

DEPARTMENT OF PHYSICS AND ENGINEERING

Overview

367 The Sciences & Engineering Center and The Commons
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Department of Physics and Engineering (<http://www.wcupa.edu/physics/>)

Matthew Waite (mwaite@wcupa.edu), *Chairperson*
Kevin Aptowicz (kaptowicz@wcupa.edu), *Assistant Chairperson*

The Department of Physics and Engineering offers two 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 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

Physics

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.

The **Dr. Michael F. Martens Award** was established by a bequest of the estate of Dr. Martens, a faculty member of the Department of Physics and Engineering. Dr. Martens was a long-time member of the Lions Club of West Chester, which administers the funds for the award. The award is for achievement in Physics. Awards are determined by the department's faculty.

Other awards include the **Benjamin Faber Award** in physics and mathematics, awarded to an exemplary non-traditional physics or mathematics major; the **Dr. Gary Pascuzzo Scholarship**, which is given to one or more students in SCI 102 who are engaged in and excel in the course and who show promise to transfer the knowledge gained in the course to their own classroom; and the **Dr. Russell K. Rickert Award for Undergraduate Student Research**, which recognizes up to two students who have demonstrated a sustained and significant commitment to undergraduate research. Awards shared with other departments at WCU include the **Richard '59, M '69 and Jeanette Merion Scholarship**, which is awarded to a sophomore, junior, or senior physics, chemistry, or biology major for academic excellence, with preference given to a ROTC participant; the **Diane and Roger Casagrande Scholarship** for students in pre-engineering or communication studies; and the **Yarosewick Family Scholarship**, which supports a fourth-year science major pursuing a B.S.Ed. who has a GPA of at least a 3.2 (in physics, chemistry, biology and earth/space science).

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> (<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

- B.S. in Physics (<https://catalog.wcupa.edu/undergraduate/sciences-mathematics/physics-engineering/physics-bs/>)
- B.S. in Physics/B.S. in Engineering (<https://catalog.wcupa.edu/undergraduate/sciences-mathematics/physics-engineering/physics-bs-engineering-bs/>)

Minor

- Physics (<https://catalog.wcupa.edu/undergraduate/sciences-mathematics/physics-engineering/physics-minor/>)

Policies

- See undergraduate admissions information. (<https://catalog.wcupa.edu/general-information/admissions-enrollment/undergraduate-admissions/>)
- See academic policies. (<https://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

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

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

Visit the Registrar's website (<https://www.wcupa.edu/registrar/testCredit.aspx>) for information on how course credit for success on AP exams in physics is awarded.

Faculty

Professors

Kevin B. Aptowicz (kaptowicz@wcupa.edu) (2005)
Assistant Chairperson, Physics and Engineering

B.S., Columbia University; M.S., University of Colorado; Ph.D., Yale University

Anil Kumar Kandalam (akandalam@wcupa.edu) (2012)
B.Sc., Osmania University; M.Sc., University of Hyderabad; Ph.D., Michigan Technological University

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

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

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

Associate Professors

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

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

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

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

Courses

NSC

NSC 200. Tools of Nanoscience. 3 Credits.

This survey course introduces students to the major concepts and techniques of nanoscience through lectures and demonstrations. This survey is intended to be phenomenological and conceptual, setting the stage for the exploration of experimental nanoscience. Students will be introduced to why nanoscale objects are different, how to make them, how to characterize them, and how to visualize them.

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
Distance education offering may be available.

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

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.

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.

PHY 116 Prerequisite: Successful completion of PHY 115, with a minimum grade of D-.

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, viscosity, diffusion, self-assembly, polymer physics) are discussed and used to gain insight into food and cooking.

Gen Ed Attribute: Science Distributive

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.

Gen Ed Attribute: Humanities Distributive

Equivalent courses: PHI 125

PHY 130. General Physics I. 4 Credits.

An introductory, noncalculus, physics course. Mechanics of solids and fluids, wave motion, heat and temperature, thermodynamics, and kinetic theory.

PHY 130 Corequisite: PHY 130L.

Gen Ed Attribute: Science Distributive

PHY 130L. General Physics I Lab. 0 Credits.

