PHIL 495, 496 Individual Study (2 credits)
PHIL 497, 498 Individual Study (4 credits)
See the description of these courses at the beginning of the "Curricula" section of this catalog.

Physical Education

See Health and Human Performance

Physics (PHYS)

College of Arts and Sciences, Department of Physics
Owens Science Hall (OWS) 153, (651) 962-5214
Johnston (chair), Green, Jalkio, Lopez del Puerto, Ohmann, Ruch; Blilie, Koser, Thomas

Physics majors learn the fundamental laws that govern the physical universe, from the smallest subatomic particle to the largest galaxies to the very structure of space and time. Emphasis is placed on general understanding, problem solving, and the communication skills essential for success in a career grounded in science. In the laboratory, students use state-of-the-art instrumentation in applying physics to a wide variety of systems. Opportunities are available for students to participate in research projects during the school year and over the summer.

There are three educational options from which to choose: a Bachelor of Science (B.S.) degree; a Bachelor of Arts (B.A.) degree; or a minor in physics. The B.S. degree provides the necessary background for students interested in graduate school, engineering or industrial work; for students interested in professional programs such as medicine or patent law, or students double majoring in areas such as mathematics or chemistry, the Bachelor of Arts degree gives a solid background in physics with the flexibility to meet other needs.

For students interested in teacher licensure, see the various combinations of science education in the School of Education Department of Teacher Education in this catalog.

The department offers courses for non-majors to fulfill the laboratory science component of the core curriculum.

Graduation with Honors in Physics
Students graduating with a B.A. or B.S. degree in physics may also qualify for departmental honors. Students interested in this designation must consult with the department chair one year or more before graduation. All requirements must be met one month before graduation.

1. Complete four credits in 400-level physics research or the equivalent research experience
2. Prepare a written thesis in the format of primary literature
3. Defend the thesis before a panel composed of:
   thesis director (chair of committee)
   two additional UST physics faculty
   one UST faculty member outside of physics
4. Achieve a final cumulative grade point average in physics department courses of 3.50 and 3.50 overall
5. Present their research at a scientific meeting beyond the St. Thomas community

Major in Physics (B.S.)

PHYS 111 Introduction to Classical Physics I (4 credits)
PHYS 112 Introduction to Classical Physics II (4 credits)
PHYS 215 Foundations of Modern Physics: From the Atom to the Big Bang (4 credits)
PHYS 225 Applications of Modern Physics: From the Atom to the Diode (4 credits)
PHYS 323 Methods of Experimental Physics (4 credits)
PHYS 331 Theoretical Mechanics (4 credits)
PHYS 341 Electricity and Magnetism (4 credits)
PHYS 347 Optics (4 credits)
PHYS 410 Statistical Mechanics and Thermodynamics (4 credits)
PHYS 431 Quantum Mechanics (4 credits)

Plus:
four PHYS credits 104 or greater

Allied requirements
MATH 113 Calculus I (4 credits)
MATH 114 Calculus II (4 credits)
MATH 200 Multi-Variable Calculus (4 credits)
MATH 210 Introduction to Differential Equations and Systems (4 credits)
MATH 240 Linear Algebra (4 credits)

Plus:
ENGR 350 Introduction to Electronics (4 credits)
or
ENGR 230 Digital Design (4 credits) *and* ENGR 240 Circuit Analysis (4 credits)

Plus four credits from the following:
CISC 130 Introduction to Programming and Problem Solving in the Sciences (4 credits) *or* CISC 131 Introduction to Programming and Problem Solving (4 credits)
Note: CISC 130 is recommended for this major
CISC 230 Object-Oriented Design and Programming (4 credits)

Major in Physics (B.A.)

PHYS 111 Introduction to Classical Physics I (4 credits)
PHYS 112 Introduction to Classical Physics II (4 credits)
PHYS 215 Foundations of Modern Physics: From the Atom to the Big Bang (4 credits)
PHYS 225 Applications of Modern Physics: From the Atom to the Diode (4 credits)
PHYS 323 Methods of Experimental Physics (4 credits)

Plus:
four PHYS credits 104 or greater
eight PHYS credits above 301

Allied requirements
MATH 113 Calculus I (4 credits)
MATH 114 Calculus II (4 credits)
MATH 200 Multi-variable Calculus (4 credits)
MATH 210 Introduction to Differential Equations and Systems (4 credits)

Plus either:
ENGR 350 Introduction to Electronics (4 credits)
or
ENGR 230 Digital Design (4 credits) *and* ENGR 240 Circuit Analysis (4 credits)

Plus four credits from the following:
CISC 130 Introduction to Programming and Problem Solving in the Sciences (4 credits) *or* CISC 131 Introduction to Programming and Problem Solving (4 credits)
Note: CISC 130 is recommended for this major
CISC 230 Object-Oriented Design and Programming (4 credits)

