PHYSICS (PHYS)

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PHYS 101 Liberal Arts Physics (3 Credit Hours)
Pre-requisites: ENVS 101 or equivalent; please check requirements for declared majors/minors for exceptions
For non-science majors. Selected topics from classical and modern physics emphasizing beauty, symmetry, and simplicity. Contemporary issues of physics and society.
Knowledge Area: Tier 2 Scientific Knowledge
Outcomes:
Understanding of interaction between theory and experiment, role of physics in society, science vs. nonscience; solve problems using algebra, geometry, vectors, and graphs; synthesize disparate physics topics

PHYS 102 Planetary and Stellar Astronomy (3 Credit Hours)
Pre-requisites: ENVS 101 or equivalent; please check requirements for declared majors/minors for exceptions
This course covers the astronomy of the solar system and planetary science as well as the astronomy of stars and galaxies. This includes study of earth and comparative study of all the planets, as well as the birth, evolution, and death of stars, the clustering of stars and galaxies, the expanding universe and cosmology.
Knowledge Area: Tier 2 Scientific Knowledge
Outcomes:
Students will demonstrate an understanding of the fundamental knowledge and concepts in astronomy, the qualitative and quantitative reasoning used, and how this science can be applied

PHYS 106 Physics of Music (3 Credit Hours)
Pre-requisites: ENVS 101 or equivalent; please check requirements for declared majors/minors for exceptions
Language, structure, history and styles of music; motion, force, energy and waves applied to production of sound; physical properties of instruments and musical acoustics.
Knowledge Area: Tier 2 Scientific Knowledge
Outcomes:
Knowledge of music fundamentals; understand how instruments function; apply physics concepts and experimentation to analyze the production of music and acoustics

PHYS 111 College Physics I Lec / Dis (3 Credit Hours)
Pre-requisites: Math Placement Test or MATH 118
Non-calculus introduction to vectors, kinematics, Newtonian mechanics of translational, rotational, and oscillatory motion, energy and momentum conservation, and thermodynamics.
Interdisciplinary Option: Forensic Science
Outcomes:
Understanding of analytical description of motion and application of conservation laws; develop scientific insight and proficiency in solving representative problems

PHYS 111L College Physics Laboratory I (1 Credit Hour)
Pre- or co-requisites: PHYS 111 or PHYS 121; Prerequisite: MATH 118 or MDT
Laboratories cover selected topics in introductory mechanics, including freefall, uniform circular motion, work-energy, collisions, rotational motion, and harmonic motion.
Interdisciplinary Option: Forensic Science
Outcomes:
Experience and familiarity with basic measuring devices and simple mechanics equipment; Understand measurement errors and their propagation, plotting and interpretation of data, the connection between theory and experiment for selected topics in elementary mechanics

PHYS 112 College Physics II Lec/Disc (3 Credit Hours)
Pre-requisites: PHYS 111 or equivalent
PHYS 111 and 112 provide a non-calculus introduction to physics. Topics include electricity and magnetism, sound, optics, and selected topics from modern physics.
Interdisciplinary Option: Forensic Science
Course equivalencies: PHYS112/PHYS112K/PHYS122
Outcomes:
Understand and apply electromagnetism to 2- and 3-dimensional problems in physical and biological sciences

PHYS 112L College Physics Lab II (1 Credit Hour)
Pre-requisites: PHYS 112 or PHYS 122 (may also be taken as corequisite); also prerequisite PHYS 111L; For ESBE, ESCE, and ESEE majors only: Prerequisite or corequisite of PHYS 122
Laboratories cover selected topics in electrical circuits and optics, including DC circuits, resonance in AC circuits, ray optics, and prism and grating spectrometers.
Interdisciplinary Option: Forensic Science
Outcomes:
Understand the connection between theory and experiment for selected topics in elementary electrical circuits and optics; Experience and familiarity with DC power supplies, digital multi-meters, function generators, oscilloscopes, mirrors, lenses, and spectrometers; Ability to correlate simple electronic schematic diagrams with actual circuits

PHYS 121 College Physics I with Calculus Lecture/Discussion (3 Credit Hours)
Co-requisites: MATH 131 or MATH 161
Calculus-based introduction to vectors, kinematics, Newtonian mechanics of translational, rotational, and oscillatory motion, energy and momentum conservation, and thermodynamics.
Interdisciplinary Option: Forensic Science
Outcomes:
Understanding of analytical description of motion and application of conservation laws; develop scientific insight and proficiency in solving representative problems

