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 B.S. with a major in Physics provides a rigorous background in physics as a preparation for graduate studies or a career in industry. The B.A. 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.

For more information contact the College of Science and Engineering 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 should visit the catalog program page if interested in seeking a certification in Physical Science (Texas Grades 6-12) (http://mycatalog.txstate.edu/undergraduate/science-engineering/physics/physics-teacher-certification-physical-science-grades-6-12-bs) or Physics/Mathematics (Texas Grades 7-12) (http://mycatalog.txstate.edu/undergraduate/science-engineering/physics/physics-teacher-certification-physics-math-grades-7-12-bs). 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 (B.A.)

- Major in Physics (http://mycatalog.txstate.edu/undergraduate/science-engineering/physics/physics-ba)

Bachelor of Science (B.S.)

- Major in Physics (http://mycatalog.txstate.edu/undergraduate/science-engineering/physics/physics-bs)
- Major in Physics (Teacher Certification in Physical Science, Grades 6-12) (http://mycatalog.txstate.edu/undergraduate/science-engineering/physics/physics-teacher-certification-physical-science-grades-6-12-bs)
- Major in Physics (Teacher Certification in Physics/Mathematics, Grades 7-12) (http://mycatalog.txstate.edu/undergraduate/science-engineering/physics/physics-teacher-certification-physics-math-grades-7-12-bs)

Minor

- Physics

Courses in Physics (PHYS)

**PHYS 1110. Elementary Physics Laboratory.**
This course explores and illustrates some of the basic principles covered in PHYS 1310 and PHYS 1320. This lab should be taken as the second of two courses, PHYS 1310 and PHYS 1320.
1 Credit Hour. 0 Lecture Contact Hours. 2 Lab Contact Hours.
Grade Mode: Standard Letter
TCCN: PHYS 1105

**PHYS 1115. General Physics I Laboratory.**
First of two laboratory courses in General Physics for science-related majors. Course introduces students to the basics of measurement. Topics cover mechanics and heat. Prerequisite or Corequisite: PHYS 1315.
1 Credit Hour. 0 Lecture Contact Hours. 2 Lab Contact Hours.
Grade Mode: Standard Letter
TCCN: PHYS 1101

**PHYS 1125. General Physics II Laboratory.**
Second of two laboratory courses in General Physics for science-related majors. Course introduces the students to experimental measurements and demonstration of principles of electricity, magnetism, optics, modern physics, electromagnetic waves.
1 Credit Hour. 0 Lecture Contact Hours. 2 Lab Contact Hours.
Grade Mode: Standard Letter
TCCN: PHYS 1102

**PHYS 1140. Introductory Laboratory in Astronomy.**
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 PHYS 1350 or those students desiring a laboratory course.
1 Credit Hour. 0 Lecture Contact Hours. 2 Lab Contact Hours.
Course Attribute(s): Lab Required
Grade Mode: Standard Letter
TCCN: PHYS 1111

**PHYS 1310. Elementary Physics.**
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 PHYS 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.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Life & Phys Sciences Core 030
Grade Mode: Standard Letter
TCCN: PHYS 1305
PHYS 1315. General Physics I.
The first course in a two-semester sequence which is a survey of the basic laws and principles of physics and includes the topics of mechanics and heat. Designed for students whose program requires technical physics, but who are not pre-engineering students or majors or minors in physics. Credit for both (PHYS 1315 and PHYS 1115) and PHYS 1430 cannot be given. Prerequisite: MATH 1315 with a grade of "C" or higher. Prerequisite or Co-requisite: PHYS 1115. MATH 1317 is recommended.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Co-requisite(s): PHYS 1115
Course Attribute(s): Life & Phys Sciences Core 030
Grade Mode: Standard Letter
TCCN: PHYS 1301

PHYS 1320. Elementary Physics.
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 PHYS 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.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Life & Phys Sciences Core 030
Lab Required
Grade Mode: Standard Letter
TCCN: PHYS 1307

