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

487, 488 Topics **2 credits**
489, 490 Topics
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491, 492 Research **2 credits**
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495, 496 Individual Study **2 credits**
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Physics (PHYS)

Johnston (chair), Feng, Lane, Ohmann, Tommet; Blilie, Koser, Nesmelova, Rada

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
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 3.00 overall
5) Present their research at a scientific meeting beyond the St. Thomas community

Major in Physics (B.S.)

111 Introduction to Classical Physics I
112 Introduction to Classical Physics II
225 Introduction to Modern Physics I
226 Introduction to Modern Physics II
300 Physics Seminar I (1 credit)
301 Physics Seminar II (1 credit)
323 Methods of Experimental Physics
331 Theoretical Mechanics
341 Electricity and Magnetism
342 Electromagnetic Waves
347 Optics
410 Statistical Mechanics and Thermodynamics
431 Quantum Mechanics

Allied requirements
MATH 113 Calculus I
MATH 114 Calculus II
MATH 200 Multi-Variable Calculus
MATH 210 Linear Algebra and Differential Equations

Plus either:
ENGR 350 Introduction to Electronics
or
ENGR 230 Digital Design and ENGR 240 Circuit analysis

Plus one of:
QMCS 230 Software Design Using the JAVA Language
QMCS 342 Computer Applications in Experimental Sciences

Major in Physics (B.A.)
111 Introduction to Classical Physics I
112 Introduction to Classical Physics II
225 Introduction to Modern Physics I
226 Introduction to Modern Physics II
300 Physics Seminar I (1 credit)
301 Physics Seminar II (1 credit)
323 Methods of Experimental Physics

Plus:
twelve PHYS credits above 301

Allied requirements
MATH 113 Calculus I
MATH 114 Calculus II
MATH 200 Multi-variable Calculus
MATH 210 Linear Algebra and Differential Equations

Plus either:
ENGR 350 Introduction to Electronics
or
ENGR 230 Digital Design and ENGR 240 Circuit analysis

Plus one of:
QMCS 230 Software Design Using the JAVA Language
QMCS 342 Computer Applications in Experimental Sciences

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 School of Education Department of Teacher Education

Minor in Physics
111 Introduction to Classical Physics I
112 Introduction to Classical Physics II
225 Introduction to Modern Physics I
226 Introduction to Modern Physics II

Plus:
four PHYS credits above 226

101 Physics as a Liberal Art I (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.
Prerequisite: Three years of high school mathematics

102 Physics as a Liberal Art II (110, 112)
This course is intended for students who have completed PHYS 101 and wish to continue their study, or for those who have had high school physics. It is organized around a thematic approach and includes specifically studies of a) electric charges and related forces, b) commonly observed light behavior, and c) interactions of light and particles. The course consists of lecture, discussion, and laboratory.
Prerequisite: 101 or high school physics

104 Astronomy
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.
Prerequisite: Three years of high school mathematics

105 Musical Acoustics
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 second-level Computer Competency requirement in the core curriculum.
Prerequisites: High school algebra and a music background (one year practice, instrument or voice, or one course)

109 General Physics I (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.
Prerequisite: Math placement at a level of MATH 111 or above.

110 General Physics II (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.
Prerequisite: A minimum grade of C in 109 or 111

111 Introduction to Classical Physics I (109)
This course and its continuation 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.
Prerequisite: A minimum grade of C in MATH 113

112 Introduction to Classical Physics II (110)
Continuation of 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.
Prerequisites: A minimum grade of C in both 111 and MATH 114

225 Introduction to Modern Physics I
This course and its continuation 226 serve as an introduction to modern physics. The topics of this first course are quantum theory of light, particle nature of matter, wave aspects of particles, quantum mechanics in one-dimension, statistical physics, lasers, 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 both 112 and MATH 200

226 Introduction to Modern Physics II
Continuation of 225. Topics include atomic structure, molecular structure, relativity, nuclear physics, elementary particles, other topics of contemporary interest. 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 both 112 and MATH 200

295, 296 Topics **2 credits**
297, 298 Topics
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300 Physics Seminar I **1 credit**
This course and 301 are a sequence of two courses taken during the spring semesters of the junior and senior years. The goal of the course is to provide an overview of physics, relating ideas and concepts presented in other physics classes as well as in research investigations within the department. Additionally, students will be exposed to topics presented by outside speakers and will learn about opportunities that a physics degree provides, smoothing the transition between being a physics student and becoming a physicist.
Prerequisite: A minimum grade of C in either 225 or 226

301 Physics Seminar II **1 credit**
Continuation of 300
Prerequisite: A minimum grade of C in either 225 or 226

323 Methods of Experimental Physics
Introduction to some of the standard tools of experimental physics. Topics include: data acquisition and instrument control, data analysis, error analysis, vacuum techniques, Monte-Carlo techniques, timing and detection techniques, and experiment design. The course consists of lecture, discussion and laboratory.
Prerequisite: A minimum grade of C in either 225 or 226 and in either ENGR 240 or 350

331 Theoretical Mechanics
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 225 or 226 and in MATH 210

341 Electricity and Magnetism
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 225 or 226 and in MATH 210

342 Electromagnetic Waves (ENGR 475)
A continuation of electricity and magnetism with a view of Maxwell's equations and the resulting wave equation, traveling wave solutions and applications, radiation, interference and diffraction, optics, wave guides. Lecture and discussion.
Prerequisite: A minimum grade of C in 341

347 Optics
The nature of light. Geometrical optics, image formation, and optical instruments. Interference, diffraction, and polarization. Lasers, holography, and other aspects of physical optics. Lecture, discussion, and laboratory.
Prerequisite: A minimum grade of C in either 225 or 226

410 Statistical Mechanics and Thermodynamics
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 225, 226, and MATH 210

431 Quantum Mechanics
Application of quantum mechanics to advanced problems in modern physics; perturbation theory; spin and its effects; identical particles; many-electron atoms; topics in scattering theory and nuclear physics. Lecture and discussion.
Prerequisite: A minimum grade of C in 225, 226, and MATH 210

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