

## Department of Physics

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### Degree Programs Offered

- BA, major in Physics
- BS, major in Physics

### Minor Offered

- Physics

Physics, the study of matter and energy, is at the root of every field of natural science and underlies all physical phenomena. The problem-solving skills learned in the study of physics are valuable even if one's career is not in a physics-related field.

The BS with a major in Physics provides a rigorous background in physics as a preparation for graduate studies or a career in industry. The BA with a major in Physics is for students who want a background in physics but plan to pursue fields of interest other than physics as a life's work.

Career opportunities for a physics major exist in a wide variety of settings—from teaching in a classroom to basic research in an industrial or government laboratory, as a self-employed consultant, or as a member of a multidisciplinary research team.

Students who enter Texas State needing mathematics at a level below MATH 2417 are urged to attend a summer session to avoid any delay in starting their physics courses.

**Pre-Engineering:** There are two pre-engineering options offered through the Department of Physics for those students who want an engineering program that is not currently offered at Texas State. **Option 1:** Called a 3-2 option in which students spend approximately six semesters in a physics and mathematics curriculum. The student must complete at least 96 hours of prescribed work that is required by the Department. All of the prescribed course work must be earned in residence or as dual credit, IB, or AP credit prior to enrollment at Texas State. A student who is approved to be in the 3-2 pre-engineering program and who later earns an engineering degree from an approved engineering school in the state of Texas may be granted a bachelor's degree by Texas State. The student must (1) satisfy all general education core curriculum requirements, (2) satisfy all prescribed coursework for the major and minor, and (3) request a degree audit in the College of Science Advising Center before leaving Texas State. After completing the entire program, students receive both an engineering degree from the school they attended and a BS in Physics from Texas State. **Option 2:** Students spend three to six semesters taking courses basic to the field of engineering they intend to enter and then transfer to the engineering school to pursue a degree, but do not earn a degree from Texas State.

Because of the many choices of curricula in the field of engineering, all pre-engineering students, from the time they first enroll, should regularly consult with their advisor in selecting courses. Failure to do so may result in loss of transfer credit. Even courses accepted for transfer credit by another university may not apply toward a degree in engineering. Only those courses acceptable by the dean of the student's elected engineering school may be counted toward the corresponding degree.

Concerning transfer of courses, Texas State has entered into transfer articulation agreements with The University of Texas at Austin, Texas A&M, Texas Tech University, and the University of Texas at San Antonio. These agreements specify suggested equivalences of courses. For additional information, contact your academic advisor.

For more information contact the College of Science Advising Center or the departmental advisor for the Department of Physics. For information on engineering technology, electrical engineering, industrial engineering, and manufacturing engineering see the Ingram School of Engineering and Department of Engineering Technology sections of this catalog.

## Teacher Certification

Students interested in seeking a Physical Science (Texas Grades 8-12) certification should contact the Science Advisor for requirements. Initial or additional certification may also be acquired as a post-baccalaureate or graduate student. Students interested in certification are strongly encouraged to see the Science Advisor early in their undergraduate program or certification process.

## Bachelor of Arts Major in Physics

Minimum required: 120 semester hours

### General Requirements:

1. A minimum of 9 writing intensive hours and a total of 36 advanced hours are required to graduate. An advanced course is one that is numbered above 3000 and below 5000.
2. See the University College section of this catalog for general education core curriculum requirements.
3. The major requires 31-34 hours.
4. 9-12 additional hours of advanced physics courses selected from PHYS 3315 (spring), 3414 (fall), 3416 (spring), 3417 (fall), 4310 (fall), 4311 (fall), 4312 (spring), 4315 (spring), 4317 (fall), 4320 (see dept.), 4321 (see dept.), or 4340 (spring).
5. Majors should consult the department advisor or the College of Science Advising Center before choosing a minor and the electives.
6. BIO 1430 and 1431 may be taken instead of CHEM 1141, 1341 and 1142, 1342 listed below.
7. ENG 3303 Technical Writing course can be substituted for the second English literature course from the general education core curriculum.

<b>Freshman Year – 1<sup>st</sup> Semester</b>	<b>Hours</b>
MATH 2471.....	4
US 1100.....	1
ENG 1310.....	3
HIST 1310.....	3
COMM 1310.....	3
PFW one course.....	1
<b>Total</b>	<b>15</b>

<b>Sophomore Year – 1<sup>st</sup> Semester</b>	<b>Hours</b>
PHYS 2425.....	4
CHEM 1141, 1341 (see gen. req. 6).....	4
Modern Language 1410.....	4
Social Science Component (see gen. req. 2).....	3
<b>Total</b>	<b>15</b>

