

# DEPARTMENT OF PHYSICS

*Dr. Brower Chair; Dr. Fair, Dr. Mackay, Dr. Marsch, Dr. Wagner, Dr. Wolinski.*

God has given humankind the ability to observe and to reason. It is the application of these talents toward an understanding of the universe and its awesome beauty that comprises the discipline of physics. Humankind has reaped a rich technological harvest from physics research, and along the way, has come to many profound and far-reaching conclusions. To study physics is to join a celebration of human intellect that follows in the tradition of some great men (Clerk Maxwell, Bohr, and Einstein) and women (Curie, Meitner, and Noether) in an ongoing exploration of the universe and our place in it.

The goal of the Department is to teach physics principles and to promote an appreciation of the natural world. Introductory coursework is offered that spans classical and modern physics, including a laboratory component, at three different levels: Fundamentals of the Universe (one semester), College Physics (two semesters), and Engineering Physics (three semesters). In addition, the department offers several intermediate and advanced lecture and laboratory courses toward a Bachelor of Science degree in applied Physics, Applied Physics/Computer, or Physics/General Science/Secondary Education. Students electing the Applied Physics major may also earn secondary education certification by taking the appropriate courses as listed under the major requirements. Some courses required for these majors are offered through other departments. There is ample work-study opportunity to assist in laboratory courses or to tutor both groups and individuals. Students are encouraged to undertake independent seminar projects under the guidance of a faculty supervisor, or to apply to summer internship opportunities off campus. A minor in Applied Physics is also available.

Training in both oral and written communication skills is an oft-neglected part of the undergraduate science curriculum. At the same time, communicating one's ideas and results in a clear and coherent manner is an essential skill for a scientist, requiring clarity of thought and expression. In addition, a scientist must know how to find, analyze, and use information developed by others in their field. To address these concerns, all physics majors are required to take Physics 288 as a Writing Intensive (WI) course and Physics 321 as a Speaking Intensive (SI) and Information Literacy (IL) course. In tandem, these courses provide focused, discipline specific training in the areas of oral and written communications as well as the ability to gather, analyze and use information within the field of physics.

## **Course Requirements for Bachelor of Science Degree in Applied Physics**

### **Physics Core (43 hours):**

Physics 101, 102, 210, 232, 234, 288, 303, 304, 305, 310, 321, 421, 431, and 442.

### **Technical Core requirements (27 hours):**

Mathematics 161, 162, 261, 262, 263, and Engineering 274.\*

Chemistry 105.

Computer 141.

### **Technical Electives (12 hours):**

Courses must be approved by the department.

*\* Students may substitute Mathematics 211 and 222 for Engineering 274 in order to receive a minor in Mathematics.*

### **Additional Course Requirements for Applied Physics with Secondary Education Certification**

Students seeking the Applied Physics major may also earn secondary education certification (7-12) by fulfilling the Professional Education Requirements:

Education 201, 202, 305, 309, 361, 371, 431, 488; and Psychology 102.

### **Course Requirements for Bachelor of Science Degree in Applied Physics/Computer Physics/Computer Core requirements (36 hours):**

Physics 101, 102, 232, 234, 288, 303, 321, and 442.

Computer Science 141, 244, 252, and 342.

#### **Technical Elective (3 hours):**

Choose one of the following: Physics 304, 305, 421, or 431.

#### **Technical Core requirements (23 hours):**

Chemistry 105.

Mathematics 161, 162, 211, 261, 262, and 263.

#### **Hardware or Software Option (25-26 hours):**

Choose one of the following options:

##### ***Computer Software option:***

Computer Science 220, 222, 340, 341, and 450.

Physics 210.

Two of the following:

Electrical Engineering 204; Computer Science 480 or Physics 488 (limit 3 hours);

Computer Science 314, 322, or any 400-level computer course; Mathematics 222\* or Engineering 274.

##### ***Computer Hardware option:***

Electrical Engineering 201, 202, 204, 206, 251, 252, 306, and 310.

Two of the following:

Computer Science 220, 341, 450, 480; Mathematics 222\* or Engineering 274.

*\* Students who elect Mathematics 222 will also receive a minor in Mathematics.*

### **Course Requirements for Physics/General Science Secondary Education Major leading to (7-12) certification**

#### **Physics Core (24 hours):**

Physics 101, 102, 206, 232, 234, 288, 321, and 486.

