2331 or 2472 with a grade of "C" or higher. (WI)

4315 Analysis II. (3-0) A continuation of MATH 3380. Topics include integration, series and sequences of functions and associated topics. Prerequisite: MATH 3380 with a grade of "C" or higher.

4330 General Topology. (3-0) Topics include introductory treatment of convergence, continuity, compactness, connectedness and fixed points in topological spaces with special emphasis on metric spaces. Prerequisite: MATH 3330 or 3380 with a grade of "C" or higher.

4336 Studies in Applied Mathematics. (3-0) Selected topics including Laplace transforms, complex variables, advanced calculus for applications, calculus of variations, integral equations, intermediate differential equations, vector analysis, etc. May be repeated once for credit with a different topic. Prerequisite: Consent of instructor.

4350 Introduction to Combinatorics (3-0) This course introduces fundamental concepts and results in combinatorics such as counting techniques, binomial coefficients, and recurrence relations; and applications in different fields such as complexity of algorithms and graph theory. Mathematical proofs are an essential part of this course. Prerequisite: Math 2472 with a grade of "C" or higher.

4382 The Literature and Modern History of Mathematics and Its Applications. (3-0) This course will focus on mathematical articles in recent journals. The articles will be re-written so that the proofs and comments are more easily understood by the casual reader. This embellishment of journal articles will take place in class with the class participating, in groups for outside work and as individual assignments. May not be applied toward a minor in mathematics. Prerequisites: A grade of "C" or higher in two of these three: MATH 3380, 4307, or 4330. (WI)

Department of Physics

Roy F. Mitte Building, Room 3240
T: 512.245.2131 F: 512.245.8233
www.physics.txstate.edu

Degree Programs Offered
Bachelor of Arts (BA), major in Physics
Bachelor of Science (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.

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 interested in seeking a Physical Science (Texas Grades 6-12) or Physics/Mathematics (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 (BA)
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 Academic Services section of this catalog for general education core curriculum requirements.
3. The major requires 35 hours.
4. At least 13-16 advanced PHYS chosen from: PHYS 3210, 3315, 3416, 4340 (spring); 3414, 3417, 4305, 4311, 4313, 4314, 4315, 4317 (fall); 4320, 4321 (see dept.), or courses approved by the department advisor.
5. Majors should consult the department advisor or the College of Science and Engineering Advising Center before choosing a minor and the electives.
6. BIO 1330/1130 or 1430 and BIO 1331/1131 or 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.

Freshman Year - 1st Semester		Freshman Year - 2nd Semester		Sophomore Year - 1st Semester		Sophomore Year - 2nd Semester	
Course	Hr	Course	Hr	Course	Hr	Course	Hr
MATH 2471	4	PHYS 1430	4	PHYS 2425	4	PHYS 2435	4
US 1100	1	MATH 2472	4	CHEM 1141, 1341 (see gen. req. 6)	4	CHEM 1142, 1342 (see gen. req. 6)	4
ENG 1310	3	ENG 1320	3	Modern Language 1410	4	Modern Language 1420	4
POSI 2310	3	HIST 1310	3	Social Science Component (see gen. req. 2)	3	PHIL 1305 or 1320	3
COMM 1310	3						
Total	14	Total	14	Total	15	Total	15

Junior Year - 1st Semester		Junior Year - 2nd Semester		Senior Year - 1st Semester		Senior Year - 2nd Semester	
Course	Hr	Course	Hr	Course	Hr	Course	Hr
PHYS 3312	3	PHYS 3320	3	PHYS Electives (see gen. req. 4)	3-4	PHYS Electives (see gen. req. 4)	10-12
MATH 3373	3	PHYS 3411	4	Minor/Electives (see gen. req. 1,5 & 7)	6	Minor/Electives (see gen. req. 1 & 5)	6
Modern Language 2310	3	MATH 3323	3	ART, DAN, MU, or TH 2313	3		
HIST 1320	3	Modern Language 2320	3	Second ENG Literature (see gen. req. 2 & 7)	3		
ENG Literature (see gen. req. 2)	3	POSI 2320	3				
Total	15	Total	16	Total	15-16	Total	16-18

<div align="center">

Bachelor of Science (BS)
Major in Physics
Minimum required: 120 semester hours

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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 Academic Services 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 48-50 semester hours.
5. At least 13-15 advanced PHYS chosen from: PHYS 3210, 3315, 3416, 4340 (spring); 3417, 4305, 4311, 4313, 4314, 4315, 4317 (fall); 4320, 4321 (see dept.), 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 1330/1130 or 1430 and BIO 1331/1131 or 1431 may be taken instead of CHEM 1141, 1341, and 1142, 1342 listed below.

