Physics and Astronomy

Kurtis Williams (Interim Department Head)
Location: Science Building, Room 106, 903-886-5488
Physics and Astronomy Web Site (http://www.tamuc.edu/physics/)

The Department of Physics & Astronomy offers majors and minors for the Bachelor of Science and the Bachelor of Arts degrees. The programs have been designed for degrees with or without teacher certification. The department provides instruction in physics, applied physics, astronomy and astrophysics, and computational physics and astrophysics.

The degree programs are designed for students wishing continue their studies at the graduate level in for example physics, astronomy, engineering, or medicine, as well as for students who are seeking careers in the private sector that will utilize their analytical or problem solving skills. The teacher education curriculum is designed for pre-college teachers of science.

Students seeking a bachelor's degree in one of these majors must complete:

1. Degree requirements for a Bachelor of Arts or Science degree, and
2. Core Curriculum Requirements (https://coursecatalog.tamuc.edu/undergrad/core-curriculum-requirements/) (refer to those sections of this catalog).

Fast-Track Bachelors + Masters Physics with Teaching Emphasis (https://coursecatalog.tamuc.edu/undergrad/colleges-and-departments/college-of-science-and-engineering/physics-astronomy/accelerated-bs-ma-physics-with-teaching-emphasis/)

Physics B.A./B.S. (https://coursecatalog.tamuc.edu/undergrad/colleges-and-departments/college-of-science-and-engineering/physics-astronomy/physics-ba-bs/)

Physics B.A./B.S. w/6-12 Physical Science Certification (https://coursecatalog.tamuc.edu/undergrad/colleges-and-departments/college-of-science-and-engineering/physics-astronomy/physical-science-cert/)

Physics B.A./B.S. Emphasis in Astrophysics (https://coursecatalog.tamuc.edu/undergrad/colleges-and-departments/college-of-science-and-engineering/physics-astronomy/physics_astrophysics_emphasis/)

Physics B.A./B.S. Emphasis in Biophysics (https://coursecatalog.tamuc.edu/undergrad/colleges-and-departments/college-of-science-and-engineering/physics-astronomy/emphasis_in_biophysics/)

Physics B.A./B.S. with Emphasis in Engineering (https://coursecatalog.tamuc.edu/undergrad/colleges-and-departments/college-of-science-and-engineering/phys-emphasis-engr/)

Physics B.A./B.S. with Emphasis in Pre-Medical (https://coursecatalog.tamuc.edu/undergrad/colleges-and-departments/college-of-science-and-engineering/physics-astronomy/phys-premed/)

Physics Minor (https://coursecatalog.tamuc.edu/undergrad/colleges-and-departments/college-of-science-and-engineering/physics-astronomy/physics-minor/)

Physics Second Major (https://coursecatalog.tamuc.edu/undergrad/colleges-and-departments/college-of-science-and-engineering/physics-astronomy/physics-second-major/)

Astronomy Minor (https://coursecatalog.tamuc.edu/undergrad/colleges-and-departments/college-of-science-and-engineering/physics-astronomy/astronomy-minor/)

ASTR 1103 - Introductory Astronomy Lab
Hours: 1
This lab course is designed to give students a hands-on approach to learning about the Solar System, stars, and galaxies using techniques similar to those used by modern astronomers. Laboratory activities will include using the planetarium to learn the names and locations of stars and constellations, hands-on experiments, and computer simulations.

ASTR 1303 - Stars and the Universe
Hours: 3
This course is designed for non-science majors. A descriptive survey of astronomy with emphasis on modern developments in stellar and galactic astronomy and the role of physical science in the measurement and interpretation of astronomical data. Included are studies of structure and evolution of stars and galaxies and of current cosmological theories

ASTR 1304 - Solar System
Hours: 3
A descriptive survey of the solar system specifically including the sun, planets and their satellites, comets, and other members of the solar system. The course will also examine the history of astronomy and the development of scientific tools for understanding the nature of the solar system.

ASTR 120 - Life in the Universe
Hours: 3
The basic science of the search for evidence of life in the universe, including the origin and evolution of life on the Earth, terrestrial extremophiles, the history of the search for life in the Universe, the search for habitable environments in the Solar System, and the search for habitable (exo-)planets and signs of life around other stars.

