Engineering Physics Undergraduate Program

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The engineering physics program is designed for undergraduates with an interest in both science and engineering. The program is focused on those students who wish to work in areas of rapid technological change, where a good background in the underlying science is an important ingredient to success in their careers. The curriculum includes classical and modern physics, mathematics, and their applications to one or more areas of engineering. The student learns the physical science and engineering principles underlying modern technology. Four design concentrations are offered:

- Aerospace Systems: Aircraft track OR Spacecraft track
- Chemical Systems
- Digital Electronic Systems
- Electromechanical Control Systems

Each option incorporates a significant design component and provides a strong base in one or more engineering disciplines. The Bachelor of Science degree in Engineering Physics is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org.

For programs in physics, see Physics and Astronomy (http://catalog.ku.edu/liberal-arts-sciences/physics-astronomy/) in the College of Liberal Arts and Sciences section of the online catalog.

Educational Objectives

Engineering physics graduates will be capable of

- Completing or successfully progressing toward completion of an advanced degree in graduate or professional school,
- Using their analytical, problem-solving, and communications skills to conduct research or contribute to technology development projects, individually or as a team member,
- Using their background knowledge in physics and engineering fundamentals as a foundation for developing new knowledge and experience in their chosen disciplines.

Careers

Professional Opportunities

Engineering physics enables graduates to combine an extensive background in physics, the science that underlies modern technology, with an engineering degree. Their broad training and technical breadth provide a unique flexibility. They have the science background to pursue pure research opportunities, the engineering degree and design concentration to solve practical problems in industry or a variety of other settings, and the understanding to act as a communication link between highly diversified divisions of an organization. Engineering physics graduates typically work in aerospace and avionic industries, electronics industries, research and development laboratories, telecommunications, design and consulting firms, and government agencies, and as defense contractors. Many engineering physics graduates attend graduate or professional school before entering the work force.

Courses

EPHX 211. General Physics I. 4 Hours NP / N.
Introduction to classical mechanics and thermodynamics. Designed for students in engineering and physical science majors. Prerequisite: MATH 116 or MATH 125 or MATH 145; corequisite MATH 126 or MATH 146; courses in high school physics and/or chemistry are recommended. LEC.

EPHX 212. General Physics II. 3 Hours NP / N.
Study of electricity, magnetism, waves, and optics. Prerequisite: PHSX 201, PHSX 210, PHSX 211 or PHSX 213; MATH 126 or MATH 146. Corequisite in MATH 127 or MATH 147 is strongly encouraged. LEC.

EPHX 400. Topics in Engineering Physics: ____. 1-3 Hours.
A course on special topics in engineering physics, given as the need arises. Course may be repeated for different topics. Each section may have additional prerequisites to be determined by the instructor. LEC.

EPHX 501. Honors Research. 1-4 Hours AE61 / N.
This course is for students seeking Departmental Honors in Astronomy, Engineering Physics, or Physics to fulfill the undergraduate research requirement. At the completion of the required four hours of total enrollment, a written and oral report of the research is required. (Same as ASTR 501 and PHSX 501.) Prerequisite: Junior/Senior standing in Astronomy, Engineering Physics, or Physics; or permission of instructor. IND.

EPHX 503. Undergraduate Research. 1-4 Hours AE61 / N.
This course is for students seeking to fulfill the undergraduate research requirement. Students are expected to participate in some area of ongoing research in the department, chosen with the help of their advisor. At the end of the term, students will present their results in a seminar to other students and faculty. (Same as ASTR 503 and PHSX 503.) Prerequisite: Junior/Senior standing in Astronomy, Engineering Physics, or Physics; or permission of instructor. IND.

EPHX 511. Introductory Quantum Mechanics. 3 Hours N.
An introduction to quantum mechanics, emphasizing a physical overview. Topics should include the formalisms of non-relativistic quantum mechanics, the 3-dimensional Schrodinger equation with applications to the hydrogen atom; spin and angular momentum; multi-particle systems of Fermi-Dirac and Bose-Einstein particles; time-independent perturbation theory. (Same as PHSX 511.) Prerequisite: PHSX 313 and MATH 290. LEC.

EPHX 516. Physical Measurements. 4 Hours N.
A laboratory course emphasizing experimental techniques and data analysis, as well as scientific writing and presentation skills. Experiments will explore a range of classical and modern physics topics. Students will also practice ethical decision making using case studies appropriate for the discipline. (Same as PHSX 516.) Prerequisite: PHSX 313, EPHX 316 or PHSX 316 and EPHX 521 or PHSX 521. (EPHX 521 or PHSX 521 may be taken concurrently.) LAB.

EPHX 518. Mathematical Physics. 3 Hours N.
Applications of modern mathematical methods to problems in mechanics and modern physics. Techniques include application of partial differential equations and complex variables to classical field problems in continuous mechanics, unstable and chaotic systems, electrodynamics, hydrodynamics, and heat flow. Applications of elementary transformation theory and group theory, probability and statistics, and nonlinear analysis to selected problems in modern physics as well as to graphical representation of experimental data. Prerequisite: PHSX 313 and MATH 320 or permission of instructor. (Same as PHSX 518.) LEC.
EPHX 521. Mechanics I. 3 Hours N.
Newton's laws of motion. Motions of a particle in one, two, and three dimensions. Motion of a system of particles. Moving coordinate systems. (Same as PHSX 521.) Prerequisite: PHSX 211 and PHSX 216, or PHSX 213; MATH 127; MATH 290; and MATH 220 or MATH 320. LEC.