PHYS 122 College Physics II with Calculus Lecture/Discussion (3 Credit Hours)
Pre-requisites: PHYS 121; Corequisite: MATH 132 or MATH 162
Calculus-based introduction to electricity and magnetism, sound, optics, and selected topics from modern physics.
Interdisciplinary Option: Forensic Science
Course equivalencies: PHYS112/PHYS112K/PHYS122
Outcomes:
Understand and apply electromagnetism to 2- and 3-dimensional problems in physical and biological sciences

PHYS 125 General Physics I Lec/Dis (4 Credit Hours)
Co-requisites: PHYS 125L and MATH 161
This is a calculus-based introductory course that covers Mechanics and Thermodynamics. It is designed for physics majors or minors and dual-degree engineering students.
Interdisciplinary Option: Forensic Science
Outcomes:
Understanding of vectors, forces, Newtonian mechanics related to translational, rotational, and oscillatory motion; thermodynamics

PHYS 125L General Physics Laboratory I (1 Credit Hour)
Co-requisites: PHYS 125
Laboratories cover selected topics in introductory mechanics, including freefall, uniform circular motion, work-energy, collisions, rotational motion, and harmonic motion. Includes a freshmen project.
Interdisciplinary Option: Forensic Science
Outcomes:
Experience and familiarity with basic measuring devices and simple mechanics equipment; Understand measurement errors and their propagation, plotting and interpretation of data, the connection between theory and experiment for selected topics in elementary mechanics

PHYS 126 General Physics II Lec/Dis (3 Credit Hours)
Pre-requisites: PHYS 125; Corequisites: PHYS 126F, PHYS 126L & MATH 162; Department Consent Required
A continuation of PHYS 125, covering Electricity and magnetism, sound, optics.
Interdisciplinary Option: Forensic Science
This course satisfies the Engaged Learning requirement.
Outcomes:
Understanding of electrostatics, magnetostatics, time varying currents, resistive, capacitative and inductive elements, electromagnetic and sound waves, geometrical and wave optics, introductory special relativity

PHYS 126F Freshman Projects (1 Credit Hour)
Pre-requisites: PHYS 111 or 121 (C- or better); Enrollment restricted to PHYS, BPHY, TPAM, and PCSC majors Outcomes: Students should gain a deeper understanding of the material covered in introductory physics and learn about research methods employed by physicists
Under the guidance of a faculty member, students perform research on a physics-related topic through a semester-long project. The project involves development of a proposal, building of experimental apparatus, data collection/analysis, and theoretical calculations.
This course satisfies the Engaged Learning requirement.

PHYS 126L General Physics Laboratory II (1 Credit Hour)
Co-requisites: PHYS 126
Laboratories cover selected topics in electrical circuits and optics, including DC circuits, resonance in AC circuits, ray optics, and prism and grating spectrometers. Includes a freshmen project.
Interdisciplinary Option: Forensic Science
Outcomes:
Experience and familiarity with DC power supplies, digital multimeters, function generators, oscilloscopes, mirrors, lenses, and spectrometers; Ability to correlate simple electronic schematic diagrams with actual circuits; Understand the connection between theory and experiment for selected topics in elementary electrical circuits and optics

PHYS 130 Introduction to Computational Physics (3 Credit Hours)
Pre-requisites: PHYS 121 (C- or better); Corequisite: PHYS 122
This is an introductory computational physics course. The course will cover basic computational skills using Python and common scientific Python packages. We will solve a set of programming exercises that enhances both the understanding of introductory physics (Newton's laws, work, energy, momentum) and physics problem solving skills.
Outcomes:
Students should be able to write a Python program to perform numerical calculations in physics and gain computational skills that would be utilized in upper division physics coursework and research

PHYS 235 Modern Physics (3 Credit Hours)
Pre-requisites: PHYS 122 (C- or better); Corequisites: PHYS 235L and MATH 263; Enrollment is restricted to PHYS, BPHY, TPAM and PCSC majors and PHYS minors
This course covers the Special Theory of Relativity and Introductory Quantum Mechanics.
Outcomes:
Understand the relative nature of space and time; the duality of waves and particles; the microscopic structure of matter and its macroscopic consequences

PHYS 235L Modern Physics Laboratory (1 Credit Hour)
Co-requisites: PHYS 235
Modern physics experiments including electromagnetic waves (microwaves), interferometry, spectroscopy, electron and quantum physics, and solid-state physics.
Outcomes:
Students will gain hands on experience and familiarity with experiments from early modern physics, the ability to use spreadsheets and symbolic algebraic software for problem solving and data interpretation, and experience documenting and reporting results including historical background searches