PHYS 1325. General Physics II.
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, light, electricity and magnetism. Designed for students whose program requires technical physics, but who are not pre-engineering students or majors or minors in physics. Prerequisites: PHYS 1315 and MATH 1315 with a grade of "C" or higher. MATH 1317 and concurrent enrollment in PHYS 1125 are recommended.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Co-requisite(s): PHYS 1125
Course Attribute(s): Life & Phys Sciences Core 030
Grade Mode: Standard Letter
TCCN: PHYS 1302

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.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Life & Phys Sciences Core 030
Grade Mode: Standard Letter
TCCN: PHYS 1312

PHYS 1350. Astronomy: Stars and Galaxies.
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.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Life & Phys Sciences Core 030
Grade Mode: Standard Letter
TCNC: PHYS 1311

This studio-style course introduces physics concepts through active exploration and discussion of physical phenomena. Course content includes developing concepts of electricity, magnetism, and energy, and research on physics learning. Focus is on how physics helps make sense of everyday experience. It's the first in a sequence of two courses.

3 Credit Hours. 4 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Life & Phys Sciences Core 030
Grade Mode: Standard Letter

PHYS 1370. Development of Concepts in Physics II.
This studio-style course introduces physics concepts through active exploration and discussion of physical phenomena. Course content includes concepts of force, motion, waves, light, and matter, and research on physics learning. Focus is on how physics helps make sense of everyday experience. It's the second in a sequence of two courses.

Prerequisite: PHYS 1360.

3 Credit Hours. 4 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Life & Phys Sciences Core 030
Grade Mode: Standard Letter

This course covers the principles of classical mechanics through problem solving and laboratory investigations. PHYS 1430, PHYS 2425, and PHYS 2435 are designed for students majoring and minorin physics and/or other disciplines within the college of science and engineering. Credit for both (PHYS 1315 and PHYS 1115) and PHYS 1430 cannot be given. Pre or Co-requisite: MATH 2471 with a "C" or better or concurrent enrollment in MATH 2471.

4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Life & Phys Sciences Core 030
Lab Required
Grade Mode: Standard Letter
TCCN: PHYS 2425

PHYS 2150. Professional Development for Beginning Physicists.
This course introduces to physics majors career options and opportunities for internships, scholarships, and research internal and external to the university. The course also develops essential practical skills for job seekers. Prerequisite: PHYS 1430; PHYS 2425; PHYS 2435.
1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 2230. Introduction to Computational Modeling for Physics.
This course is an introduction to computational concepts and tools that physicists use for data analysis, simulation and modeling, and visualization in research and dissemination. Python and its various libraries are emphasized. Prerequisite: PHYS 1430 with a grade of "D" or better. Corequisite: PHYS 2425 or PHYS 2435 with a grade of "C" or better.
2 Credit Hours. 0 Lecture Contact Hours. 3 Lab Contact Hours.
Grade Mode: Standard Letter
PHYS 2425. Electricity and Magnetism.
This course is a study of the field of electricity and magnetism for physics majors and minors. PHYS 1430, PHYS 2425, and PHYS 2435 are designed for those students majoring or minoring in physics and for pre-engineering students. Credit in both PHYS 1325 and PHYS 1125 and PHYS 2425 cannot be given. Prerequisites: PHYS 1430 and MATH 2472, all with a grade of "C" or better.
4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Life & Phys Sciences Core 030|Lab Required
Grade Mode: Standard Letter
TCCN: PHYS 2426

PHYS 2435. Waves and Heat.
This course is a study of the fields of wave motion, sound, light, and heat at a beginning level for physics majors and minors. Prerequisites: PHYS 1430 and MATH 2471 with grades of "C" or better. Co-requisite: MATH 2472.
4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Lab Required
Grade Mode: Standard Letter
TCCN: PHYS 2427

PHYS 3210. Physics Cognition and Pedagogy.
This course is an introduction to physics-specific pedagogy and the methods and results of physics education research (PER). Students will investigate relevant literature in PER and cognitive science, engage in discussions about physics teaching and learning, and reflect on their own teaching practice in the role of Physics Learning Assistants. (WI).
2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Writing Intensive
Grade Mode: Standard Letter