#### **Technical Core requirements (32-35 hours):**

Chemistry 105.

Computer Science 141.

Geology 201 or Science 204.

Mathematics 161, 162, and 261.

Science 202 or Biology 101.

Technical Electives: 6-8 credit hours approved by the department.

**Education requirements (33 hours):**

Education 201, 202, 305, 309, 361, 371, 431, and 488.  
Psychology 102.

**Course Requirements for a minor in Applied Physics (20 hours)**

Physics 101, 102, 232\*, and 234 (14 hours).

Two of the following (6 hours):

Physics 303, 305, 310, 431 or 442 (Electrical Engineering majors may not take Physics 305).

\*Physics 201 will be accepted in place of Physics 232 provided the student also takes Mechanical Engineering 214.

*Students are expected to contact their advisors for a detailed schedule of courses recommended to meet requirements for a major.*

**PHYSICS (PHYS)**

**101. GENERAL PHYSICS I-ENGINEERING.** A calculus-based study of mechanics including kinematics, Newton's laws of motion, work, energy, momentum, equilibrium, angular motion, fluids, oscillations, and gravity. Three lectures and one workshop per week. Corequisite: Mathematics 161. *Fall semester only, four hours.*

**102. GENERAL PHYSICS II – ENGINEERING.** A survey of the fundamental principles of electricity, magnetism, Maxwell's equations, and circuit theory. Three lectures and one workshop per week. Prerequisite: Physics 101. Corequisite: Mathematics 162. *Spring semester only, four hours.*

**121. COLLEGE PHYSICS I.** A study of mechanics at the pre-calculus level with applications to the life sciences. Topics include kinematics, Newton's laws, work, energy, momentum, angular motion, fluids, oscillations, and gravity. Three lectures and one workshop per week. *Fall semester only, four hours.*

**122. COLLEGE PHYSICS II.** A study of electricity, magnetism, and modern physics at the pre-calculus level with applications to the life sciences. Topics include electric field and potential, DC circuits, magnetism, induction, geometric and physical optics, relativity, and nuclear physics. Three lectures and one workshop per week. Prerequisite: Physics 121. *Spring semester only, four hours.*

**201. GENERAL PHYSICS III – ENGINEERING.** Contains a general introduction to physics for scientists and engineers covering a range of topics including light and modern optics, quantum physics, the structure of matter, relativity, nuclear and elementary particle physics. Prerequisites: Physics 101 and 102. *Spring semester only, two hours.*

**206. ASTRONOMY.** Open to all students. Contains an introduction and overview of astronomy covering range of topics including the night sky, the astronomer's tools, the solar system, stars and stellar evolution, galaxies and cosmology. Prerequisites: none.

*Semester course, three hours.*

**210. ELECTRONICS.** An introduction to electronics emphasizing those topics most useful to the experimental physicist. As such, the physics of active and passive devices (resistors, capacitors, inductors, diodes, transistors, sensors, etc.) will be discussed along with practical circuit applications (filters, operational amplifiers, voltage regulators, oscillators, timers, etc.). The bulk of this course is devoted to analog electronics but digital electronics is discussed briefly at the end of the semester. Three hours of lecture and three hours of lab per week. Prerequisite: Physics 102.

*Fall semester only, four hours.*

**232. INTERMEDIATE GENERAL PHYSICS.** An investigation of the physical laws associated with waves, sound, light, optical devices, thermodynamics, and possibly other selected topics not covered in Physics 101 and 102. Prerequisite: Physics 102.

*Fall semester only, three hours.*

**234. MODERN PHYSICS.** An introduction to modern physics, building upon the foundation laid in Physics 232. Two essential areas will be covered: the special theory of relativity and the origins of quantum mechanics. Prerequisite: Physics 201 or 232.

*Spring semester only, three hours.*

**288. INTERMEDIATE LABORATORY.** This course is designed to teach students the *process* of scientific investigation, transitioning them from introductory, cook-book labs to actual experimental design and execution. Experiments cover a variety of topics from classical and modern physics including propagation of error, waves, thermodynamics, optics, spectrophotometry, speed of light, and the photoelectric effect. This course is designed to fulfill the requirements for a Writing Intensive (WI) course in the physics major. Prerequisite: Physics 201 or 232.