PHYS 266 Digital Electronics Lab (3 Credit Hours)
Pre-requisites: PHYS 126 and MATH 162
Combinatorial and sequential logic devices, oscillators and timers, microprocessor components, CPU operation, computer architecture and digital/analog conversion.
Course equivalencies: X-PHYS266/COMP266
Outcomes:
Students will gain a working knowledge of digital electronics design and its application to computers, an understanding of CPU design and operation and the ability to document and report experimental results

PHYS 301 Mathematical Methods in Physics (3 Credit Hours)
Pre-requisites: PHYS 235; Corequisite: MATH 264
Lecture and computer laboratory; Mathematical and computer methods in physics and engineering; Topics include vector calculus, functions of a complex variable, phasors, Fourier analysis, linear transformations, matrices, first and second order differential equations, special functions, numerical and symbolic computer applications.
Course equivalencies: X-PHYS301/PHYS271/MATH355

PHYS 303 Electronics I (3 Credit Hours)
Pre-requisites: PHYS 122 (C- or better); Corequisite: PHYS 303L; Enrollment restricted to PHYS, BPHY, TPAM, PCSC majors and PHYS minors
Study of analog electronics, including direct and alternating circuit analysis, resonant circuits, diodes, transistors, amplifiers, operational amplifiers, noise, feedback and oscillators.
Outcomes:
Students will understand and manipulate equations and concepts, and gain experience with electronics equipment, plotting and interpretation of data, synthesizing and writing laboratory results, and the formal verbal presentation of results

PHYS 303L Electronics Laboratory (1 Credit Hour)
Pre-requisites: PHYS 122 (C- or better); Corequisite: PHYS 303; Enrollment restricted to PHYS, BPHY, TPAM, PCSC majors and PHYS minors
Students will learn to use various electronic components, instruments, techniques, and applications. This course is the lab component for PHYS 303.
Outcomes:
Students should get a deeper understanding of the material covered in PHYS 303 (Analog and digital electronics) by experimentally verifying many of the concepts covered in that course; Students will also learn to recognize various components and develop confidence in using them

PHYS 310 Optics (3 Credit Hours)
Pre-requisites: PHYS 235 (C- or better); Corequisite: PHYS 310L; Enrollment restricted to PHYS, BPHY, TPAM, PCSC majors and PHYS minors
The course covers electromagnetic nature of light, geometrical optics, polarization, Fresnel relations, interference, Fraunhofer and Fresnel diffraction, Fourier optics, lasers, and holography.
Outcomes:
Students will gain knowledge of the principles of classical and modern optics, the role of optics in the development of quantum mechanics and its applications to modern technology

PHYS 310L Optics Lab (1 Credit Hour)
Pre-requisites: PHYS 235 (C- or better); Corequisite: PHYS 310; Enrollment restricted to PHYS, BPHY, TPAM, PCSC majors and PHYS minors
Students will learn to use various optical components, instruments, techniques, and applications. This course is the lab component to PHYS 310.
Outcomes:
Students should get a deeper understanding of the material covered in PHYS 310 (Geometrical and wave optics) by experimentally verifying many of the concepts covered in that course; Students will also learn to recognize various components and develop confidence in using them

PHYS 314 Theoretical Mechanics I (3 Credit Hours)
Pre-requisites: PHYS 122 (C- or better); Corequisites: MATH 264 and PHYS 301 Outcomes: Students will gain understanding of analytical and numerical methods of mechanics, understanding of principles in dynamics, and experience in applying formalisms of Lagrange and Hamilton to mechanics in preparation for other areas of physics and engineering
Newtonian particle dynamics, conservation theorems, oscillations, gravitation, generalized coordinates, Lagrange and Hamilton formalisms.

PHYS 315 Theoretical Mechanics II (3 Credit Hours)
Pre-requisites: PHYS 314
This course is a continuation of PHYS 314 and covers dynamics of system of particles, moving coordinates, rigid body dynamics, systems of oscillators, motion in a central force field, relativity.
Outcomes:
Students will gain understanding of analytical and numerical methods of mechanics, and of the laws of dynamics and their applications

PHYS 328 Thermal Physical & Statistical Mechanics (3 Credit Hours)
Pre-requisites: PHYS 235 and PHYS 301
This course examines the fundamental concepts of temperature, entropy, and thermodynamic equilibrium, the first and second law, engines, the third law, and Boltzmann, Fermi-Dirac, and Bose-Einstein statistics.
Outcomes:
Students will learn to compare thermodynamical versus statistical characterizations of macroscopic systems with applications ranging from analyzing Fermi gases and black body radiation to information theory

