PHYSICS

FACULTY

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PHYSICS STUDIES

LEARNING GOALS:

- Students will demonstrate analytic thinking in physics.
- Students will develop and demonstrate effective written and oral communication skills in physics.

Requirements for the Major in Physics. Susquehanna offers both Bachelor of Arts and Bachelor of Science programs in physics. The department strongly recommends the Bachelor of Science program for students interested in graduate school or industrial employment. Majors can pursue an interdisciplinary interest, such as biophysics, by carefully choosing electives. The Bachelor of Arts is a good choice for students preparing to teach secondary school.

Double-counting restrictions: students majoring in Physics cannot double-count courses toward a Chemical Physics major.

The Bachelor of Science degree requires the following courses completed with grades of C- or better:

32 semester hours in physics, including:
Introductory Physics I – choose from: PHYS-202, PHYS-203 or PHYS-204
Introductory Physics II – choose from: PHYS-205 or PHYS-206
PHYS-301 and 302

20 semester hours in mathematics
MATH 111-Calculus I, MATH-112 Calculus II, MATH-201 Linear Algebra, MATH-211 Multivariate Calculus and MATH-353 Differential Equations

12 4 semester hours from CHEM-101, CHEM-103, or CHEM-111, and
8 additional hours in approved biology, chemistry, earth and environmental sciences, mathematics, or computer science courses

The Bachelor of Arts degree requires the following courses completed with grades of C- or better:

32 semester hours in physics, including:
Introductory Physics I – choose from: PHYS-202, PHYS-203 or PHYS-204
Introductory Physics II – choose from: PHYS-205 or PHYS-206
PHYS-301 and PHYS-302

16 semester hours in mathematics courses consisting of:
MATH-111 Calculus I, MATH-112 Calculus II, MATH-201 Linear Algebra, MATH-211 Multivariable Calculus and MATH-353 Differential Equations

12 4 semester hours in General Chemistry I (CHEM-101, CHEM-103, or CHEM-111), and
8 additional hours in approved biology, chemistry, earth and environmental sciences, mathematics, or computer science courses

Minor in Physics. Students consult with their major adviser and a physics faculty member to design minor programs. The minor requires with grades of C- or better 18 semester hours in physics, including Introductory Physics I (PHYS-202, -203, or 204) and Introductory Physics II (PHYS-205 or -206). Suggested additional courses for computer science majors are PHYS-101 and PHYS-303. Suggestions for mathematics majors are PHYS-301 and PHYS-302 and PHYS-401.

Double-counting restriction: students majoring in chemical physics may not double-count courses towards a chemistry or physics minor.

Honors. The departmental honors program recognizes superior work in the physics courses. To enter the program, majors must do the following:

- Write a request to the department one month before senior registration,
- Maintain a cumulative 3.00 GPA and a 3.25 GPA in physics, and
- Demonstrate scholarly work in the field by completing at least four semester hours of PHYS-550 Research Physics or PHYS-500 Independent Study.

Teaching Certification. Coursework required by the state of Pennsylvania for admission to the teacher certification program includes successful completion of ENGL-100 Writing and Thinking or equivalent course, at least 3 semester hours in British or American literature, at least 6 semester hours of mathematics coursework (or other courses which satisfy the Central Curriculum Analytical Thought requirement), and at least one 40-hour externship.

Education course requirements for secondary education are EDUC-101 Introduction to Education and Society, EDUC-102 Historical and Philosophical Foundations of Education, EDUC-250 Educational Psychology, EDUC-260 Introduction to Special Education, EDUC-270 Instruction of Exceptional Students, EDUC-330 Technology in Education, EDUC-350 English Language Learners: Theory and Instruction, EDUC-380 Instructional Design, EDUC- 424 Methods of Curriculum, Instruction, and Assessment in Teaching Science, EDUC-479 Principles of Learning and Teaching in Secondary Education, EDUC-483 Differentiated Instruction and Classroom Management in Secondary Education, and the EDUC-500 Student Teaching package (EDUC-501, EDUC-502, EDUC-503, and EDUC-600).

In addition, secondary education physics students complete all of the usual requirements for the physics major.

Summer Research. The department encourages physics students to apply for summer research grants. Recent students have been accepted at the University of Alaska, The Pennsylvania State University and Brookhaven National Laboratory. Academic year internship and research opportunities are also valuable, but more difficult to arrange.

