DEPARTMENT OF PHYSICS AND ENGINEERING
College of the Sciences and Mathematics

Overview

127 Merion Science Center
610-436-2497
Department of Physics and Engineering (http://www.wcupa.edu/physics)
Anthony J. Nicastro (anicastro@wcupa.edu), Chairperson
Anil K. Kandalam (akandalam@wcupa.edu), Assistant Chairperson

The Department of Physics and Engineering offers three undergraduate degree programs:

- **The B.S. in Physics** is designed as preparation for graduate school or careers in government or industry. The curriculum includes a strong foundation in mathematics and the humanities. A wide choice of electives in the program provides the flexibility to develop a minor in a related area of interest.

- **The B.S. in Education in Physics** provides a solid background in physics, mathematics, and related sciences for a teaching career at the secondary level and leads to certification to teach physics in the public schools of Pennsylvania.

- **The B.S. in Physics/B.S. in Engineering** is a cooperative, dual-degree, five-year engineering program with The Pennsylvania State University at University Park, Philadelphia University, Columbia University, and Case Western Reserve University.

Scholarships/Awards

The Robert M. Brown Endowed Scholarship for Physics was established in 1997 by Mr. Robert M. Brown. Partial tuition scholarships are awarded annually on a competitive basis to students in the physics program.

In addition, the Dr. Michael F. Martens Award, established by the West Chester Lions Club, is given annually to students who have shown outstanding achievement in physics. Awards are determined by the department’s faculty. Other awards include the Benjamin Faber Award in physics and mathematics, and the Diane and Roger Casagrande Scholarship for students in pre-engineering or communication studies. In addition to these, the Physics/Philosophy Prize is awarded to a student who has made a notable contribution on a topic related to the interface of science and theology. These awards are granted annually at an induction ceremony for new members of the West Chester University Chapter of Sigma Pi Sigma, the national physics honor society.

The physics programs can also be found on the Internet: http://www.wcupa.edu/physics.

Cooperative Physics/Engineering Programs

The Department of Physics and Engineering offers multiple 3+2 Physics-Engineering Programs. These are dual-degree programs in which a student typically spends three years at West Chester and two years at one of our partner institutions, after which a student holds a B.S. in Physics from West Chester University and a bachelor’s degree in engineering from the partner institution. Currently, WCU has agreements with Penn State University (main campus), Thomas Jefferson University, Columbia University, and Case Western Reserve University.

Admission to one of the affiliate engineering institutions is contingent upon a recommendation from the Department of Physics and Engineering and the student having maintained the overall average for the specific engineering program. Check with an advisor in Physics for updates on program availability and GPA requirements. Transfer students and students who have completed a bachelor’s degree are not eligible for the Penn State program.

Programs

Majors in Physics and Engineering
- **B.S. in Physics** (http://catalog.wcupa.edu/undergraduate/sciences-mathematics/physics-engineering/physics-bs)
- **B.S.Ed. in Physics** (http://catalog.wcupa.edu/undergraduate/sciences-mathematics/physics-engineering/physics-bsed)
- **B.S. in Physics/B.S. in Engineering** (http://catalog.wcupa.edu/undergraduate/sciences-mathematics/physics-engineering/physics-bs-engineering-bs)

Minors in Physics and Engineering
- **Physics** (http://catalog.wcupa.edu/undergraduate/sciences-mathematics/physics-engineering/physics-minor)

Policies

- See undergraduate admissions information. (http://catalog.wcupa.edu/general-information/admissions-enrollment/undergraduate-admissions)
- See academic policies. (http://catalog.wcupa.edu/undergraduate/academic-policies-procedures)

All undergraduate students are held to the academic policies and procedures outlined in the undergraduate catalog. Students are encouraged to review departmental handbooks for program tips, suggested course sequences, and explanations of procedures. When applicable, additional policies for specific department programs may be listed below.

Admission Policy for the Department of Physics and Engineering Programs

For admission to the physics program, most students should have completed, in addition to the general University requirements, one year each of high school chemistry and physics, and a minimum of three years of mathematics, including algebra and trigonometry, and be prepared to start calculus. Any student with a deficiency must complete WRT 120 and MAT 161 with grades of C- or better to be admitted to the program.

Transfer Policy for the Department of Physics and Engineering Programs

Transfer students must take a minimum of six credits at West Chester at the 250 level or above. A 2.0 GPA or better must be maintained for all physics courses.