Teacher Licensure

Elementary Education with a Co-major in Science and Mathematics for Elementary Education
Elementary Education with a Specialty in Science (5-8)
Co-major in Science (5-8) – Physics (9-12) and a Co-major in Secondary Education
See Education

Minor in Physics

Four credits from the following:
PHYS 109 General Physics I (4 credits)
PHYS 111 Introduction to Classical Physics I (4 credits)

Plus four credits from the following:
PHYS 110 General Physics II (4 credits)
PHYS 112 Introduction to Classical Physics II (4 credits)

Plus:
twelve PHYS credits 104 or greater

PHYS 101 Physics as a Liberal Art (4 credits) (PHYS 109, 111)
Intended for non-science majors; treats fundamental principles of physics and their application to familiar phenomena, stressing qualitative understanding. The course will survey topics from mechanics, fluids, temperature and heat, oscillations, waves and sound, light and optics, and properties of matter. The course consists of lecture, discussion and laboratory. This course is designed especially for elementary education majors. It is not intended for students who have had high school physics. This course fulfills the core-area in natural science in the Natural Science and Mathematical and Quantitative Reasoning requirement in the core curriculum.
Prerequisite: Three years of high school mathematics
NOTE: Students who receive credit for PHYS 101 may not receive credit for PHYS 109 or 111.

PHYS 104 Astronomy (4 credits)
Introduction to physical principles and their application to astronomy for non-science majors. Emphasis is on comprehension of ideas and principles. Topics include the motions of the sun, moon, stars and planets; properties of the solar system; the stars including giants, dwarfs, pulsars and black holes; nebulae, galaxies and quasars; cosmology and life. The course consists of lecture, discussion and laboratory. This course fulfills the core-area in natural science in the Natural Science and Mathematical and Quantitative Reasoning requirement in the core curriculum.
Prerequisite: Three years of high school mathematics

PHYS 105 Musical Acoustics (4 credits)
An introductory course intended for non-science majors; treats fundamental principles of physics and acoustics as they relate to musical sounds and musical instruments. The course consists of lecture, discussion and laboratory. This course fulfills the core-area in natural science in the Natural Science and Mathematical and Quantitative Reasoning and the second-level Computer Competency requirements in the core curriculum.
Prerequisites: High school algebra and a music background (one year practice, instrument or voice, or one course)

PHYS 109 General Physics I (4 credits) (PHYS 111)
This course and its continuation PHYS 110 serve as a two-semester introduction to classical and modern physics. Applications are chosen that focus on the life-sciences. Topics include principles of classical mechanics: description of motion, force, torque and rotational motion, energy, momentum and their conservation, fluid mechanics; thermodynamics. The course meets three times a week for two consecutive periods consisting of integrated lecture, discussion and laboratory. This course fulfills the core-area in natural science in the Natural Science and Mathematical and Quantitative Reasoning requirement in the core curriculum.
Prerequisite: Math placement at a level of MATH 111 or above.
NOTE: Students who receive credit for PHYS 109 may not receive credit for PHYS 111.

PHYS 110 General Physics II (4 credits) (PHYS 112)
Continuation of 109. Topics include oscillations, waves and sound, electricity and magnetism; light and optics; atomic, quantum and nuclear physics. The course meets three times a week for two consecutive periods consisting of integrated lecture, discussion and laboratory. This course fulfills the core-area in natural science in the Natural Science and Mathematical and Quantitative Reasoning requirement in the core curriculum.
Prerequisite: A minimum grade of C in PHYS 109 or 111
NOTE: Students who receive credit for PHYS 110 may not receive credit for PHYS 112.

PHYS 111 Introduction to Classical Physics I (4 credits) (PHYS 109)
This course and its continuation PHYS 112 serve as a two-semester introduction to classical physics. Applications are chosen that focus on engineering and the physical sciences. Topics include principles of classical mechanics: vectors, kinematics, particle and rigid body rotational dynamics and statics; conservation laws; and thermodynamics. The course meets three times a week for two consecutive periods consisting of integrated lecture, discussion and laboratory. This course fulfills the core-area in natural science in the Natural Science and Mathematical and Quantitative Reasoning and the second-level Computer Competency requirements in the core curriculum.
Prerequisite: A minimum grade of C in MATH 113
NOTE: Students who receive credit for PHYS 111 may not receive credit for PHYS 109.

PHYS 112 Introduction to Classical Physics II (4 credits) (PHYS 110)
Continuation of PHYS 111. Topics include waves and sound; electricity and magnetism; geometric and physical optics. The course meets three times a week for two consecutive periods consisting of integrated lecture, discussion and laboratory. This course fulfills the core-area in natural science in the Natural Science and Mathematical and Quantitative Reasoning and the second-level Computer Competency requirements in the core curriculum.
Prerequisites: A minimum grade of C in both PHYS 111 and MATH 114
NOTE: Students who receive credit for PHYS 112 may not receive credit for PHYS 110.