Laboratory studies of the mechanics of solids and fluids, wave motion, heat and temperature, thermodynamics, and kinetic theory.

PHY 130L Corequisite: PHY 130.

PHY 140. General Physics II. 4 Credits.

An extension of PHY 130. Electricity and magnetism, geometrical and physical optics, and modern physics.

PHY 140 Prerequisite: Successful completion of PHY 130, with a minimum grade of D-.

Corequisite: PHY 140L.

PHY 140L. General Physics II Lab. 0 Credits.

An extension of the laboratory studies from PHY 130L. Electricity and magnetism, geometrical and physical optics, and modern physics.

PHY 140L Corequisite: PHY 140.

PHY 170. Physics I. 4 Credits.

An introductory laboratory-based course. Includes mechanics, waves, heat, and thermodynamics. The laboratory emphasizes error analysis, the writing of technical reports, and data analysis using computers. A laboratory section must be added along with the lecture and discussion.

PHY 170 Prerequisite: Successful completion of MAT 161 with a minimum grade of D-; or successful completion of MAT 143 or MAT 145, with minimum grades of D-, and a corequisite of MAT 161. Additional corequisite: PHY 170L.

Gen Ed Attribute: Science Distributive

PHY 170L. Physics I Lab. 0 Credits.

Laboratory studies on mechanics, waves, heat, and thermodynamics. The laboratory emphasizes error analysis, the writing of technical reports, and data analysis using computers.

PHY 170L Corequisite: PHY 170.

PHY 180. Physics II. 4 Credits.

A continuation of PHY 170. Includes electricity and magnetism, geometrical and physical optics, electronics, and modern physics.

PHY 180 Prerequisite: Successful completion of PHY 170, with a minimum grade of D-;

Corequisite: MAT 162 and PHY 180L.

PHY 180L. Physics II Lab. 0 Credits.

A continuation of the laboratory studies from PHY 170L. Includes electricity and magnetism, geometrical and physical optics, electronics, and modern physics.

PHY 180L Corequisite: PHY 180.

PHY 199. Physics and Engineering Transfer Credits. 1-10 Credits.

Transfer Credits

Repeatable for credit.

PHY 205. Cellular and Molecular Biophysics. 3 Credits.

This course draws on concepts and tools from physics, biology, and chemistry to understand how energy is transformed into order in living systems. This will require students to consider the roles evolution, polymer physics, and chemistry have played in shaping the machinery of life. This course is aimed at students from physics, biology, and chemistry who are interested in stretching themselves beyond disciplinary boundaries.

PHY 205 Prerequisite: Successful completion of PHY 130 or PHY 140; CHE 103; and one of MAT 143, MAT 145, or MAT 161, all with minimum grades of D-. Corequisite: PHY 140 or PHY 180.

Gen Ed Attribute: Interdisciplinary Requirement, Speaking Emphasis

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.

PHY 240 Prerequisite: Successful completion of MAT 162; and PHY 140 or PHY 180, with minimum grades of D-.

PHY 245. Measurement and Uncertainty. 1 Credit.

This course is designed to strengthen students' understanding of measurement and uncertainty in the laboratory setting as well as how to present data in a manner consistent with (i) the standards and conventions of the scientific community and (ii) the concepts of transparency, reproducibility, and credibility.

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.

PHY 260 Prerequisite: Successful completion of MAT 162; and PHY 130 or PHY 170, with minimum grade of D-.

PHY 275. Computational Physics. 3 Credits.

This is an introductory course on the basic ideas and programming skills of computational physics, with a seven-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.

PHY 275 Prerequisite: Successful completion of MAT 162 with minimum grade of D-. Corequisite: PHY 180.

PHY 300. Mechanics. 3 Credits.

Particle kinematics, dynamics, energy, and momentum considerations; oscillations; central force motion; accelerated reference frames; rigid body mechanics; Lagrangian mechanics.

PHY 300 Prerequisite: Successful completion of MAT 162; and PHY 140 or PHY 180, with minimum grades of D-.

PHY 310. Intermediate Physics Lab: Experimental Methods & Scientific Communication. 3 Credits.