Advanced Placement Policy for the Department of Physics and Engineering Programs

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<th>AP Test</th>
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<td>Physics B</td>
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Faculty

Professors

Kevin B. Aptowicz (kaptowicz@wcupa.edu) (2005)
Chairperson, Physics and Engineering
B.S., Columbia University; M.S., University of Colorado; Ph.D., Yale University

Anthony J. Nicastro (anicastro@wcupa.edu) (1990)
Chairperson, Physics and Engineering
**B.S., B.S., M.S., Ph.D., University of Delaware**

**Associate Professors**

Anil Kumar Kandalam (akandalam@wcupa.edu) (2012)
Assistant Chairperson, Physics and Engineering
B.S., Osmania University; M.S.c., University of Hyderabad; Ph.D., Michigan Technological University

Shawn Pfeil (spfeil@wcupa.edu) (2012)
B.S., University of California, San Diego; M.A., Ph.D., University of California, Santa Barbara

Jeffrey Sudol (jsudol@wcupa.edu) (2007)
B.A., Macalester College; Ph.D., University of Wyoming

Robert J. Thornton (rthornton@wcupa.edu) (2008)
B.S., Lehigh University; Ph.D., University of Hawaii

Matthew M. Waite (mwaite@wcupa.edu) (2001)
B.A., Gettysburg College; Ph.D., University of Delaware

**Assitant Professors**

Tianran Chen (tchen@wcupa.edu) (2014)
B.S., Zhejiang University; Ph.D., University of Minnesota

Brandon Mitchell (bmitchell@wcupa.edu) (2016)
B.S., SUNY Fredonia; M.S., Ph.D., Lehigh University

Ian A. Morrison (imorrison@wcupa.edu) (2016)
A.B., Bowdoin College; M.S., Ph.D., University of California, Santa Barbara

Michelle Caler (mcaler@wcupa.edu) (2016)
Ph.D., University of Pennsylvania

**Courses**

**PHY**

**PHY 100. Elements of Physical Science. 3 Credits.**
A study of motion, energy, light, and some aspects of modern physics.
Gen Ed Attribute: Science Distributive Requirement.

Typically offered in Fall & Spring.

**PHY 105. Structure of the Universe. 3 Credits.**
A survey of phenomena and objects in the universe from the very smallest distance scales to the grandest in the cosmos. Includes a historical consideration of the developments of modern theories of the physical world.
Gen Ed Attribute: Science Distributive Requirement.

Typically offered in Fall & Spring.

**PHY 115. Engineering Graphics I. 1 Credit.**
Use and preparation of engineering drawings. Topics include the use of instruments, linework, geometric construction, lettering, four types of projections, dimensioning, and sections.
Typically offered in Fall.

**PHY 116. Engineering Graphics II. 1 Credit.**
A continuation of PHY 115, to include topics such as layout, detail, and assembly drawings, developments, auxiliary drawings, various types of drafting, machine tool processes, and computer drafting.
Pre / Co requisites: PHY 116 requires prerequisite of PHY 115.
Typically offered in Spring.

**PHY 123. Food, Fire, and Physics: The Science of Cooking. 3 Credits.**
An exploration of food and cooking from a physical science perspective. Principles of soft matter physics (e.g. phase diagram, intermolecular forces, rheology, diffusion, self-assembly, polymer physics) are discussed and used to gain insight into food and cooking.
Gen Ed Attribute: Science Distributive Requirement.

Typically offered in Spring.

**PHY 125. Theology and Science: Enemies or Partners. 3 Credits.**
An inquiry into the relationship of theology to the natural sciences. Team taught by both a physicist and a philosopher, the course investigates how ideas of God have been affected by advances in physics and biology.

Typically offered in Spring.

Cross listed courses PHI 125, PHY 125.

**PHY 130. General Physics I. 4 Credits.**
LEC (3), LAB (2), DIS (1)
An introductory, noncalculus, physics course. Mechanics of solids and fluids, wave motion, heat and temperature, thermodynamics, and kinetic theory.
Gen Ed Attribute: Science Distributive Requirement.

Typically offered in Fall, Spring & Summer.

**PHY 140. General Physics II. 4 Credits.**
LEC (3), LAB (2), DIS (1)
An extension of PHY 130. Electricity and magnetism, geometrical and physical optics, and modern physics.
Pre / Co requisites: PHY 140 requires prerequisite of PHY 130.
Gen Ed Attribute: Science Distributive Requirement.