PHYS 338 Advanced Physics Laboratory (2 Credit Hours)
Pre-requisites: PHYS 301 and PHYS 314; Restricted to PHYS, TPAM, PCSC, and BPHY majors
Lab course with advanced experiments in mechanics, biophysics, electromagnetism, quantum mechanics, solid state, and particle physics. Students will receive training in data analysis methods, data acquisition systems, signal processing, and 3D fabrication. Students will work in teams on a final independent project.
This course satisfies the Engaged Learning requirement.
Outcomes:
Students will gain an understanding of experiment design, data analysis, and error estimation in the context of investigating physical principles and using different instrumentation

PHYS 351 Electricity and Magnetism I (3 Credit Hours)
Pre-requisites: PHYS 235, 301 & MATH 264
Electrostatics and magnetostatics in a vacuum as well as in linear media, and an introduction to electrodynamics.
Outcomes:
Students will gain an understanding of mathematical methods of electrodynamics, of static electricity and magnetism including Coulomb's, Gauss', Ampere's, and Faraday's laws and their applications, and of solutions of Laplace's and Maxwell's equations

PHYS 352 Electricity and Magnetism II (3 Credit Hours)
Pre-requisites: PHYS 351
Introduction to electrodynamics and the special theory of relativity.
Outcomes:
Students will gain an understanding of electromagnetic field energy and momentum, Maxwell's equations and their applications including electromagnetic radiation and emission, involving retarded potentials and Lorentz covariance

PHYS 361 Quantum Mechanics I (3 Credit Hours)
Pre-requisites: PHYS 235 & PHYS 301
Non-relativistic quantum mechanics.
Outcomes:
Students will understand and use separation of variables, finite polynomials, and matrix algebra to solve the Schroedinger equation, explain microscopic structure of matter, and describe philosophical interpretations of quantum mechanics

PHYS 371 Biophysics (3 Credit Hours)
Pre-requisites: For Biology and Molecular Biology majors: BIOL 251, (PHYS 112 or 122), and (MATH 132 or 162); For all other majors: PHYS 235 and BIOL 101
An upper-level course in biological physics focused on a quantitative description of the physical processes driving molecular and cellular processes with an emphasis on experiment design and analysis.
Outcomes:
Students will understand how to apply physical principles and probabilistic analysis toward the study of biological phenomena at molecular and cellular levels

PHYS 380 Special Topics in Physics (1-3 Credit Hours)
Pre-requisites: Instructor's permission
This variable (1-3) credit enrichment course introduces students to a topic not generally covered in other courses. This course can be repeated.
Outcomes:
Students will understand the material of the course and develop an ability to apply the knowledge gained to other contexts

PHYS 381 Special Topics in Physics (1-3 Credit Hours)
Pre-requisites: Instructor's permission
This variable (1-3) credit enrichment course introduces students to a topic not generally covered in other courses. This course can be repeated.
Outcomes:
Students understand the material of the course and develop an ability to apply the knowledge gained to other contexts

PHYS 391 Research (1-12 Credit Hours)
Research in physics or an associated field. This is a variable credit course and can be repeated.
This course satisfies the Engaged Learning requirement.
Course equivalencies: PHYS391 / PHYS385 / PHYS386
Outcomes:
Under the guidance of a faculty member, students study and understand research methods employed by physicists and gain a deeper understanding of a particular area of physics

PHYS 394 Argonne Lab Research (3 Credit Hours)
Pre-requisites: Chairperson's permission and acceptance by appropriate program
Study and research at the Argonne National Laboratory. Only those students who are accepted into the Argonne National Laboratory's student program (or similar programs elsewhere) are eligible. No tuition is charged.
Outcomes:
Students will work with a research group at Argonne or other laboratory to understand research methods employed by physicists and get a deeper understanding of a particular area of physics

PHYS 395 Argonne Lab Research (3 Credit Hours)
Pre-requisites: Chairperson's permission and acceptance by appropriate program
Study and research at the Argonne National Laboratory. Only those students who are accepted into the Argonne National Laboratory's student program (or similar programs elsewhere) are eligible. No tuition is charged.
Outcomes:
Students will work with a research group at Argonne or other laboratory to understand research methods employed by physicists and get a deeper understanding of a particular area of physics

PHYS 473 Energy and Sustainability (4 Credit Hours)
A course that investigates the role of energy in physical systems such as thermosphere and also various sources of energy.
Outcomes:
Ability to apply laws of thermodynamics to physical systems and apply material to high school science class

PHYS 495 AP Physics Workshop (3 Credit Hours)
This graduate level course offers pedagogical content knowledge training for in-service high school teachers preparing to teach AP Physics.