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 PHYS 1420, or equivalent, all with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 3311. Mechanics I.
This course discusses the fundamentals of classical mechanics focusing on the physical description of the behavior of single and multiple particle systems. Topics included are advanced problem solving strategies for systems with position and velocity dependent forces, simple harmonic oscillators, and non-inertial reference frames. Prerequisite: PHYS 2435 with a "C" or better. Co-requisite: PHYS 3320.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 3312. Modern Physics.
This course is 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 Schrödinger equation. Prerequisite: PHYS 2435 with a "C" or better. PHYS 2425 with a grade of "C" or better, or concurrent enrollment allowed.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 3313. Astrophysics.
This course surveys a variety of issues in astrophysics through problem solving, quantitative measurements, and theoretical reasoning. Topics include celestial mechanics, stellar dynamics and evolution, galaxy evolution, and cosmology. Corequisite: PHYS 3312 with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 3315. Thermodynamics.
This course is a fundamental study of thermodynamics and statistical mechanics. Prerequisites: MATH 3323 and PHYS 2435 or PHYS 1325 and PHYS 1125 or PHYS 2425 and ENGR 2300, all with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 3320. Introduction to Mathematical Physics.
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. Prerequisites: PHYS 2425 and MATH 3373 with grades of "C" or better; MATH 3323 with a grade of "C" or better, or concurrent enrollment.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 3411. Advanced Physics Laboratory.
Experiments in modern physics, with emphasis on demonstrating quantum effects and introducing nuclear physics. Prerequisites: PHYS 2425 with a grade of "C" or better; PHYS 3312 with a grade of "C" or better, or concurrent enrollment. (WI).
4 Credit Hours. 2 Lecture Contact Hours. 6 Lab Contact Hours.
Course Attribute(s): Lab Required|Writing Intensive
Grade Mode: Standard Letter

This Laboratory/lecture course is an introduction to electronic test bench methods for the construction, operation and analysis of important DC/AC circuits utilizing resistors, capacitors, diodes, BJTs, FETs, and OpAmps. The behavior of the circuits will be modeled in SPICE. Elementary semiconductor device physics and microfabrication methods will be discussed. Prerequisites: PHYS 2425 and PHYS 2435, all with a grade of "C" or better. (WI).
4 Credit Hours. 3 Lecture Contact Hours. 4 Lab Contact Hours.
Course Attribute(s): Writing Intensive
Grade Mode: Standard Letter

PHYS 3417. Optics.
This course is 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. Prerequisites: PHYS 2425 and PHYS 2435, all with a grade of "C" or better. (WI).
4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Writing Intensive
Grade Mode: Standard Letter
PHYS 4121. Undergraduate Research.
This course represents a student's research project in physics to be carried out under the supervision of a faculty member. The student must contact a faculty member in advance to arrange the topic and specific course objectives. This course may be repeated for credit. Instructor's approval required.
1 Credit Hour. 0 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter

PHYS 4150A. Physics Cognition and Pedagogy Lab.
In this lab course, students will apply principles introduced in PHYS 3210, which include observation of student interactions, reflection on the process of learning and the use of evidence based reasoning, metacognition, and facilitation, of discourse around difficult concepts. Corequisite: PHYS 3210. Prerequisite: PHYS 1430 with grade of "C" or better, or Instructor approval.
1 Credit Hour. 0 Lecture Contact Hours. 4 Lab Contact Hours.
Course Attribute(s): Topics
Grade Mode: Standard Letter

PHYS 4150B. Computational Modeling Lab: Mechanics.
This lab provides experience in computational modeling of problems in classical mechanics. Students design and code computer programs to simulate physical dynamics and analyze data. Co-requisite: PHYS 3311.
1 Credit Hour. 0 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Topics
Grade Mode: Standard Letter