Typically offered in Fall, Spring & Summer.

**PHY 170. Physics I. 4 Credits.**
LEC (3), LAB (2), DIS (1)
An introductory laboratory-based course. Includes mechanics, kinetic theory, waves, heat, and thermodynamics. The laboratory emphasizes error analysis, the writing of technical reports, and data analysis using computers.
Pre / Co requisites: PHY 170 requires prerequisite of MAT 161.
Gen Ed Attribute: Science Distributive Requirement.

Typically offered in Fall & Spring.

**PHY 175. Computational Physics. 3 Credits.**
This is an introductory course on the basic ideas and programming skills of computational physics, with a six-week introduction to programming given at the beginning of the course. Students will develop their own computer software to solve problems in mechanics, electrostatics, magnetism, quantum mechanics, chaos and other areas.
Pre / Co requisites: PHY 175 requires prerequisites of MAT 161, MAT 162, and PHY 170.

PHY 175 requires corequisite courses of MAT 261, MAT 311, and PHY 180.

Typically offered in Spring.

**PHY 180. Physics II. 4 Credits.**
LEC (3), LAB (2), DIS (1)
A continuation of PHY 170. Includes electricity and magnetism, geometrical and physical optics, electronics, and modern physics.
Pre / Co requisites: PHY 180 requires prerequisite of PHY 170 and co-requisite of MAT 162.
Gen Ed Attribute: Science Distributive Requirement.

Typically offered in Fall & Spring.

**PHY 240. Introduction to Modern Physics. 3 Credits.**
An atomic view of electricity and radiation, atomic theory, special relativity theory, X-rays, radioactivity, nuclear fission, and introductory quantum mechanics.
Pre / Co requisites: PHY 240 requires prerequisites of PHY 140 or PHY 180 and MAT 162.

Typically offered in Spring & Summer.

**PHY 260. Engineering Statics. 3 Credits.**
Composition and resolution of forces, equivalent force systems, equilibrium of particles and rigid bodies, centroids and center of gravity, analysis of simple structures, internal forces in beams, friction, moments and products in inertia, and methods of virtual work.
Pre / Co requisites: PHY 260 requires prerequisites of PHY 130 or PHY 170 and MAT 162.

Typically offered in Spring.

**PHY 300. Mechanics. 3 Credits.**
Particle kinematics, dynamics, energy, and momentum considerations; oscillations; central force motion; accelerated reference frames; rigid body mechanics; Lagrangian mechanics.
Pre / Co requisites: PHY 300 requires prerequisites of PHY 140 or PHY 180 and MAT 162.

Typically offered in Fall.
PHY 310. Intermediate Physics Lab I. 3 Credits.
LEC (1), LAB (2)
A lecture and laboratory course designed to familiarize students with modern physics laboratory equipment and practices through a series of experiments. Students write three research papers and give one research talk describing the experiments and their results in a style consistent with scientific conventions.
Pre / Co requisites: PHY 310 requires a prerequisite of PHY 240.
Gen Ed Attribute: Writing Emphasis.
Typically offered in Fall & Spring.

PHY 320. Intermediate Physics Lab II. 3 Credits.
LEC (1), LAB (2)
This course is a continuation of PHY 310, a lecture and laboratory course designed to familiarize students with modern physics laboratory equipment and practices through a series of experiments. Students write three research papers and give one research talk describing the experiments and their results in a style consistent with scientific conventions.
Pre / Co requisites: PHY 320 requires a prerequisite of PHY 310.
Gen Ed Attribute: Writing Emphasis.
Typically offered in Fall & Spring.

PHY 330. Electronics I. 3 Credits.
Emphasis is divided between theory and experiment. The course begins with a brief review of resistive and RC voltage dividers. Electronic circuits studied include basic operational amplifiers, timers, instrumentation amplifiers, logic circuits, flip flops, counters, and timers.
Pre / Co requisites: PHY 330 requires prerequisites of MAT 161 and PHY 140 or PHY 180.
Typically offered in Fall.

PHY 350. Heat and Thermodynamics. 3 Credits.
Equations of state, first and second laws of thermodynamics, ideal and real gases, entropy, and statistical mechanics.
Pre / Co requisites: PHY 350 requires prerequisite of PHY 240 or co-requisite of MAT 262.
Typically offered in Fall.

PHY 370. Mathematical Physics. 3 Credits.
Selected topics in mathematics applied to problems in physics, ordinary differential equations, vector calculus, Fourier analysis, matrix algebra, and eigenvalue problems.
Pre / Co requisites: PHY 370 requires prerequisites of MAT 261 and PHY 140 or PHY 180.
Typically offered in Fall & Spring.

PHY 390. Fundamentals of Astrophysics. 3 Credits.
An advanced physics course that deals with a broad range of topics in modern astrophysics. Topics include, but are not limited to, astronomical measurements, celestial mechanics, radiative transfer theory, stellar structure, and both newtonian and relativistic cosmology.
Pre / Co requisites: PHY 390 requires prerequisites of PHY 240.
Typically offered in Spring.

PHY 400. Analytical Dynamics. 3 Credits.
Wave propagation, Lagrange’s equations and Hamilton’s principle, rigid body motion, and special relativity.
Pre / Co requisites: PHY 400 requires prerequisites of PHY 300 and MAT 343.
Typically offered in Spring.

PHY 410. Optics. 3 Credits.
Geometrical and physical optics. Reflection and refraction at surfaces, lenses, interference and diffraction, and polarization.
Pre / Co requisites: PHY 410 requires prerequisites of PHY 140 or PHY 180 and co-requisite of MAT 262.
Typically offered in Fall.

PHY 420. Quantum Mechanics I. 3 Credits.
This course is an introductory quantum mechanics course. The following fundamental topics will be covered: the Schrodinger equation, Solutions to systems with stationary states (potential step, potential well, potential barrier, and harmonic oscillator), an abstract view of quantum mechanics (Dirac notation, Operator methods), the hydrogen atom, Angular momentum, and Spin.
Pre / Co requisites: PHY 420 requires prerequisites of PHY 240 and PHY 300 and MAT 343 or PHY 370.
Typically offered in Fall.

PHY 425. Quantum Mechanics II. 3 Credits.
This course is the second-semester quantum mechanics course. The following fundamental topics will be covered: Time-independent Perturbation Theory, the Variational Principle, the WKB approximation, time-dependent Perturbation Theory, and advanced topics.
Pre / Co requisites: PHY 425 requires a prerequisite of PHY 420.
Typically offered in Spring.

PHY 430. Electricity and Magnetism I. 3 Credits.
Electrostatics of point charges and extended charge distributions, fields in dielectrics, and magnetic fields due to steady currents. Ampere’s Law and induced emfs. Topics in electromagnetic waves as time permits.
Pre / Co requisites: PHY 430 requires prerequisites of PHY 300 and MAT 343 or PHY 370.
Typically offered in Fall.

PHY 435. Electricity and Magnetism II. 3 Credits.
This course covers the applications of Maxwell’s equations. Specific topics include: conservation laws, electromagnetic waves, guided waves, gauge transformations, retarded potentials, radiation from point charges and dipoles, and transformations of the electromagnetic field.
Pre / Co requisites: PHY 435 requires prerequisites of PHY 240, PHY 370, and PHY 430.
Typically offered in Spring.

PHY 440. Microcomputer Electronics. 3 Credits.
Laboratory study of special circuits, integrated circuits, microcomputers, and microcomputer interface applications.
Pre / Co requisites: PHY 440 requires prerequisites of PHY 330 and MAT 343 or PHY 370.
Typically offered in Spring.

PHY 450. Advanced Physics Lab I. 1 Credit.
A course to familiarize students with contemporary laboratory equipment and methods.
Typically offered in Fall.

PHY 460. Advanced Physics Lab II. 1 Credit.
A continuation of PHY 450.
Typically offered in Spring.

PHY 470. Seminar in Physics. 1 Credit.
Oral and written reports on approved topics. Variation in topics from year to year, depending on the interest and needs of students.
Typically offered in Spring.
Repeatable for Credit.

PHY 480. Special Topics in Physics. 1-3 Credits.
Topics of special interest to be presented once or twice. Enrollment requirements to be specified by the instructor. Course may be repeated by student for credit any number of times when different topics are presented.
Typically offered in Spring.
Repeatable for Credit.

PHY 490. Introduction to Research. 1-9 Credits.
Specific problems in consultation with the faculty adviser.
Consent: Permission of the Department required to add.
Typically offered in Fall.
Repeatable for Credit.