ASTR 203 - Stars and the Universe for STEM Majors
Hours: 3
A mathematically-guided overview of modern astronomy, including the scientific method; fundamental physical laws; the formation of planets; stars; galaxies; introduction to cosmology. Instructor approval required for students who have taken ASTR 1303. Prerequisites: Concurrent or previous enrollment in ASTR 1103.

ASTR 260 - Archaeoastronomy
Hours: 3
A course designed to study specific ancient structures and their associations with astronomical events. Topics will include many ancient sites including Paleolithic structures like Stonehenge, Mayan, Aztec, Native American culture, and the pyramids of Egypt.

ASTR 310 - Observational Astronomy
Hours: 4
Astronomical observation techniques and analysis of data including practical experience with modern telescopes and imaging devices, computer-based reduction and analysis, and interpretation of astronomical data. Prerequisites: ASTR 1303 or ASTR 1304 or ASTR 120.

ASTR 337 - Contemporary Frontiers in Astronomy
Hours: 3
Current and engaging areas of astronomical research, including our Solar System, extra-solar planets, cosmology, dark matter, and dark energy. Students will engage in evidence-based discussions, explore up-to-the minute scholarly articles, and apply concepts of basic physics to illuminate the current limits of astronomical knowledge. Prerequisites: (ASTR 1303 or ASTR 203) and (ASTR 1304 or ASTR 120) with consent of instructor.

ASTR 410 - Stellar Structure and Evolution
Hours: 3
The leading observational facts about stars as interpreted by current theories of stellar structure and evolution. Equations of stellar structure, energy generation and nucleosynthesis, opacity and equation of state, radiative and convective transport, stellar atmospheres and emergent spectra, stellar evolution and stellar end states. Prerequisites: ASTR 203 and Co/Prequisite (PHYS 321 or PHYS 333).

ASTR 418 - Undergraduate Research
Hours: 3
Individual research related to physics, directed by a faculty member. Prerequisites: Department head approval.

ASTR 420 - Galaxies and Cosmology
Hours: 3
The basic observations, physical properties, and evolution of galaxies, active galactic nuclei, and large scale structure. Topics also include the Big Bang theory, basic equations of cosmology, inflation, dark matter and dark energy, and observational techniques used in testing these hypotheses. Prerequisites: ASTR 203 and Co/Prerequisite (PHYS 321 or PHYS 333).

ASTR 450 - Nuclear Astrophysics
Hours: 3
Nuclear astrophysics describes the elemental and energy production in stars via nuclear reactions. It explains the occurrence of all the naturally occurring chemical elements in the universe from the simplest elements to the most complex. It also explains how astrophysical neutrinos (from the sun, cosmic rays and supernovae) are produced and detected and what they have to say about both neutrinos and the universe. Nuclear astrophysics also describes how the structure of compact stars (e.g. neutron stars) arises due to the interactions of protons, neutrons, electrons, and quarks and gluons. The course will also explain how the Universe evolved from a primordial state to the present including a discussion of the abundances of the observed elements.

ASTR 489 - Independent Study
Hours: 1-4
Independent Study 1-4 hours.

ASTR 490 - Honors Thesis
Hours: 3
Honors Thesis.

ASTR 491 - H Ind Honors Readings
Hours: 3
H Ind Honors Readings.

ASTR 497 - Special Topics
Hours: 0-4
Special Topics. One to Four semester hours. Organized class. May be repeated when topics vary. Some sections are graded on a Satisfactory (S) or Unsatisfactory (U) basis.

IS 1315 - Integrated Science I
Hours: 3
This is a University Studies science course. The interdisciplinary application of scientific principles is emphasized. The scientific principles developed in this course include astronomy, motion, energy, Earth science, and other topics typically covered in physical science courses. Connections and applications of these principles to the other sciences are examined.

IS 1317 - Integrated Science II
Hours: 3
This is a University Studies science course. The interdisciplinary application of scientific principles is emphasized which include heat, energy, the periodic table, chemical bonds and reactions and other topics covered in physical sciences courses. Connections and applications of these principles to the other sciences are examined.