Freshman Year - 1st Semester		Freshman Year - 2nd Semester		Sophomore Year - 1st Semester		Sophomore Year - 2nd Semester	
Course	Hr	Course	Hr	Course	Hr	Course	Hr
MATH 2471	4	PHYS 1430	4	PHYS 2425	4	PHYS 2435	4
US 1100	1	MATH 2472	4	MATH 3323	3	MATH 3373	3
ENG 1310	3	ENG 1320	3	CHEM 1141, 1341 (see gen. req. 7)	4	CHEM 1142, 1342 (see gen. req. 7)	4
POSI 2310	3	HIST 1310	3	PHIL 1305 or 1320	3	ENG Literature (see gen. req. 2)	3
COMM 1310	3					Minor (see gen. req. 6)	3
Total	14	Total	14	Total	14	Total	17

Junior Year - 1st Semester		Junior Year - 2nd Semester		Senior Year - 1st Semester		Senior Year - 2nd Semester	
Course	Hr	Course	Hr	Course	Hr	Course	Hr
PHYS 3312	3	PHYS 3320	3	PHYS 4310	3	PHYS 4312	3
PHYS 3414	4	PHYS 3411	4	PHYS electives (see gen. req. 5)	9-11	PHYS 4315	3
Social Science Component (see gen. req. 2)	3	Electives/Minor (see gen. req. 1,3 & 6)	6	Electives/Minor (see gen. req. 1,3 & 6)	4	PHYS electives (see gen. req. 5)	4-6
HIST 1320	3	POSI 2320	3			Electives/Minor (see gen. req. 1,3 & 6)	3-5
ART, DAN, MU, or TH 2313	3						
Total	16	Total	16	Total	16-18	Total	13-17

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.

1115 (PHYS 1101) General Physics I Laboratory. (0-2) 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 Co-requisite: PHYS 1315.

1125 (PHYS 1102) General Physics II Laboratory. (0-2) Second of two laboratory courses in general Physics. Course introduces the students to experimental measurements and demonstration of principles of electricity, magnetism, optics, modern physics, electromagnetic waves. Prerequisites: PHYS 1315, PHYS 1115. Prerequisite or Co-requisite: PHYS1325.

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.

1315 (PHYS 1301) General Physics I. (3-0) 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. Prerequisite: MATH 1315 with a grade of "C" or higher. Prerequisite or Co-requisite: PHYS 1115. MATH 1317 is recommended.

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.

1325 (PHYS 1302) General Physics II. (3-0) 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 grades of "C" or higher. Prerequisite or Co-requisite: PHYS 1125. MATH 1317 is recommended

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.

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 and minoring in physics and/or other disciplines within the college of science and engineering. Credit for both PHYS 1315/1115 and 1430 cannot be given. Pre or Co-requisite: MATH 2471 with a C or higher or concurrent enrollment in MATH 2471. (MC)

2425 (PHYS 2426) Electricity and Magnetism. (3-3) This course is 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 1325/1125 and 2425 cannot be given. Prerequisite: PHYS 1430 and MATH 2471 with grades of C or higher. 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: PHYS 2425 and MATH 2472 with grades of C or higher.

3210 Physics Cognition and Pedagogy. (2-0) 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)

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 1315/1115 or 1410 and PHYS 1325/1125 or 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 Schroedinger equation. Prerequisite: PHYS 2435 with a grade of C or higher.

3315 Thermodynamics. (3-0) This course is a fundamental study of thermodynamics and statistical mechanics. Prerequisites: MATH 3323 and (PHYS 2435 or PHYS 1325/1125 or (PHYS 2425 and ENGR 2300)).

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 with a grade of C or higher. Co-requisite: MATH 3323.

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

3414 Mechanics I. (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 dependent forces, simple harmonic oscillators, and non-inertial reference frames. Prerequisite: PHYS 2435 with a grade of C or higher.

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 with a grade of C or higher. (WI)

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 with a grade of C or higher. (WI)

4305 Statistical Physics (3-0) 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 MATH 3323 with grades of C or higher.

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, magneto static energy, and magnetic properties of matter. Prerequisites: MATH 3323, MATH 3373 and PHYS 2435 with grades of "C" or higher; PHYS 3320 (or equivalent preparation with instructor approval).

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 I. (3-0) An introductory course in quantum mechanics. Topics include mathematical foundations, fundamental postulates, time development, and one dimensional problems. Prerequisites: MATH 3323 with a grade of C or higher; PHYS 3312, 3320, and six additional hours of advanced physics.

4313 Quantum Mechanics II (3-0) 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. Prerequisites: PHYS 4312.

4314 Mechanics II (3-0) 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 3414 and MATH 3323 with grades of C or higher.

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 approval.

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: Instructor approval.

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.

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)