PHYS 4221. Undergraduate Research.
This course represents a student's research project in physics to be carried out under the supervision of a faculty member. The student must contact a faculty member in advance to arrange the topic and specific course objectives. This course may be repeated for credit. Instructor's approval required.
2 Credit Hours. 0 Lecture Contact Hours. 6 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter

PHYS 4305. Statistical Physics.
This course will examine the physics that describes the equilibrium thermal properties of systems. Statistical physics explains the microscopic properties of systems that give rise to their measurable macroscopic behavior. This includes thermodynamic properties, transport processes, fluctuations from equilibrium, phase transitions and critical phenomena, and quantum fluids. Prerequisites: PHYS 3312 and PHYS 3320 and MATH 3323, all with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 4310. Electromagnetic Field Theory I.
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, magneto static energy, and magnetic properties of matter. Prerequisites: MATH 3323 and MATH 3373 and PHYS 3320, all with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

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. Prerequisites: PHYS 3312 and PHYS 3320, all with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 4312. Quantum Mechanics I.
An introductory course in quantum mechanics. Topics include mathematical foundations, fundamental postulates, time development, and one dimensional problems. Prerequisites: MATH 3323 and PHYS 3312 and PHYS 3320, all with a grade of "C" or better; and six additional hours of advanced physics.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 4313. Quantum Mechanics II.
An advanced course in quantum mechanics intended as an elective for students intending to pursue graduate study in physics. Topics include angular momentum, three dimensional problems, matrix mechanics, and perturbation theory. Prerequisite: PHYS 4312 with a "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 4314. Mechanics II.
Fundamentals of Classical Mechanics focusing on the physical description of the behavior of single and multiple particle systems. Topics include central force motion, rigid body rotation, and coupled oscillations. This course is intended as an elective for students intending to pursue graduate study in physics. Prerequisites: PHYS 3311 and MATH 3323, all with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 4315. Electromagnetic Field Theory II.
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 with a "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 4317. Computational Physics.
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 highlevel programming language. Prerequisites: PHYS 3320 with a grade of "D" or better and six additional hours of advanced physics or instructor approval.
3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Writing Intensive
Grade Mode: Standard Letter
PHYS 4320. Selected Study in Physics.
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: Instructor approval.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter

PHYS 4321. Undergraduate Research.
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.
3 Credit Hours. 0 Lecture Contact Hours. 9 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter

PHYS 4340. Materials Physics Laboratory.
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 and PHYS 3411 and PHYS 4311, all with a grade of "D" or better. (WI).
3 Credit Hours. 0 Lecture Contact Hours. 9 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Writing Intensive
Grade Mode: Standard Letter

PHYS 4350A. Thin Film Photovoltaic Devices.
This course is a survey of the Physics of photovoltaic devices with emphasis on device physics including the photovoltaic effect, photon absorption, electrons and holes, generation and recombination, the pn-junction, charge separation, monocrystalline solar cells, thin film solar cells, and losses. Prerequisites: PHYS 2425 and PHYS 2435, all with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

PHYS 4350B. Relativity.
This course includes a review of Special Relativity, an introduction to the mathematics of tensor calculus and differential geometry, and such topics from General Relativity as the Schwarzschild solution and black holes, tests of General Relativity, cosmological models, and applications of relativity in the Global Positioning System (GPS). Prerequisites: PHYS 2425 and PHYS 2435, all with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

PHYS 4350D. Biophysics.
This course applies the principles of physics to the study of living organisms. An emphasis will be placed on the topics of structure, fluids, diffusion, entropy, stochastic processes, and probabilities, and on scientific modes of thinking including modeling, estimation, and data analysis. Prerequisite: PHYS 1430, PHYS 2425, and PHYS 2435, all with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

PHYS 4360. Physics Cognition and Pedagogy II.
This course addresses historical, philosophical, and cognitive perspectives on the learning, teaching, and discovery of physics, including results from contemporary research on learning. It is recommended for students pursuing teacher certification. Prerequisites: PHYS 3210 and PHYS 3312 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter