PHYSICS

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FUSION A periodic newsletter about the sciences at Albright College

The Physics Department offers a flexible course of study that prepares students for success in a wide range of technically related fields. Opportunities after graduation include graduate study, industrial research and development, engineering, teaching, technical management and software development. Students receive excellent education in the fundamentals of physics, with special emphasis on strong mathematical skills, advanced laboratory training and collaborative student-faculty research. Students may choose from three major tracks of study:

- General Physics, in preparation for graduate study in physics or for work in industry
- Optical Physics, in preparation for a career in industrial research and development, engineering, or for graduate study in physics/optics
- Secondary education certification in physics, in preparation for certification by the state of Pennsylvania as a high school physics teacher

Physics concentrators interested in graduate programs are encouraged to take courses beyond the basic requirements. Since requirements for graduate programs vary, students are encouraged to seek advice from faculty members in the department. Students interested in pursuing teacher certification in physics must consult the chair of the Education Department regarding specific requirements for the program.

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Concentration in Physics

Requirements for the General Physics track:

First Year: • PHY 201, 202 • MAT 131, 132

Second Year: • PHY 203, 251, 262 • MAT 233, 334 • IDS 255

Third Year: • PHY 340, 351

Fourth Year: • PHY/OPT 431, 441, 490

Requirements for the Optical Physics track:

First Year: • PHY 201, 202 • MAT 131, 132

Second Year: • PHY 203 • OPT 241, 261 • MAT 233, 334

Third Year: • PHY 351, 441 • OPT 324 • IDS 255

Fourth Year: • OPT 431 • One from OPT 101, 362, 400, 442, PHY 262, 490 • PHY 490

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Teacher Certification Requirements

The Physics Education program provides a sound foundation in physics combined with secondary education courses. Graduates of the program are certified for secondary teaching in physics, meeting all Pennsylvania state requirements for certification. Students interested in teacher certification in physics should consult Education Department faculty for specific requirements to meet both college and state guidelines.

Requirements:

• PHY 201, 202, 203 • PHY 251, 262 • PHY 340, 351 • PHY/OPT 431, PHY 441, 490 • IDS 255 • MAT 131, 132, 233, 334 • ENG 102, 235 • PSY 100 • EDU 214, 230, 301, 303, 345, 346, 350, 403, 407, and 408 • SPE 215

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Co-Concentration in Physics

Requirements

- PHY 201, 202, 203
- PHY 340, 351
- PHY 441
- MAT 131, 132, 233
- IDS 255

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Co-Concentrations in Optical Physics

Requirements

• PHY 201, 202 • OPT 241, 261 • OPT 431 • Two from OPT 324, 362, 400, 442, PHY 351, 441

A student may combine optics with any other concentration. However, the high level of computational background required for most optics courses favors combining with mathematics.

The mathematics courses required are:

• MAT 131, 132 • MAT 233 • MAT 250, 334, 435, 438 • MAT 491

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Courses

IDS 255 Mathematics for Chemistry and Physics The physical applications of analytic and numerical methods are studied in such topics as differential equations, Fourier series, Laplace transforms, matrices, complex numbers and vectors. Prerequisite: MAT 132

PHY 102 Modern Astronomy This is an exposition of a wide variety of topics in modern astronomy including celestial motion, stellar spectra and evolution, galaxies, solar systems and cosmology. Three hours of lecture and three-hour laboratory per week.

PHY/OPT 101 Modern Optics and Technology This course is a survey of basic properties of light, diffraction, holography, interference, imaging and applications to modern technology including telescopes, lasers, CDs, fiber optics and optical data storage. The course satisfies the general studies lab science requirement. Three hours of lecture and three-hour laboratory per week.

PHY 184 Concepts of Physical Science This is a course particularly focused on the needs of teachers in elementary and middle schools. The main focus is to have students learn by doing, that is, they will, in support of the lectures, carry out activities and demonstrations in various areas of the physical sciences. For each concept presented in the lecture class the students will carry out

quantitative activities, which demonstrate the validity of the concept. They are required to keep a careful record of not only lecture notes but of their activities. Thus, at the end of the course each student will have produced a reference notebook of lesson plans, covering both theory and supporting activities/demonstrations, which are invaluable in teaching physical science in grades K through eight. General studies natural science credit.

PHY 201 General Physics I This is an introductory course in general physics including mechanics, heat, sound, light, electricity, magnetism and modern physics. Calculus methods are used. Three hours of lecture and three-hour laboratory per week. Prerequisite: MAT 131 (may be taken concurrently with Physics Department permission)

PHY 202 General Physics II Continuation of 201. Three hours of lecture and three-hour laboratory per week. Prerequisites: PHY 201 and MAT 132 (may be taken concurrently with Physics Department permission)

PHY 203 General Physics III An introduction to the fundamentals of physics: thermodynamics, kinetic gas theory, and Quantum theory of photons, atoms, nuclei and solids. Prerequisite: PHY 202

PHY 251 Thermodynamics and Statistical Physics This course explores thermodynamic systems and variables; the laws of thermodynamics; thermodynamic potentials and applications; ideal and real gas relations; changes of phase; introduction to probability theory; elementary kinetic theory of gases; micro and macro-states of simple quantum-mechanical systems; Fermi-Dirac, Bose-Einstein and Maxwell-Boltzmann statistics. Four hours of lecture per week.

PHY 262 Electronics This course is an introduction to electronic components and circuits, including power supplies, amplifiers and digital logic circuits, and the integration of electronics with software. Prerequisite: PHY 202, MAT 131

PHY 301 Mathematical Physics I This course covers a variety of mathematical tools needed in upper-level physics courses. The focus is on the applications of mathematics to interesting physical situations. Topics covered may include vector and matrix algebra, series expansion, calculus techniques in physics, vector calculus, ordinary and partial differential equations, complex numbers and probability in physics. Prerequisite: MAT 132 or permission of the instructor

PHY 302 Mathematical Physics II This course is a continuation of PHY 301 and covers a variety of mathematical tools needed in upper-level physics courses. Prerequisite: MAT 132 or permission of the instructor

PHY 340 Classical Mechanics This course examines fundamentals of Newtonian mechanics; conservation theorems; central forces; motion in non-inertial frames; rigid-body motion; and Lagrange's and Hamilton's equations. Four hours of lecture per week.

PHY 351 Electromagnetism I This course looks at electrostatics and magnetostatics in vacuum and in material media; Maxwell's equations; energy and momentum in the electromagnetic field; electromagnetic waves; and special relativity. Four hours of lecture per week.

PHY 391 Selected Topics in Physics Topics are determined by the needs of the students and the availability of faculty. Some possible topics are advanced mathematical physics, electromagnetism II, modeling and simulation in physics.

PHY 431 Advanced Physics Laboratory I This is an introduction to the techniques of experimental research in the areas of electronics, electromagnetism and modern physics. Measurement technique and error analysis are emphasized. Two three-hour lab periods each week.

PHY 441 Quantum Physics I This course is an introduction to non-relativistic quantum mechanics; wave functions, amplitudes and probabilities; the superposition of quantum states; and the Heisenberg uncertainty principle. It also explores time evolution including: the Schroedinger equation, stationary states, and two-state systems, and motion in one-dimensional potentials including: tunneling, particle in a box and harmonic oscillator. Four hours of lecture per week.

PHY 490 Senior Seminar in Physics This is a seminar specifically designed for students admitted to the department's honors program. Topics are determined by instructor.

PHY 491 Selected Topics in Physics and Optics Topics are determined by the needs of the students and availability of faculty. Some possible topics are Quantum Physics II, Advanced Lab II and topics dealing with current trends in physics and optics.

OPT 241 Geometrical Optics This course studies optical instruments and their use, including first-order Gaussian optics and thin-lens system layout. Lectures and laboratory exercises examine photometrics theory applied to optical systems such as the eye, magnifier and microscope, matrix optics and the

nature of Seidel aberrations. Three hours of lecture and three-hour laboratory per week. Prerequisite: MAT 131

OPT 261 Wave Optics This course covers complex representation of waves; scalar diffraction theory; Fresnel and Fraunhofer diffraction and application to measurement; diffraction and image formation; optical transfer function; coherent optical systems, optical data processing and holography. Three hours of lecture and three-hour laboratory per week.

OPT 324 Lasers and Applications This course includes fundamentals and applications of laser systems, such as optical amplification, cavity design, beam propagation and modulation. Emphasis is placed on developing the basic principles needed to design new systems, as well as an understanding of the operation of those currently in use. Prerequisites: OPT 261 and 323, MAT 334 recommended

OPT 362 Electromagnetic Theory This course explores vector analysis; Maxwell's equations, energy flow in electromagnetic fields, dipole radiation from Lorentz atoms, partially polarized radiation, spectral line broadening, dispersion, reflection and transmission, crystal optics, electro-optics and quantum optics. Prerequisites: PHY 202, MAT 233, and MAT 334

OPT 400 Applied Optics Application of optics to current technology in optics, covering topics such as advanced detection systems, semiconductor optoelectonics and optical system performance specification. Prerequisites: OPT 261, 323 and 324 (may be taken concurrently)

OPT 431 Advanced Optics Laboratory I Intensive project-based laboratory course with experiments on optical imaging systems, testing of optical instruments, diffraction, interference, holography, lasers and detectors. Two three-hour lab periods per week.

OPT 442 Quantum Theory of Optics This course is an introduction to quantum mechanics in the context of modern optics and optical technology. Wave mechanics applied to electrons in crystals and in quantum wells are discussed. Other topics include: absorption and emission in semiconductors and the optical properties of materials; Shrodinger equation; potential wells; barriers; electron in a periodic potential; energy bands; and Fermi statistics. Prerequisites: PHY 202, 255

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