PHYSICS

Robin McRae, Chair
department page (https://www.ewu.edu/cstem/programs/physics)
226 Science Bldg.
509.359.2798

Faculty

Berenice Emehiser, Brian D. Houser, Robert W. Ruotsalainen, Achin Sen, David Syphers.

Undergraduate Degrees

Bachelor of Arts (BA)

- Physics (http://catalog.ewu.edu/science-technology-engineering-mathematics/physics/physics-ba)

Bachelor of Arts in Education (BAE)

- Physics/Secondary (http://catalog.ewu.edu/science-technology-engineering-mathematics/physics/physics-secondary-bae)

Bachelor of Science (BS)

- Physics (http://catalog.ewu.edu/science-technology-engineering-mathematics/physics/physics-bs)

Undergraduate Minors

- Physics (http://catalog.ewu.edu/science-technology-engineering-mathematics/physics/physics-minor)
- Physics/Secondary (http://catalog.ewu.edu/science-technology-engineering-mathematics/physics/physics-secondary-minor)

Teacher Certification/Add-on Endorsements

- General Science/Add-on Endorsement (http://catalog.ewu.edu/science-technology-engineering-mathematics/physics/teacher-certification-addon-endorsements)

Undergraduate Programs

Physics is the study of the physical environment and the laws governing the behavior of particles, fields and space/time. More specifically, physicists study mechanics, heat, light, electric and magnetic fields, gravitation, relativity, atomic and nuclear physics, solid state physics and many other topics. In general, physics strives for a mathematical description of the laws of nature at the most fundamental level and is therefore the most mathematical of the basic sciences.

Employment opportunities have been plentiful for physicists in recent years, especially for those with strong backgrounds in electrical instrumentation and computer electronics. Careers in research and development are available in many companies and federal agencies. The armed forces recruit technically trained people, especially physicists, to become officers and offer further educational opportunities to those selected. Secondary teaching positions in math and science are readily available. Careers exist in technical sales. Many students go on to graduate school for advanced degrees before starting a career. Advanced degrees lead to community college and university faculty positions, as well as increased opportunities for leadership roles in research and management.

In addition to its degree programs, the department provides several components to the university community in general and to a wide variety of majors in other disciplines. Introductory Physics and General Physics are supporting courses for such degree programs as chemistry and geology and are required courses for schools of physical therapy and medicine. General Physics is required in all schools of engineering.

General Admissions and Preparation Information for Physics

Bachelor of Science majors should complete the required chemistry sequence and as much of the General Education Core Requirements (http://catalog.ewu.edu/undergraduate-degree/#text) as possible during the first two years.

Beginning physics students are advised to start the PHYS 151, PHYS 152, PHYS 153, PHYS 221 sequence as soon as possible.

- This can be done fall quarter if the student is also prepared to enroll in MATH 161.
- Otherwise the student should take MATH 141, MATH 142 and MATH 161 their first year and be prepared to enroll in PHYS 151 the following fall quarter.

Grades

Most upper division courses require either a minimum grade ≥2.0 in each prerequisite or permission of the instructor in order to register.

Required courses in the following programs of study may have prerequisites. Reference the course description section for clarification.

Physics Courses

PHYS 100. PHYSICAL SCIENCE I. 5 Credits.
Pre-requisites: pre-university basic skills in mathematics.
Satisfies: a GECR for natural sciences, physics.
Course covers the elementary aspects of physical science and astronomy. It operates in an informal laboratory mode with ample opportunity for discussion and individual assistance. No mathematics beyond basic arithmetic is used.

PHYS 115. INVESTIGATING PHYSICAL SCIENCE. 5 Credits.
Pre-requisites: MATH 211.
Satisfies: a GECR for natural sciences, physics.
For students planning to teach elementary school. Includes inquiry based physical science investigations that support science instruction outlined in the National Science Education Standards and Washington Essential Academic Learning Requirements.

PHYS 121. DESCRIPTIVE ASTRONOMY. 5 Credits.
Pre-requisites: pre-university basic skills in mathematics.
Satisfies: a GECR for natural sciences, physics.
This course follows the development of astronomy from the earth-centered model of the early Greeks through the sun-centered model of Copernicus to the modern dynamic model of the universe incorporating the known laws of physics in its description. Topics covered in this development include a study of the solar system and a brief description of the physical laws used in astronomy. Additional topics such as distances, motions properties and evolution of stars lead to a study of galaxies, the structure of the universe and to modern cosmological models. Laboratory activities include naked-eye observation and measurement, planetarium sessions, Celestial Globe activities, computer simulations, as well as experiments in optics, spectra and the use of telescopes.