A lecture and laboratory course designed to familiarize students with experimental physics and scientific communication. Students conduct experiments, analyze data, and come to evidence-based conclusions. In addition, explicit instruction occurs on writing and presenting in the discipline of physics. Students write a scientific report on an experiment and present their findings to the department.

PHY 310 Prerequisite: Successful completion of PHY 275 and PHY 240, with minimum grades of D-. Corequisite: PHY 310L.

Gen Ed Attribute: Speaking Emphasis, Writing Emphasis (select both)

PHY 310L. Intermediate Physics Lab: Experimental Methods & Scientific Communication. 0 Credits.

Laboratory studies designed to familiarize students with experimental physics and scientific communication. Students conduct experiments, analyze data, and come to evidence-based conclusions. In addition, explicit instruction occurs on writing and presenting in the discipline of physics. Students write a scientific report on an experiment and present their findings to the department.

PHY 310L Corequisite: PHY 310L.

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, instrumentation amplifiers, logic circuits, flip flops, counters, and timers.

PHY 330 Prerequisite: Successful completion of MAT 161; and PHY 140 or PHY 180, with minimum grades of D-.

PHY 330L. Electronics I Lab. 0 Credits.

Laboratory studies of electronic circuits, including basic operational amplifiers, instrumentation amplifiers, logic circuits, flip flops, counters, and timers.

PHY 350. Heat and Thermodynamics. 3 Credits.

Equations of state, first and second laws of thermodynamics, ideal and real gases, entropy, and statistical mechanics.

PHY 350 Prerequisite: Successful completion of MAT 261, PHY 275, and PHY 240, with minimum grades of D-.

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.

PHY 370 Prerequisite: Successful completion of MAT 261; MAT 315 or (MAT 311 and MAT 343); PHY 275; and PHY 180, with minimum grades of D-, or permission of instructor.

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.

PHY 390 Prerequisite: Successful completion of PHY 275 and PHY 240, with minimum grades of D-.

PHY 410. Optics. 3 Credits.

Geometrical and physical optics. Reflection and refraction at surfaces, lenses, interference and diffraction, and polarization.

PHY 410 Prerequisite: Successful completion of MAT 261, MAT 315, and PHY 275, with minimum grades of D-.

PHY 420. Quantum Mechanics I. 3 Credits.

An introductory course in quantum mechanics. Topics covered include the Schrödinger equation, stationary states, time evolution, position and momentum space wave functions, bound states, scattering states, spin and orbital angular momentum, hydrogenic atoms, and entanglement. Additional topics may include perturbation theory, conserved quantities, particle statistics, and quantum information.

PHY 420 Prerequisite: Successful completion of PHY 240 with minimum grade of D-. Prerequisite or Corequisite: PHY 370.

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.

PHY 425 Prerequisite: Successful completion of PHY 420, with a minimum grade of D-.

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.

PHY 430 Prerequisite: Successful completion of MAT 343 or PHY 370; and PHY 300, with minimum grades of D-.

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.

PHY 440 Prerequisite: Successful completion of PHY 240, PHY 370, and PHY 430, with minimum grades of D-.

PHY 455. Advanced Physics Lab: Experimental Methods & Scientific Communication. 3 Credits.

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.

PHY 455 Prerequisite: Successful completion of PHY 310, with a minimum grade of D-.

Gen Ed Attribute: Speaking Emphasis, Writing Emphasis (select both)

PHY 455L. Advanced Physics Lab: Experimental Methods & Scientific Communication. 0 Credits.

This course is a continuation of the laboratory studies from PHY 310L, 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.

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.

Repeatable for credit.

PHY 481. Special Topics with Lab. 3 Credits.

Topics of special interest to be presented with a laboratory component. Enrollment requirements to be specified by the instructor. Course may be repeated by student for credit up to three times when different topics are presented.

Repeatable for credit.

PHY 481L. Special Topics with Lab. 0 Credits.

Laboratory studies of topics of special interest. Enrollment requirements to be specified by the instructor. Course may be repeated by student for credit up to three times when different topics are presented.

Repeatable for credit.

PHY 490. Introduction to Research. 1-9 Credits.

Specific problems in consultation with the faculty adviser.

Repeatable for credit.