EPHX 531. Electricity and Magnetism. 3 Hours N.
The properties of electric and magnetic fields, including electrostatics, Gauss' Law, boundary value methods, electric fields in matter, electromagnetic induction, magnetic fields in matter, the properties of electric and magnetic dipoles, and of dielectric and magnetic materials. (Same as PHSX 531.) Prerequisite: PHSX 214, or PHSX 212 and PHSX 236; PHSX 521 or special permission; MATH 127; MATH 290; and MATH 220 or MATH 320. LEC.

EPHX 536. Electronic Circuit Measurement and Design. 4 Hours N.
A laboratory course that explores the theory and experimental techniques of analog and digital electronic circuit design and measurements. Topics include transient response, transmission lines, transistors, operational amplifiers, and digital logic. (Same as PHSX 536.) Prerequisite: PHSX 214 or PHSX 212 and PHSX 236; MATH 127; and MATH 290. PHSX 313 and 316 recommended. LAB.

EPHX 537. Special Topics in Physics: ______. 3 Hours N.
Different topics will be covered as needed. This course will address topics in physics and astrophysics not covered in regularly offered courses. May be repeated if topic differs. (Same as PHSX 600.) Prerequisite: Permission of instructor. LEC.

EPHX 538. Electromagnetic Theory. 3 Hours N.
Maxwell's equations, wave propagation, optics and waveguides, radiation, relativistic transformations of fields and sources, use of covariance and invariance in relativity. Normally a continuation of PHSX 531. (Same as PHSX 531.) Prerequisite: PHSX 531 or PHSX 531. LEC.

EPHX 600. Special Topics in Physics and Astrophysics: ______. 3 Hours N.
Different topics will be covered as needed. This course will address topics in physics and astrophysics not covered in regularly offered courses. May be repeated if topic differs. (Same as PHSX 600.) Prerequisite: Permission of instructor. LEC.

EPHX 601. Design of Physical and Electronic Systems. 4 Hours AE61 / N.
A laboratory course emphasizing the application of physical principles to the design of systems for research, monitoring, or control. Topics include the use of microcomputers as controllers, interfacing microcomputers with measurement devices, and use of approximations and/or computer simulation to optimize design parameters, linear control systems, and noise. (Same as PHSX 601.) Prerequisite: Twelve hours of junior-senior credit in physics or engineering, including one laboratory course. LAB.

EPHX 615. Numerical and Computational Methods in Physics. 3 Hours N.
An introduction to the use of numerical methods in the solution of problems in physics for which simplifications allowing closed-form solutions are not applicable. Examples are drawn from mechanics, electricity, magnetism, thermodynamics, and optics. (Same as PHSX 615.) Prerequisite: PHSX 313, MATH 320 or equivalent, and EECS 138 or equivalent. LEC.

EPHX 621. Mechanics II. 3 Hours N.
Continuation of PHSX 521. Lagrange's equations and generalized coordinates. Mechanics of continuous media. Tensor algebra and rotation of a rigid body. Special relativity and relativistic dynamics. (Same as PHSX 621.) Prerequisite: EPHX 521 or PHSX 521. LEC.

EPHX 631. Electromagnetic Theory. 3 Hours N.
Maxwell's equations, wave propagation, optics and waveguides, radiation, relativistic transformations of fields and sources, use of covariance and invariance in relativity. Normally a continuation of PHSX 531. (Same as PHSX 631.) Prerequisite: EPHX 531 or PHSX 531. LEC.

EPHX 641. Introduction to Nuclear Physics. 3 Hours N.
Experimental methods in nuclear physics, elementary concepts and simple considerations about nuclear forces, alpha and beta decay, gamma radiation, nuclear structure, and reaction systematics. (Same as PHSX 641.) Prerequisite: PHSX 313 and PHSX 511. LEC.

EPHX 655. Optics. 3 Hours N.
Geometric optics. Wave properties of light: interference, diffraction, coherence. Propagation of light through matter. Selected topics in modern optics, e.g., lasers, fibers. (Same as PHSX 655.) Prerequisite: PHSX 313 and PHSX 316; EPHX 531 or special permission from instructor. LEC.

EPHX 661. Introduction to Elementary Particle Physics. 3 Hours N.
Properties and interactions of quarks, leptons, and other elementary particles; symmetry principles and conservation laws; broken symmetry; gauge bosons; the fundamental interactions, grand unified theories of strong, electromagnetic, and weak interactions; the cosmological implications of elementary particle physics. (Same as PHSX 661.) Prerequisite: PHSX 511 and MATH 320. LEC.

EPHX 671. Thermal Physics. 3 Hours N.
Development of thermodynamics from statistical considerations. Techniques of calculating thermodynamic properties of systems. Application to classical problems of thermodynamics. Elementary kinetic theory of transport processes. Fermi-Dirac and Bose-Einstein systems. (Same as PHSX 671.) Prerequisite: PHSX 511. LEC.

EPHX 681. Concepts in Solids. 3 Hours N.
Properties of common types of crystals and amorphous solids. Lattice vibrations and thermal properties of solids. Electrons and holes in energy bands of metals, semiconductors, superconductors, and insulators. (Same as PHSX 681.) Prerequisite: PHSX 313 and PHSX 511. LEC.

EPHX 691. Astrophysics I. 3 Hours N.
An introduction to radiation processes, thermal processes, and radiative transfer in stellar atmospheres and the interstellar medium. (Same as ASTR 691 and PHSX 691.) Prerequisite: PHSX 313 or consent of instructor. LEC.

EPHX 693. Gravitation and Cosmology. 3 Hours N.
An overview of topics relevant to gravitation and modern cosmology: special relativity, tensor notation, the equivalence principle, the Schwarzschild solution, black holes, and Friedmann models. Cosmic black body radiation, dark matter, and the formation of large-scale structure. The idea of quantum gravity and an introduction to the current literature in cosmology. (Same as PHSX 693.) Prerequisite: PHSX 313 and MATH 320. LEC.