PHYS 131. INTRODUCTORY PHYSICS I. 4 Credits.
Notes: Each course consists of 4 credits of lecture and 1 credit of required instrumentation laboratory.
Pre-requisites: MATH 142, concurrent enrollment in PHYS 161 for PHYS 131 is recommended; PHYS 131 for PHYS 132; and PHYS 132 for PHYS 133.
Satisfies: The completion of PHYS 131, PHYS 161 satisfies the GECR for natural sciences, physics; counts as one course. The completion of PHYS 131, PHYS 132, PHYS 161, plus any one of the following: PHYS 162, PHYS 163, PHYS 164 satisfies the GECR for natural sciences, physics; counts as two courses.
These courses are designed primarily for science students with mathematical preparation through algebra and trigonometry. No calculus is used. The topics covered are PHYS 131–kinematics, dynamics, conservation of momentum and energy and simple harmonic motion; PHYS 132–sound/waves, heat/thermo-dynamics, geometric optics; PHYS 133–electricity and magnetism, physical optics, modern physics.

PHYS 132. INTRODUCTORY PHYSICS II. 4 Credits.
Notes: Each course consists of 4 credits of lecture and 1 credit of required instrumentation laboratory.
Pre-requisites: MATH 142, concurrent enrollment in PHYS 161 for PHYS 131 is recommended; PHYS 131 for PHYS 132; and PHYS 132 for PHYS 133.
Satisfies: The completion of PHYS 131, PHYS 161 satisfies the GECR for natural sciences, physics; counts as one course. The completion of PHYS 131, PHYS 132, PHYS 161, plus any one of the following: PHYS 162, PHYS 163, PHYS 164 satisfies the GECR for natural sciences, physics; counts as two courses.
These courses are designed primarily for science students with mathematical preparation through algebra and trigonometry. No calculus is used. The topics covered are PHYS 131–kinematics, dynamics, conservation of momentum and energy and simple harmonic motion; PHYS 132–sound/waves, heat/thermo-dynamics, geometric optics; PHYS 133–electricity and magnetism, physical optics, modern physics.

PHYS 133. INTRODUCTORY PHYSICS III. 4 Credits.
Notes: Each course consists of 4 credits of lecture and 1 credit of required instrumentation laboratory.
Pre-requisites: MATH 142, concurrent enrollment in PHYS 161 for PHYS 131 is recommended; PHYS 131 for PHYS 132; and PHYS 132 for PHYS 133.
Satisfies: The completion of PHYS 131, PHYS 161 satisfies the GECR for natural sciences, physics; counts as one course. The completion of PHYS 131, PHYS 132, PHYS 161, plus any one of the following: PHYS 162, PHYS 163, PHYS 164 satisfies the GECR for natural sciences, physics; counts as two courses.
These courses are designed primarily for science students with mathematical preparation through algebra and trigonometry. No calculus is used. The topics covered are PHYS 131–kinematics, dynamics, conservation of momentum and energy and simple harmonic motion; PHYS 132–sound/waves, heat/thermo-dynamics, geometric optics; PHYS 133–electricity and magnetism, physical optics, modern physics.

PHYS 151. GENERAL PHYSICS I. 4 Credits.
Notes: the completion of PHYS 151, PHYS 161 satisfies the GECR for natural sciences, physics; counts as one course.
Pre-requisites: Concurrent enrollment in MATH 161. Concurrent enrollment in PHYS 161 is recommended.
Part of a four-quarter beginning sequence (PHYS 151, PHYS 152, PHYS 153, PHYS 221) suitable for all students of natural science and mathematics. Topics covered include: one and multi-dimensional kinematics and dynamics, energy and momentum and oscillations.

PHYS 152. GENERAL PHYSICS II. 4 Credits.
Notes: the completion of PHYS 151, PHYS 152, PHYS 161, plus any one of the following: PHYS 162, PHYS 163, PHYS 164 satisfies the GECR for natural sciences, physics; counts as two courses.
Pre-requisites: PHYS 151 and concurrent enrollment in MATH 162.
Part of a four-quarter beginning sequence (PHYS 151, PHYS 152, PHYS 153, PHYS 221) suitable for all students of natural science and mathematics. Topics covered include: rotational motion, gravity, fluids, waves and thermodynamics.