IS 1415 - Integrated Science I
Hours: 4
1415 - Integrated Science I. Four semester hours. (3 lecture, 2 lab) This is a University Studies science course. The interdisciplinary application of scientific principles to society is emphasized. The scientific principles developed in this course are motion, energy, chemical changes, and other topics typically covered in physical science courses. Connections and applications of these principles to the other sciences and public issues are examined.

IS 1417 - Integrated Science II
Hours: 4
IS 102 Integrated Science II. Four semester hours (3 lecture, 2 lab). This is a University Studies science course. The interdisciplinary application of scientific principles to society is emphasized. The scientific principles developed in this course are cellular structure, genetics, DNA, astronomical and geological issues, and other topics covered in life earth sciences courses. Connections and applications of these principles to the other sciences and public issues are examined.

IS 351 - Science Inquiry I for Pre-service Educators
Hours: 3
Science topics and themes are chosen to emphasize broad concepts highlighted in the Texas and national science standards. Topics will include conservation laws, systems in nature, the nature of scientific inquiry and presentation of scientific information. The course will be taught by an inquiry based method, modeling instructional techniques proved effective by current educational research. This course is designed for interdisciplinary majors. It will not count toward a major or minor in the sciences.

IS 352 - Science Inquiry II for Pre-service Educators
Hours: 3
Science topics and themes are chosen to emphasize broad concepts highlighted in the Texas and National Science Standards. Topics include fundamental physical and chemical processes such as the chemistry of the environment, macromolecules of life, systems in nature, and the nature of scientific inquiry. The course will be taught using an inquiry based method, modeling instructional techniques proven effective by current educational research. This course is designed for interdisciplinary majors. It will not count towards a major in the sciences.

IS 397 - Special Topics
Hours: 1-4
Special Topics. One to four semester hours. Organized class. May be repeated when topics vary.

IS 451 - Historical Development of Great Ideas in Science for Pre-service Educators
Hours: 3
Science is a diverse topic that influences the quality of life. This class uses the history of science as a timeline, to explore contributions of major people, discoveries, and the evolution of fundamental concepts and theories through time which are examined through literature, research, and hands-on inquiry based investigations. This class is designed for education majors and by the end of the course, each student should have an understanding of his/her own philosophy of teaching.

IS 489 - Independent Study
Hours: 1-4
Independent Study. One to four semester hours.

IS 497 - Special Topics
Hours: 3

PHYS 1401 - College Physics I
Hours: 4
Topics include vectors, mechanics, Newton's laws of motion, work, energy, power, impulse and momentum, conservation laws, heat and thermodynamics.Prerequisites: MATH 1314 Min Grade C or MATH 2312 Min Grade C or MATH 1325 Min Grade C or MATH 2413 Min Grade C.

PHYS 1402 - College Physics II
Hours: 4
Topics include electric charges and fields, DC circuits, magnetic fields, fields due to currents. Prerequisites: PHYS 1401 Min Grade C.

PHYS 2425 - University Physics I
Hours: 4
Calculus based physics course in mechanics for science, mathematics and engineering students. Prerequisites: MATH 2413 with a minimum grade of C or concurrent enrollment.

PHYS 2426 - University Physics II
Hours: 4
Second semester of calculus based physics with topics in electricity and magnetism for science, mathematics, and engineering students. Prerequisites: PHYS 2425 with a minimum grade of C, MATH 2414 with a minimum grade of C or concurrent enrollment.

PHYS 101 - Physics and Astronomy Seminar
Hours: 1
Introduces some of the major contemporary problems and research areas in physics and astronomy.

PHYS 119 - Introduction to Python Computer Programming for the Physical Sciences
Hours: 1
An introductory Python programming course designed to provide students without any prior programming experience with basic programming skills. The course includes an overview of Python programming language and scientific library packages. Students will learn skills to build programs and applications useful for problem solving and simulations in the physical sciences and engineering.

PHYS 131 - Introduction to Musical Acoustics: The Science of Sound
Hours: 3
The course covers basic physical principles of waves required to understand the phenomenon of music, the characteristics of musical instruments and sound effects of rooms/halls for music majors and any one interested in the sciences behind the music, in musician-friendly format. Basic concepts such as frequency, harmonics, and pitch, physics-based questions on such topics as music acoustics, stringed instruments, wind instruments, singing and electronic instruments will be discussed in lectures. Hands on labs and web-based exercises will supplement the lectures. Prerequisites: MATH 1314 or MATH 2312 or MATH 1325 or MATH 1332 or MATH 2413.