<b>Junior Year – 1<sup>st</sup> Semester</b>	<b>Hours</b>
PHYS 3312.....	3
MATH 3373.....	3
Modern Language 2310.....	3
POSI 2310.....	3
ENG Literature (see gen. req. 2).....	3
<b>Total</b>	<b>15</b>

<b>Senior Year – 1<sup>st</sup> Semester</b>	<b>Hours</b>
PHYS Electives (see gen. req. 4).....	3-4
Minor/Electives (see gen. req. 1, 5 & 7).....	6
ART, DAN, MU, or TH 2313.....	3
Second ENG Literature (see gen. req. 2 & 7).....	3
<b>Total</b>	<b>15-16</b>

<b>Freshman Year – 2<sup>nd</sup> Semester</b>	<b>Hours</b>
PHYS 1430.....	4
MATH 2472.....	4
ENG 1320.....	3
HIST 1320.....	3
PFW one course.....	1
<b>Total</b>	<b>15</b>

<b>Sophomore Year – 2<sup>nd</sup> Semester</b>	<b>Hours</b>
PHYS 2435.....	4
CHEM 1142, 1342 (see gen. req. 6).....	4
Modern Language 1420.....	4
PHIL 1305.....	3
<b>Total</b>	<b>15</b>

<b>Junior Year – 2<sup>nd</sup> Semester</b>	<b>Hours</b>
PHYS 3320.....	3
PHYS 3411.....	4
MATH 3323.....	3
Modern Language 2320.....	3
POSI 2320.....	3
<b>Total</b>	<b>16</b>

<b>Senior Year – 2<sup>nd</sup> Semester</b>	<b>Hours</b>
PHYS Electives (see gen. req. 4).....	6-8
Minor/Electives (see gen. req. 1 & 5).....	5-8
<b>Total</b>	<b>13-14</b>

## Bachelor of Science Major in Physics

Minimum required: 120 semester hours

### General Requirements:

1. A minimum of 9 writing intensive hours and a total of 36 advanced hours are required to graduate. An advanced course is one that is numbered above 3000 and below 5000.
2. See the University College section of this catalog for general education core curriculum requirements.
3. If two years of the same foreign language were taken in high school, then no additional language hours required for the degree. In the absence of such high school language, two semesters of the same modern language must be taken at the college level.
4. The major requires at least 44-46 semester hours.
5. At least 9-11 advanced PHYS chosen from: PHYS 3315 (spring), 3416 (spring), 3417 (fall), 4311 (fall), 4317 (fall), 4320 (see dept.), 4321 (see dept.), or 4340 (spring) or courses approved by the department advisor.
6. Recommended minor is mathematics. Minors and electives should be chosen in consultation with the academic advisor.
7. BIO 1430 and 1431 may be taken instead of CHEM 1141, 1341, and 1142, 1342 listed below.

<b>Freshman Year – 1<sup>st</sup> Semester</b>		<b>Hours</b>	<b>Freshman Year – 2<sup>nd</sup> Semester</b>		<b>Hours</b>
MATH 2471.....	4	PHYS 1430.....	4		
US 1100.....	1	MATH 2472.....	4		
ENG 1310.....	3	ENG 1320.....	3		
HIST 1310.....	3	HIST 1320.....	3		
COMM 1310.....	3	PFW one course.....	1		
PFW one course.....	1				
<b>Total</b>	<b>15</b>	<b>Total</b>	<b>15</b>		
<b>Sophomore Year – 1<sup>st</sup> Semester</b>		<b>Hours</b>	<b>Sophomore Year – 2<sup>nd</sup> Semester</b>		<b>Hours</b>
PHYS 2425.....	4	PHYS 2435.....	4		
MATH 3323.....	3	MATH 3373.....	3		
CHEM 1141, 1341 (see gen. req. 7).....	4	CHEM 1142, 1342 (see gen. req. 7).....	4		
PHIL 1305.....	3	ENG Literature (see gen. req. 2).....	3		
		Minor (see gen. req. 6).....	3		
<b>Total</b>	<b>14</b>	<b>Total</b>	<b>17</b>		
<b>Junior Year – 1<sup>st</sup> Semester</b>		<b>Hours</b>	<b>Junior Year – 2<sup>nd</sup> Semester</b>		<b>Hours</b>
PHYS 3312.....	3	PHYS 3320.....	3		
PHYS 3414.....	4	PHYS 3411.....	4		
Social Science Component (see gen. req. 2).....	3	Electives/Minor (see gen. req. 1, 3 & 6).....	6		
POSI 2310.....	3	POSI 2320.....	3		
ART, DAN, MU, or TH 2313.....	3				
<b>Total</b>	<b>16</b>	<b>Total</b>	<b>16</b>		
<b>Senior Year – 1<sup>st</sup> Semester</b>		<b>Hours</b>	<b>Senior Year – 2<sup>nd</sup> Semester</b>		<b>Hours</b>
PHYS 4310.....	3	PHYS 4312.....	3		
PHYS electives (see gen. req. 5).....	6-8	PHYS 4315.....	3		
Electives/Minor (see gen. req. 1, 3 & 6).....	4	PHYS electives (see gen. req. 5).....	3		
		Electives/Minor (see gen. req. 1, 3 & 6).....	3-5		
<b>Total</b>	<b>13-15</b>	<b>Total</b>	<b>12-14</b>		

## Minor in Physics

A minor in Physics requires PHYS 1430, 2425, 2435, and 3312, and at least six hours of advanced physics.