PHYS 215 Foundations of Modern Physics: From the Atom to the Big Bang (4 credits)
This course connects the subatomic world of particle and nuclear physics to the evolution of the universe after the Big Bang through the study of relativity and the four fundamental forces of nature. The course consists of lecture, discussion and laboratory. This course fulfills the second-level Computer Competency requirement in the core curriculum.
Prerequisite: A minimum grade of C in either PHYS 110 or 112 and in MATH 114.

PHYS 225 Applications of Modern Physics: From the Atom to the Diode (4 credits)
This course investigates the quantum theory of light, wave-particle duality, quantum mechanics in one-dimension, statistical physics, lasers, and solid state physics. The course consists of lecture, discussion and laboratory. This course fulfills the second-level Computer Competency requirement in the core curriculum.
Prerequisites: A minimum grade of C in PHYS 112 and in MATH 200.

PHYS 295, 296 Topics (2 credits)
PHYS 297, 298 Topics (4 credits)
The subject matter of these courses will vary from year to year, but will not duplicate existing courses. Descriptions of these courses are available in the Searchable Class Schedule on Murphy Online,
https://banner.stthomas.edu/pls/banner/prod/bwckschd.

PHYS 323 Methods of Experimental Physics (4 credits)
Standard tools and techniques used in experimental physics are introduced while conducting an in-depth investigation of a non-linear system. Technical topics include: identifying and characterizing chaotic systems, data acquisition and instrument control using LabVIEW, signal conditioning, data and error analysis, and experimental design. Lecture, discussion and laboratory.
Prerequisite: A minimum grade of C in either 215 or 225 and in either ENGR 240 or 350 and in MATH 200

PHYS 331 Theoretical Mechanics (4 credits)
Newtonian dynamics of particles and systems of particles; conservation laws; moving coordinate systems; central-force motion; collisions and scattering; plane and general motion of rigid bodies; free, forced and coupled oscillations; Lagrangian dynamics. Lecture and discussion.
Prerequisites: A minimum grade of C in either PHYS 215 or 225 and in MATH 200 and MATH 210

PHYS 341 Electricity and Magnetism (4 credits)
Electrostatic and magnetostatic fields in vacuum and material media; energy and force relations; methods for the solution of static problems; fields and currents in conducting media; Maxwell's equations and time-dependent fields. Lecture and discussion.
Prerequisites: A minimum grade of C in either PHYS 215 or 225 and in MATH 200 and MATH 210

PHYS 342 Electromagnetic Waves (4 credits) (equivalent to ENGR 342)
A continuation of PHYS 341. An introduction to the practical applications of Maxwell's equations including propagation, reflection and absorption of electromagnetic waves. Applications include antennas, waveguides, transmission lines, and shielding from electromagnetic interference. Lecture and discussion.
Prerequisite: A minimum grade of C in PHYS 341

PHYS 347 Optics (4 credits)
Foundations of geometric optics: Fermat's Principle of Stationary Time. Nature of electromagnetic waves: dipole radiation, energy, momentum, polarization, coherence, interference, diffraction, Fourier optics. Interactions between light and matter: scattering, reflection, refraction, absorption, dispersion, birefringence, dichroism, nonlinear effects. Quantum optics: nature of the photon, lasers, detectors, other modern topics. Lecture and discussion. Laboratory with an emphasis on biomedical applications.
Prerequisites: A minimum grade of C in PHYS 225, MATH 200, and MATH 210

PHYS 410 Statistical Mechanics and Thermodynamics (4 credits)
Concepts and laws of thermodynamics and of statistical mechanics. Applications of these to various systems, including gases, liquids, solids and chemical systems. Lecture and discussion.
Prerequisite: A minimum grade of C in PHYS 215, 225, and both MATH 200 and MATH 210

PHYS 431 Quantum Mechanics (4 credits)
The foundation of Quantum Mechanics will be explored with mathematical rigor. Specific topics include the time-independent Schrödinger equation, the hydrogen atom, and angular momentum including spin. Discussion of identical particles will lead to an introduction of quantum statistical mechanics. Lecture and discussion.
Prerequisite: A minimum grade of C in PHYS 215, 225, MATH 200, 210, and 240

PHYS 483, 484 Seminar (2 credits)
PHYS 485, 486 Seminar (4 credits)
See the description of these courses at the beginning of the "Curricula" section of this catalog.

PHYS 487, 488 Topics (2 credits)
PHYS 489, 490 Topics (4 credits)
The subject matter of these courses will vary from year to year, but will not duplicate existing courses. Descriptions of these courses are available in the Searchable Class Schedule on Murphy Online,
https://banner.stthomas.edu/pls/banner/prod/bwckschd.

PHYS 491, 492 Research (2 credits)
PHYS 493, 494 Research (4 credits)
See the description of these courses at the beginning of the "Curricula" section of this catalog.

PHYS 495, 496 Individual Study (2 credits)
PHYS 497, 498 Individual Study (4 credits)
See the description of these courses at the beginning of the "Curricula" section of this catalog.