PHYS 201 - Problem Solving in Mechanics
Hours: 1
Extension of concepts developed in introductory mechanics with emphasis on problem solving techniques.

PHYS 202 - Problem Solving in Electricity & Magnetism
Hours: 1
Extension of concepts developed in introductory Electricity and Magnetism with emphasis on problem solving techniques.

PHYS 317 - Mathematical Methods for Physics and Engineering
Hours: 3
Mathematical techniques from the following areas: infinite series; integral transforming; applications of complex variables; vectors, matrices, and tensors; special functions; partial differential equations; Green's functions; perturbation theory; integral equations; calculus of variations; and groups and group representatives. Prerequisites: Concurrent enrollment in MATH 2415 or MATH 2320 or consent of instructor.

PHYS 319 - Computational Physics with Python
Hours: 3
This course introduces the student to the Python programming language as applied to computational physics applications, including finite difference methods, solving linear and non-linear equations, Fourier transforms, simulating physical systems governed by ordinary and partial differential equations, random processes and the Monte Carlo method. Prerequisites: PHYS 2425 with a minimum grade of C. In addition, PHYS 119, or ENGR 2304, or COSC 1436, or consent of instructor. Crosslisted with: CSCI 319.

PHYS 321 - Modern Physics
Hours: 3
An introduction to special relativity and elementary quantum mechanics. Topics include spacetime, relativistic energy and momentum, the uncertainty principle, Schrödinger's equation, observables and operators, bound states, potential barriers, and the hydrogen atom. Prerequisites: PHYS 2426, MATH 2415, or consent of instructor.

PHYS 332 - Electronics for Scientists and Engineers
Hours: 4
An introduction to the operation and use of fundamental components in modern analog and digital electronics. This course covers the principles of analog circuit analysis, filters, diodes, transistors, operational amplifiers, and oscillators. Additionally, it explores power supplies, Boolean logic, digital circuits, and the electrical responses of biological systems. Emphasizing hands-on experience, the course is designed for individuals utilizing electronic equipment in research and practical applications. It is recommended for students across pure and applied sciences, as well as for those not majoring in electrical engineering. Prerequisites: PHYS 1402 or PHYS 2426 or consent of instructor.

PHYS 333 - Wave Motion, Acoustics, and Optics
Hours: 4
An introduction to vibrational and wave motion with applications to acoustics, optics, and electromagnetic phenomenon. Prerequisites: PHYS 2426 with a minimum grade of C or consent of the instructor.

PHYS 335 - Advanced Physics Laboratory
Hours: 3
An introduction to the equipment and techniques of experimental physics. Experiments are selected from a wide range of fields in physics. Research grade equipment is used in many experiments. Prerequisites: PHYS 2426 Min Grade C. PHYS 321 Min Grade C or PHYS 333 Min Grade C.

PHYS 345 - Teaching and Learning Physics
Hours: 3
How people teach, learn, and understand key concepts in physics. This course is a survey of physics education research. Topics include constructivism, student conceptions, the hidden curriculum, identity and assessment. Prerequisites: PHYS 2425 and PHYS 2426.

PHYS 371 - Science and Math Education Theory and Practice
Hours: 1
Learning theory and teaching practices for science and math learning assistants. Topics include advanced questioning strategies, conceptual development, formative assessment, argumentation, metacognition, and nature of science. Prerequisites: Instructor approval. Crosslisted with: CHEM 371, BSC 371, MATH 371.

PHYS 389 - Independent Study
Hours: 0-4
Individual study of specific problems in physics. Prerequisites: Department head approval.

PHYS 401 - Current Topics in Physics and Astronomy
Hours: 1
Current problems or topics in research, employment, and trends in physics are considered. Prerequisites: Junior standing.