PHYSICS COURSES

PHYS-100 Introductory Astronomy

A general overview of astronomy, covering ancient and modern views of the solar system and beyond, out to the farthest reaches of the observable universe. The course focuses on building a basic understanding of the physical laws that dictate celestial motions and the processes behind the birth, evolution, and death of objects within the universe, as well as the universe itself. It is a primary goal to demonstrate how the scientific method works and how science builds a testable, coherent understanding of natural phenomena. Includes a laboratory component where students gain hands-on experience and are actively engaged in the process of scientific inquiry. 4 SH. 3 lecture hours, 3 laboratory hours. CC: Scientific Explanations.

PHYS-101 Introduction to Digital and Analog Electronics

The fundamental principles of digital and analog electronics are introduced, while emphasizing applications. Guided laboratory investigations are designed to develop an understanding of common electronic devices, as well as scientific instrumentation. 4 SH. 3 lecture hours, 3 laboratory hours.

PHYS-105 Independent Thought and Explorations in Physics

This course serves as an introduction to how physics developed in the last couple of centuries. The objective of this course is to give the foundations for understanding the cornerstones of physics and a general understanding of the concepts of science. The students will learn how to approach physics problems without a provided outline, and they will be expected to find their own solutions to the assigned problems with subtle but available guidance. The instructors will be on hand for help but will not provide direct solutions to the posed problems. The students will need to work actively and independently at the material. However, they will be working in teams of two or three people, where collaboration between team members is encouraged. All resources will be provided for the students to successfully complete the assigned task. The posed questions will be common experiences in physics that people generally deal with every day but don't really understand the concepts behind and, in most cases, don't even know that they were issues 200 years ago. There are no prerequisites to this course, just the interest to find out about the world in which we live. 4 SH. CC: Scientific Explanations, Writing Intensive.

PHYS-108 Physics of Music

A study of the acoustics of music. Explores the fundamental scientific principles underlying the physical aspects of music-what music is, how music is produced, how we hear it and how it is transmitted to a listener. Prerequisites: Familiarity with basic music terminology, music performance experience, a fascination with music or instructor's permission. 4 SH. 3 lecture hours, 3 laboratory hours. CC: Scientific Explanations.

PHYS-202 Introductory Physics I (Algebra-based)

Introduces the macroscopic phenomena of the physical universe. Applies concepts of force, work, energy and momentum to waves, fluids and thermodynamics. Laboratory stresses methods of acquiring data, computer data processing and analyzing the causes of errors. Uses high school algebra and trigonometry as the language. 4 SH. CC: Scientific Explanations.

PHYS-203 Introductory Physics I (Calculus-based)

Introduces the macroscopic phenomena of the physical universe. Applies concepts of force, work, energy and momentum to waves, fluids and thermodynamics. Laboratory stresses methods of acquiring data, computer data processing and analyzing the causes of errors. Uses algebra, trigonometry and calculus as the language. Prerequisite: MATH-111 recommended but not required. 4 SH. CC: Scientific Explanations.

PHYS-204 Introductory Physics I (Calculus-based)

Introduces the macroscopic phenomena of the physical universe. Applies concepts of force, work, energy and momentum to waves, fluids and thermodynamics. Laboratory stresses methods of acquiring data, computer data processing and analyzing the causes of errors. Uses algebra, trigonometry and calculus as the language. Prerequisite: MATH-111 recommended but not required. 4 SH. 3 lecture hours, 3 laboratory hours. CC: Scientific Explanations.

PHYS-205 Introductory Physics II (Algebra-based)

Continuation of Introductory Physics I. Introduces and applies the concept of a field to gravitation, electricity, magnetism, circuits, optics and the atom. Laboratory stresses electronic data acquisition and independent discovery of physical principles. Uses high school algebra and trigonometry as the language. Prerequisites: Introductory Physics I (PHYS-202, -203, or -204), and MATH-111 (recommended but not required). 4 SH. 3 lecture hours, 3 laboratory hours.

PHYS-206 Introductory Physics II (Calculus-based)

Continuation of Introductory Physics I. Introduces and applies the concept of a field to gravitation, electricity, magnetism, circuits, optics and the atom. Laboratory stresses electronic data acquisition and independent discovery of physical principles. Uses algebra, trigonometry and calculus as the language. Prerequisites: Introductory Physics I (PHYS-202, -203, or -204), and MATH-111. 4 SH.