PHYS 153. GENERAL PHYSICS III. 4 Credits.
Pre-requisites: PHYS 152 and concurrent enrollment in MATH 163.
Part of a four-quarter beginning sequence (PHYS 151, PHYS 152, PHYS 153, PHYS 221) suitable for all students of natural science and mathematics. Topics covered include: electrostatics, direct current circuit theory, magnetism and geometric optics.

PHYS 161. MECHANICS LABORATORY. 1 Credit.
Pre-requisites: MATH 142.
A laboratory course in mechanics, including one-dimensional motion, motion in a plane, dynamics, conservation of energy and momentum, and oscillating motion.

PHYS 162. HEAT AND OPTICS LABORATORY. 1 Credit.
Pre-requisites: MATH 142.
A laboratory course in heat and optics. Experiments in optics include reflection and refraction, lenses and mirrors, microscopes and telescopes, and optical spectra. Experiments in heat include heat and temperature, thermal expansion, mechanical and electrical equivalents of heat and a study of gas laws.

PHYS 163. INSTRUMENTATION LAB I. 1 Credit.
Pre-requisites: MATH 142.
A laboratory course introducing the concepts of electricity and circuits from an experimental standpoint, including construction and analysis of circuits and their components.

PHYS 164. INSTRUMENTATION LAB II. 1 Credit.
This laboratory emphasizes the use of electronic instruments in the measurement of physical quantities.

PHYS 196. EXPERIMENTAL COURSE. 1-5 Credits.

PHYS 221. GENERAL PHYSICS IV. 4 Credits.
Pre-requisites: PHYS 153.
Part of a four-quarter beginning sequence (PHYS 151, PHYS 152, PHYS 153, PHYS 221) suitable for all students of natural science and mathematics. Topics covered include: electromagnetism, alternating current circuit theory, Maxwell's equations, physical optics, quantization, and nuclear physics.

PHYS 296. EXPERIMENTAL COURSE. 1-5 Credits.

PHYS 299. SPECIAL STUDIES. 1-5 Credits.

PHYS 321. ADVANCED PHYSICS LAB I. 3 Credits.
Pre-requisites: junior standing or permission of the instructor.
A laboratory course dealing with classical experiments in all of physics as well as introducing many modern measurement techniques in atomic and nuclear physics.

PHYS 322. ADVANCED PHYSICS LAB II. 3 Credits.
Pre-requisites: junior standing or permission of the instructor.
A laboratory course dealing with classical experiments in all of physics as well as introducing many modern measurement techniques in atomic and nuclear physics.

PHYS 338. DISCOVERING WOMEN IN SCIENCE. 1 Credit.
Cross-listed: BIOL 338, CHEM 338, GEOL 338, HIST 338, PHYS 338, PSYC 338.
The course uses several scientific themes to rediscover from the past and find in contemporary research, the women who have made significant contributions to science.

PHYS 361. CLASSICAL MECHANICS I. 4 Credits.
Pre-requisites: PHYS 153, MATH 163.
A study of statics and dynamics from a mathematical point of view; an introduction to Lagrange's Equations.

PHYS 362. CLASSICAL MECHANICS II. 4 Credits.
Pre-requisites: PHYS 361.
A study of statics and dynamics from a mathematical point of view; an introduction to Lagrange's Equations.

PHYS 363. SPECIAL RELATIVITY. 4 Credits.
Pre-requisites: PHYS 153, MATH 162.
An introduction to Einstein's theory of special relativity and its application to particle dynamics.

PHYS 371. QUANTUM PHYSICS I: INTRODUCTION. 4 Credits.
Pre-requisites: MATH 163, PHYS 221.
An introduction to the origin and development of quantum theory with emphasis on the classical experiments leading to Schroedinger's wave mechanics and applications of Schroedinger's Equation to simple systems. Explicit solutions of the standard one dimensional problems and the use of the linear algebraic Dirac formalism will be discussed in detail.

PHYS 381. QUANTUM PHYSICS II: ATOMIC. 4 Credits.
Pre-requisites: PHYS 371.
A study of the application of quantum theory to the description of atoms, including exactly solvable problems and key approximation methods. Atomic structure and the resulting spectra are discussed.