PHYS 411 - Classical Mechanics
Hours: 3
A mathematical treatment of the fundamentals of classical mechanics. Topics include particle dynamics in one, two and three dimensions; conservation laws; dynamics of a system of particles; motion of rigid bodies; central force problems; central force problems; accelerating coordinate systems; gravitation; Lagrange's equations and Hamilton's equations. Prerequisites: PHYS 2426, and concurrent enrollment in MATH 2415 or MATH 2320 or consent of instructor.

PHYS 412 - Electricity and Magnetism
Hours: 3
An advanced undergraduate course in theoretical electricity and magnetism. Geometry of static electric and magnetic fields, electric charges and currents, calculating electric and magnetic fields from potentials, fields inside matter, Maxwell's equations, and EM waves. Prerequisites: PHYS 2426, and concurrent enrollment in MATH 2415 or MATH 2320 or consent of instructor.

PHYS 414 - Thermodynamics and Kinetic Theory
Hours: 3
Introduction to the kinetic theory of matter and to thermodynamics and statistical mechanics, with applications to physical and chemical systems. Prerequisites: PHYS 317 or consent of instructor.

PHYS 418 - Undergraduate Research
Hours: 3
Individual research related to physics, directed by a faculty member. Prerequisites: Department head approval.

PHYS 420 - Quantum Mechanics
Hours: 3
The Schrödinger equation; one dimensional systems; the Heisenberg uncertainty principle; magnetic moments and angular momentum; two and three dimensional systems; approximation methods; scattering theory. Prerequisites: PHYS 317 or consent of instructor.

PHYS 421 - Semiconductor Physics and Engineering
Hours: 3
The physical, chemical and electrical properties of metals and semi-conductors and the relationship between these properties and the electronic and crystal structures of these materials is studied. Prerequisites: PHYS 321 and PHYS 333.

PHYS 430 - Optics
Hours: 3
Fundamentals of geometrical and physical optics and applications to optical instrumentation. Prerequisites: PHYS 333 or consent of the instructor.

PHYS 432 - Advanced Electronics
Hours: 3
Embedded system design and programming. Topics include microcontroller selection, peripheral interfacing, low and high-level programming languages, and microcontroller development tools. Prerequisites: (PHYS 132 or PHYS 332) and (CSCI 151 or PHYS 319 or CSCI 319).

PHYS 437 - Nuclear Physics
Hours: 3
The study of nuclear phenomena and properties including mass, stability, magnetic moment, radioactive decay processes and nuclear reactions. The application of nuclear principles to other fields such as astronomy, engineering, manufacturing, and medicine. Prerequisites: PHYS 321.

PHYS 461 - Physics Research Project
Hours: 3
This is the first part of a two-semester course sequence. Each participating student will conduct literature surveys on a research topic agreed to between him/her and their local advisor. The research problem must be approved through the Texas Physics Consortium. Completion of the research will be consummated during the second semester. Areas of research will primarily be in those areas represented by the Consortium which include nuclear physics, high energy particle physics, medical/health physics, computational and mathematical physics, atomic and molecular physics, astrophysics, and other forefront areas. Prerequisites: PHYS 321 and department head approval.

PHYS 462 - Physics Research Seminar
Hours: 3
An experimental or theoretical project will be continued by the student and the results reported in a seminar. Students who have not yet taken the ETS Major Field Test in Physics are required to do so while enrolled in Seminar. Prerequisites: PHYS 461 and department head approval.

PHYS 489 - Independent Study
Hours: 1-4
Individualized instruction/research at an advanced level in a specialized content area under the direction of a faculty member. May be repeated when the topic varies. Prerequisites: Department head approval.

PHYS 490 - Honors Thesis
Hours: 3
Individualized instruction/research at an advanced level in a specialized content area under the direction of a faculty member. Note May be repeated when the topic varies. Prerequisites: Department head approval.

PHYS 491 - Individualized Honors Readings
Hours: 3
Individualized instruction/research at an advanced level in a specialized content area under the direction of a faculty member. Prerequisites: Department head approval.

PHYS 492 - Instrumentation and Control
Hours: 3
Sensors and actuators in real-time systems. Topics include the physics of sensors and actuators, sensor signal conditioning, real-time data acquisition, elementary signal processing, motion control, and software for instrumentation and control. Prerequisites: PHYS 2426.

PHYS 497 - Special Topics
Hours: 1-4
Organized class. May be repeated when topics vary.