. A descriptive, nonmathematical but analytical treatment of the physical properties of light, the camera, telescope, microscope, and laser; holography, mirages, rainbows and the blue sky; colors in flowers, gems, and pigments; human and animal vision and visual perception. Satisfies GE, category B3. Prerequisite: any physical science course or consent of instructor.

366 Intermediate Experimental Physics (3) Spring

Lecture, 2 hours; laboratory, 3 hours. Selected topics in experimental quantum physics, photonics (including fiber optic systems and lasers), materials science (including scanning electron microscopy and atomic force microscopy), X-ray analysis, applied nuclear physics, medical physics, biophysics, and precision machining. Prerequisites: PHYS 314 and 216, or consent of instructor.

381 Computer Applications for Scientists (2) Fall

Lecture, 1 hour; laboratory, 3 hours. Problem-solving techniques including data reduction and error analysis for the physical sciences. The student is introduced to high-level programming languages such as C++ and various mathematical tools including Excel, Mathematica, and MathCad. Topics include modern programming techniques, use of graphics and mathematical function libraries, linear least squares data fitting techniques, and error analysis. Prerequisites: PHYS 114 and MATH 211.

395 Community Involvement Program (1-2)

CIP involves students in basic community problems related to physics and astronomy—performing such tasks as tutoring, reading to the blind, service to local, county, and state agencies, and service as teacher aides to elementary schools. Students receive 1-2 units, depending on the specific task performed. Not more than 4 CIP units will be applicable to the physics major requirements. May be taken by petition only.

396 Selected Topics in Physics (1-3)

A course of lectures on a single topic or set of related topics not ordinarily covered in the physics curriculum. The course may be repeated for credit with a different topic. Prerequisite: consent of instructor.

413 Microprocessor Applications (3) Spring

Lecture, 3 hours. Review of digital logic and programmable logic devices. Microprocessor architecture and programming and instruction design; memory hierarchy and I/O interfaces, system design using microprocessors (data acquisition, motion control robotics and other applications). Prerequisite: ES 230/ PHYS 230, or consent of instructor. Must be taken concurrently with PHYS 413L.

413L Microprocessor Applications Laboratory (1) Spring

Laboratory work to accompany Physics 413. Microprocessor programming, analog port and sensors, motion control, interfacing microprocessors with computers (high level interfacing and programming), programmable logic devices, and data bus and memory data handling. Prerequisite: same as PHYS 413. Must be taken concurrently with PHYS 413.

430 Electricity and Magnetism (3) Spring

Lecture, 3 hours. Electrostatics, magnetostatics, electric currents, electromagnetic induction, electric and magnetic fields in matter, Maxwell's equations, retarded potentials, radiation reaction, light emission, simple scattering and antenna theory, properties of waveguides, relativistic formulation of electrodynamics, and Fourier decomposition of fields. Prerequisites: PHYS 214, PHYS 325.

445 Photonics (3) Fall

Lecture, 3 hours. Gaussian beams; guided-wave optics; fiber optics; optical resonators; resonant cavities; laser oscillation and amplification; laser excitation; optical pumping; solid state, gas, dye, chemical, excimer, and free electron lasers; semiconductor lasers; laser spectroscopy; fiber optic communication; photomultiplier and semiconductor radiation detectors including photoconductors, junction photodiodes; p-i-n diodes, avalanche photodiodes; detector noise. Prerequisite: PHYS 314 or consent of instructor.

450 Statistical Physics (2) Fall

Lecture, 2 hours. The laws of thermodynamics: Boltzmann, Bose, and Fermi statistics; applications. Prerequisite: PHYS 314.

460 Quantum Physics (3) Fall

Lecture, 3 hours. The Schrödinger equation, coordinate and momentum representation, harmonic oscillator, angular momentum and spin, Hilbert space, eigenvalues and eigenvectors, completeness relations, central potentials, hydrogen atom, scattering, perturbation theory, and Dirac notation. Extensive use of a symbolic processing program. Prerequisites: PHYS 314 and 325.

466 Advanced Experimental Physics (3) Fall

Lecture 2 hours, laboratory 3 hours. Advanced topics in experimental quantum physics, photonics (including fiber optic systems and lasers), materials science (including scanning electron microscopy and atomic force microscopy), X-ray analysis, applied nuclear physics, medical physics, and biophysics. Prerequisites: PHYS 366 or consent of instructor.

475 Physics of Semiconductor Devices (3) Spring

Lecture, 3 hours. Semiconductor materials, crystal structure and growth; energy bands and charge carriers, conductivity and mobility; metal-semiconductor and p-n junctions; p-n junction diodes; bipolar junction transistors; field-effect transistors; CCDs; photonic devices and integrated circuits. Projects in photolithography, conductivity and contact resistance measurements, I-V and C-V characteristics of diodes, and characterization of transistors may be assigned. Prerequisite: PHYS 314 or consent of instructor.

492 Instructional Design Project (2) Fall, Spring

A directed project to develop at least one laboratory experiment and/or classroom activity that teaches basic concepts in undergraduate physics. Both written and oral presentations (including a demonstration of the experiment or activity) will be required. Prerequisite: Physics 214 and 216 or Physics 210B and 209B.

493 Senior Design Project (2) Fall, Spring

A directed project to develop either a working prototype or a detailed conceptual design for an operational laboratory device. Prerequisites: PHYS 230 and 231.

494 Physics Seminar (1) Fall, Spring

A series of lectures on topics of interest in physics, astronomy, and related fields. May be repeated for credit up to 3 units maximum. Prerequisite: consent of instructor.

495 Special Studies (1-4) Fall, Spring

The Physics and Astronomy Department encourages independent study and considers it to be an educational undertaking. Students wishing to enroll for special studies are required to submit proposals to their supervising faculty members that outline their projects and exhibit concrete plans for their successful completion.

497 Undergraduate Research in Physics (2)

Supervised research in an area of physics that is currently under investigation by one or more members of the Physics and Astronomy Department's faculty. This course may be repeated for up to 6 units of credit. Both written and oral presentations will be required. Prerequisites: junior standing and consent of instructor.