PHYS-301 Newtonian Mechanics

Studies particle and rigid body motion in two and three dimensions. Uses vectors and differential equations. Introduces Lagrangian and Hamiltonian approaches to mechanics. 4 SH. 3 lecture hours, 3 laboratory hours.

PHYS-302 Electric and Magnetic Fields

Studies the concepts of fields. Uses mathematics of multivariable functions and vectors. Covers Maxwell's equations and their use in describing electric and magnetic waves. 4 SH. 3 lecture hours, 3 laboratory hours.

PHYS-303 Solid State Physics

Introduces the physics of crystalline materials. Discusses lattice dynamics, electron behavior in metals, semiconductors, and dielectric and magnetic properties. Laboratory builds on concepts introduced in analog electronics. Studies computer-to-instrument interfacing, emphasizing signal processing, measurement and control of external processing. Prerequisites: PHYS-101 and Introductory Physics II. 4 SH. 3 lecture hours, 3 laboratory hours.

PHYS-304 Classical and Modern Optics

Geometrical optics, including reflection, refraction, thick and thin lenses, stops, mirrors, aberrations, and ray tracing. Covers physical optics, including interference, diffraction, polarization and optical activity. Discusses quantum optics as they apply to lasers, holography and magneto/electro-optics. 4 SH. 3 lecture hours, 3 laboratory hours.

PHYS-305 Topics in Physics

Selected topics not covered in other courses. May include statistical mechanics, nuclear physics, heat and thermodynamics, material science, and planetary astronomy. 4 SH. 3 lecture hours, 3 laboratory hours.

PHYS-306 Modern Physics

This course serves as an introduction to the physics discovered near the beginning of the 20th century and beyond. Topics include special relativity, the wave nature of matter, the particle nature of light, the Bohr atom, non-relativistic quantum mechanics, the hydrogen atom, molecular structure, nuclear structure and nuclear applications. Additional topics may be covered depending on professor/student interests. A number of seminal experiments are performed and studied, which aids in putting the introduced ideas into both scientific and historical context. Prerequisites: MATH-112 and Introductory Physics II. 4 SH. 3 lecture hours, 3 laboratory hours. CC: Writing Intensive.

PHYS-401 Electromagnetic and Mechanical Waves

Optical, mechanical and electromagnetic wave phenomena in one, two and three dimensions. Covers free space, fluids and solids. Begins with Maxwell's equations. 4 SH. 3 lecture hours, 3 laboratory hours.

PHYS-402 Quantum Mechanics

Covers history of quantum mechanics leading to the Bohr Atom. Also focuses on mathematical treatment of quantum mechanics fundamentals. Includes Schrodinger formulation, approximation methods, symmetry and angular momentum. Covers applications to simple atoms and molecules. 4 SH. 3 lecture hours, 3 laboratory hours. CC: Writing Intensive.

PHYS-404 Thermodynamics and Statistical Methods

This course covers the laws of thermodynamics, thermodynamic functions, heat engines, kinetic theory, and the statistical mechanics of classical and quantum-mechanical systems. Prerequisites: Introductory Physics I and II and PHYS-306. 4 SH. 3 lecture hours, 3 laboratory hours.

PHYS-405 Mathematical Physics

This course focuses on developing mathematical techniques for solving advanced problems in physics including thermodynamics, optics, classical mechanics, and quantum mechanics. Mathematical methods will be introduced and examined from differential equations, calculus of variations, and advanced linear algebra. Requirements: Sophomore standing or higher. Prerequisites: MATH 201, MATH-112, Intro Physics II (PHYS-205 or -206) and sophomore standing. 4 SH. CC: Interdisciplinary.

PHYS-500 Independent Study

In-depth focus on a selected topic of student interest. Variable semester hours.

PHYS-530 Physics Internship

Work for government agency or industry under supervision of a physicist or engineer. Variable semester hours.

PHYS-550 Physics Research

Individual or group research in experimental or theoretical physics under the direction of a principal investigator. Prerequisites: Permission of adviser and principal investigator. To meet the capstone requirement, a minimum of two semester hours is required. Variable semester hours. Capstone.