### Courses in Physics (PHYS)

**1110 (PHYS 1105) Elementary Physics Laboratory.** (0-2) This course explores and illustrates some of the basic principles covered in PHYS 1310 and 1320. This lab should be taken as you take the second of the two courses, PHYS 1310 and 1320.

**1140 (PHYS 1111) Introductory Laboratory in Astronomy.** (0-2) An introduction to the constellations, the uses of telescopes, and other material relating to the study of stars and planets. This course is designed to be taken with PHYS 1340 or 1350 for those students desiring a laboratory course.

**1310 (PHYS 1305) Elementary Physics.** (3-0) A non-mathematical survey of mechanics, properties of matter, heat and sound. These topics are described in a conceptual way with applications relating to the world around us. The laboratory experience may be obtained in a separate one-hour credit lab (PHYS 1110). PHYS 1310 and 1320 are designed for the liberal arts student. The order in which they are taken is not important. They are not recommended for pre-engineering students or majors and minors in science. The laboratory experience is recommended with the second course.

**1320 (PHYS 1307) Elementary Physics.** (3-0) A non-mathematical survey of electricity, magnetism, light, relativity, and atomic and nuclear physics. These topics are described in a conceptual way with applications relating to the world around us. The laboratory experience may be obtained in a separate one-hour credit lab (PHYS 1110). PHYS 1310 and 1320 are designed for the liberal arts student. The order in which they are taken is not important. They are not recommended for pre-engineering students or majors and minors in science. The laboratory experience is recommended with the second course.

**1340 (PHYS 1312) Astronomy: Solar System.** (3-0) A study of the solar system. Topics included are a study of the sun, the planets and their satellites, the comets, and other components of the solar system. Some aspects of telescopes and ancient astronomy will be included also.

**1350 (PHYS 1311) Astronomy: Stars and Galaxies.** (3-0) A study of the universe beyond the solar system. Topics included are a study of the stars and star clusters, nebulae, galaxies, and an introduction to some aspects of cosmology.

**1410 (PHYS 1401) General Physics I.** (3-2) This course is the first of a two semester sequence which is a survey of the basic laws and principles of physics and includes the topics of mechanics and heat. Emphasis is on solutions to physics problems; a knowledge of algebra and basic trigonometry is essential. PHYS 1410 and 1420 are designed for those students whose program requires technical physics, but who are not pre-engineering students or majors or minors in physics. Prerequisite: MATH 1315 with a grade of "C" or higher. MATH 1317 is recommended.

**1420 (PHYS 1402) General Physics II.** (3-2) This is the second course in a two semester sequence which is a survey of the basic laws and principles of physics and includes the topics of waves, electricity and magnetism, and light. PHYS 1410 and 1420 are designed for those students whose program requires technical physics, but who are not pre-engineering students or majors or minors in physics. Prerequisites: PHYS 1410; MATH 1315 with a grade of "C" or higher. MATH 1317 is recommended.

**1430 (PHYS 2425) Mechanics.** (3-3) This course covers the principles of classical mechanics through problem solving and laboratory investigations. PHYS 1430, 2425, and 2435 are designed for students majoring in physics and for pre-engineering students. Credit for both PHYS 1410 and 1430 cannot be given. Co-requisite: MATH 2471. (MC)

**2425 (PHYS 2426) Electricity and Magnetism.** (3-3) A study of the field of electricity and magnetism for physics majors and minors. PHYS 1430, 2425, and 2435 are designed for those students majoring or minoring in physics and for pre-engineering students. Credit in both PHYS 1420 and 2425 cannot be given. Prerequisite: PHYS 1430. Co-requisite MATH 2472.

**2435 (PHYS 2427) Waves and Heat.** (3-3) A study of the fields of wave motion, sound, light and heat at a beginning level for physics majors and minors. Prerequisites: MATH 2472 and PHYS 2425.

**3301 Musical Acoustics.** (3-0) A survey of the physics of sound and acoustic measurement. Special emphasis will be placed on sound production, propagation, and perception as applied to music. Prerequisites: PHYS 1410 and 1420 or equivalent.