*Spring semester only, two hours.*

**303. MECHANICS I.** The application of mathematical methods to the study of the general motion of particles; Newtonian and Lagrangian mechanics; Hamilton's equations; oscillations; nonlinear dynamics including chaotic systems; and central force motion. Prerequisite: Physics 101 and Math 262 or consent of instructor.

*Fall semester only, three hours.*

**304. MECHANICS II.** A continuation of Mechanics I. Topics covered include dynamics of a system of particles, motion in a non-inertial reference frame, dynamics of rigid bodies, coupled oscillations and waves, and statistical mechanics. Prerequisite: Physics 303.

*Spring semester only, three hours.*

**305. ELECTRICITY AND MAGNETISM.** A study of the fundamental principles of electricity and magnetism. Topics covered include vector calculus, electric field and potential, polarization, electric displacement, linear dielectrics, magnetostatics, and electrodynamics. Prerequisite: Physics 102.

*Fall semester only, three hours.*

**310. OPTICS.** A study of electromagnetic waves. Topics covered include the Maxwell equations, geometric optics, interference, diffraction, polarization, coherence, holography, and topics from nonlinear optics. Prerequisite: Physics 201 or 232 and Physics 305 or Electrical Engineering 304. *Spring semester only, three hours.*

**321. RADIATION LABORATORY.** An experimental study of the detection and characteristics of alpha, beta, gamma, and neutron radiation. One lecture and one lab per week. Physics 321 is designed to fulfill the requirements for a Speaking Intensive (SI) and Information Literacy (IL) course in the Physics major. Prerequisite: Physics 201 or 234, or consent of the department. *Spring semester only, two hours.*

**390. STUDIES IN PHYSICS.** Examination of different areas in the field of physics not offered by regular course work. Subject matter varies each semester. *Semester course, three hours.*

**421. ADVANCED TOPICS.** An in-depth course in an advanced physics topic (or topics) chosen by the instructor. Content can vary from year to year but may include areas such as general relativity, nuclear physics, elementary particle physics, solid-state physics, nanotechnology, etc. Prerequisites: Physics 201 or 234; Mathematics 262. *Spring semester only, three hours.*

**431. QUANTUM MECHANICS.** A study of wave-particle duality, the Bohr atom, and the development of quantum mechanics and its application to the periodic table and the nucleus, and solving the Schrödinger equation for several 1D systems and for the Bohr atom. Prerequisite: Physics 201 or 234; Physics 303; Mathematics 262. *Fall semester only, three hours.*

**442. COMPUTATIONAL METHODS IN PHYSICS.** An advanced course in the solution of physics problems using computer programming and numerical techniques for ordinary differential equations, partial differential equations, algebraic equations, spectral analysis, optimization, and numerical integration. Corequisites: Physics 303; Mathematics 262. *Spring semester only, three hours.*

**460. INDEPENDENT STUDY.** An opportunity for independent study of specialized topics in Physics. Prerequisite: Senior standing and permission of the department. *Semester course, one, two, or three hours.*

**480. INTERNSHIP IN PHYSICS.** Selected students participate in individual field experiences under the supervision of an on-site manager and a department faculty member. Requirements include evaluation by the on-site manager, a journal of the internship experience, a final written paper, and an oral presentation describing the completed work. Prerequisite: Permission of the faculty sponsor and coordination with the internship site. *Semester course, one to six hours.*

**486. PHYSICS EDUCATION SEMINAR.** This seminar assists students in their understanding of the basic principles of physics and helps them to learn teaching methods

unique to physics. Students will gain experience in designing and constructing equipment for physics experiments and demonstrations, and will propose and design laboratory experiments suitable for physics labs. Students will also present a lecture to the Science 201 class, and will serve as a tutor to those students. Prerequisite: This seminar is open to physics/education majors only; permission of the instructor is required.

*Semester course, three hours.*

**488. SEMINAR IN PHYSICS.** An opportunity for a student to undertake a project in an area of physics of special interest. Project approval and amount of credit to be given requires consent of the department. *Semester course, one, two or three hours.*

**499. PHYSICS RESEARCH.** Seniors who have shown special aptitude in physics may, with the consent of the Department of Physics, undertake supervised physics research. Not to exceed two hours each semester. *Semester course, one or two hours.*