PHYS 390. PHYSICS TEACHING METHODS. 2 Credits.
Pre-requisites: successful completion of PHYS 221, PHYS 164, PHYS 321, PHYS 371, and successful completion or concurrent enrollment in EDUC 341 and enrollment in a co-requisite SCED 390.
This course is for physics majors planning to teach junior or senior high school. Topics include: review of the NGSS content, the development of lesson plans for several areas of the new standards, and instruction, through class examples, of teaching science by inquiry.

PHYS 395. CO-OP FIELDWORK. 1-5 Credits.

PHYS 396. EXPERIMENTAL COURSE. 1-6 Credits.

PHYS 401. ELECTROMAGNETISM I. 4 Credits.
Pre-requisites: MATH 163, PHYS 221.
A study of electric forces, fields, potentials, dielectric behavior, currents, magnetic forces, and electromagnetic waves.

PHYS 402. ELECTROMAGNETISM II. 4 Credits.
Pre-requisites: MATH 163, PHYS 221.
A study of electric forces, fields, potentials, dielectric behavior, currents, magnetic forces, and electromagnetic waves.

PHYS 403. ELECTROMAGNETISM III. 4 Credits.
Pre-requisites: MATH 163, PHYS 221.
A study of electric forces, fields, potentials, dielectric behavior, currents, magnetic forces, and electromagnetic waves.

PHYS 411. CLASSICAL THERMODYNAMICS. 3 Credits.
Pre-requisites: PHYS 153, MATH 163.
Introduction to elementary thermodynamics; first, second and third laws of thermodynamics; ideal gases; and kinetic theory.

PHYS 421. COMPUTATIONAL PHYSICS. 4 Credits.
Pre-requisites: MATH 163, PHYS 221.
Introduction to programming to solve physics problems in data analysis, theory, and statistics that are not amenable to analytical solution. Covers model fitting, computational statistical techniques, nonlinear system dynamics, iterative solutions and basic simulations.

PHYS 424. ASTROPHYSICS. 4 Credits.
Pre-requisites: MATH 163, PHYS 153.
Application of the physical principles of mechanics, fluid dynamics, thermodynamics, electromagnetism, optics and relativity within the astronomical contexts of observational techniques/instrumentation, planetary science, stellar structure/evolution, galactic/extragalactic structure and cosmology.

PHYS 431. SOLID STATE DEVICES PHYSICS. 3 Credits.
Pre-requisites: MATH 163, PHYS 221.
A course dealing with crystalline semiconductors, carrier transport generation and recombination, p-n junctions, metal-semiconductor junctions, microwave devices, photonic devices like solar cells and semiconductor lasers.

PHYS 441. SOLID STATE PHYSICS. 3 Credits.
Pre-requisites: PHYS 431.
A course dealing with the quantum properties of electrons in solids, mechanisms of electron and hole conduction, and the theory of operation of solid state devices.

PHYS 451. OPTICS. 4 Credits.
Pre-requisites: MATH 163, PHYS 153.
A study of the nature of light and its applications, with emphasis on physical optics and the electromagnetic wave theory of light. Topics selected from modern optics include Fourier optics, basics of coherence theory, and aspects of the quantum nature of light.

PHYS 461. NUCLEAR PHYSICS. 3 Credits.
Pre-requisites: PHYS 381.
A continuation of PHYS 381 which deals with properties of the nucleus, laws of radioactivity, nature of radiation, nuclear, X- and gamma rays, and nuclear reactions.

PHYS 495. INTERNSHIP. 1-5 Credits.
Prerequisite: permission of the instructor, department chair and college dean

PHYS 496. EXPERIMENTAL COURSE. 1-5 Credits.

PHYS 497. WORKSHOP, SHORT COURSE, CONFERENCE, SEMINAR. 1-6 Credits.

PHYS 498. SEMINAR. 1-2 Credits.

PHYS 499. DIRECTED STUDY. 1-5 Credits.
Prerequisite: permission of the instructor, department chair and college dean

PHYS 596. SPECIAL TOPICS. 1-5 Credits.

PHYS 597. WORKSHOP, SHORT COURSE, CONFERENCE, SEMINAR. 1-5 Credits.

PHYS 598. SEMINAR. 1-5 Credits.

PHYS 599. INDEPENDENT STUDY. 1-5 Credits.

PHYS 696. COLLEGE TEACHING INTERNSHIP. 1-5 Credits.