**3312 Modern Physics.** (3-0) An introduction to the foundations of modern physics, including the following topics: relativistic mechanics, kinetic theory of matter, quantization of charge, light and energy, the atom, wave nature of particles, and the Schrodinger equation. Prerequisite: PHYS 2435.

**3315 Thermodynamics.** (3-0) The fundamental study of thermodynamics and statistical mechanics. Prerequisites: PHYS 2435 or 1420; MATH 3323.

**3320 Introduction to Mathematical Physics.** (3-0) An introduction to the mathematical methods of theoretical physics with emphasis on the vectorial-functional approach emphasized in current research literature. Applications will be made to certain fundamental problems of mechanics and electromagnetic field theory. Prerequisite: MATH 3373. Co-requisite: MATH 3323.

(WI) **3411 Advanced Physics Laboratory.** (2-6) Experiments in modern physics, with emphasis on demonstrating quantum effects and introducing nuclear physics. Prerequisite: PHYS 3312.

**3414 Mechanics. (4-0)** Fundamentals of classical mechanics focusing on the physical description of the behavior of single and multiple particle systems. Topics include advanced problem-solving strategies for systems with position and velocity-based forces, simple harmonic oscillators, non-inertial reference systems, gravitation and central forces, and rigid body motion. Prerequisite: PHYS 2435.

(WI) **3416 Applied Electronics.** (3-4) Laboratory/lecture course introducing electronic test bench methods for the construction, operation and analysis of important DC/AC circuits utilizing resistors, capacitors, diodes, BJTs, FETs, OpAmps, and analog/digital ICs. The behavior of the circuits will be modeled in SPice. Elementary semiconductor device physics and microfabrication methods will be discussed. Prerequisite: PHYS 2435.

**3417 Optics.** (3-3) A one-semester survey of geometrical and physical optics accompanied by laboratory experience. Topics covered include electromagnetic waves and their propagation, geometrical optics, polarization, interference, diffraction, Fourier optics, and holography. Prerequisite: PHYS 2435.

**4310 Electromagnetic Field Theory I.** (3-0) An introduction to the electromagnetic field theory of classical physics for static fields. Topics included will be the electrostatic field, polarization and dielectrics, electrostatic energy, magnetic field of steady currents, magnetostatic energy, and magnetic properties of matter. Prerequisites: MATH 3323 and 3373; PHYS 3320 (or equivalent preparation with consent of the instructor).

**4311 Condensed Matter Physics.** (3-0) Application of physics principles to solid materials. Topics include crystal structure and the reciprocal lattice, including x-ray diffraction, crystal binding and elastic properties, lattice vibrations, energy bands, semiconductors and metals. Prerequisite: PHYS 3312.

**4312 Quantum Mechanics, Part I.** (3-0) An introductory course on quantum mechanics. Topics include concepts and formulation of quantum mechanics. Hamiltonian operator and Schrodinger equation, harmonic oscillator, matrix formulation of quantum mechanics, uncertainty principle, potential barrier problems, and the hydrogen atom. Prerequisites: MATH 3323; PHYS 3312, 3320, and six additional hours of advanced physics.

**4315 Electromagnetic Field Theory II.** (3-0) An introduction to the electromagnetic field theory of classical physics for time varying fields. Topics included will be electromagnetic induction, time varying electric and magnetic fields, Maxwell's equations, electromagnetic energy, electromagnetic waves and radiation, and a brief introduction to some specialized topics. Prerequisite: PHYS 4310.

**4317 Computational Physics.** (3-3) Introduction to computational techniques for problem-solving and research beyond the standard techniques of most physics courses. Numerical, symbolic, and simulation methods applied to modern physics using advanced mathematical software and a high-level programming language. Prerequisites: PHYS 3320 and six additional hours of advanced physics or instructor consent.

**4320 Selected Study in Physics.** (3-0) Topics are chosen in theoretical and experimental areas of current interest in physics with specific topic to be discussed agreed upon prior to registration. May be repeated once with different emphasis and professor for additional credit. Prerequisite: Consent of the instructor.

**4321 Undergraduate Research.** (0-9) A research project in physics to be carried out under the supervision of a faculty member by upper division physics majors. Student must contact a faculty member in advance to arrange topic and specific course objective. Course may be repeated only as an elective towards the BS or BA in physics. Prerequisite: Instructor approval.

(WI) **4340 Materials Physics Laboratory.** (0-9) A laboratory based course introducing a broad array of materials synthesis and characterization methods. The specific subjects will be coordinated with topics of current interest in the literature and will be chosen by mutual consent of the student and faculty advisor. Prerequisites: PHYS 3416, 3411, and 4311.

(WI) **4370 Capstone Course.** (0-6) Individual research on a topic selected by the student and department chair resulting in a formal paper and seminar.