

# Department of Physics

---

## College of Arts and Sciences

### Faculty

**Kyle L. Hathcox** (1974-88, 1994). Professor of Physics and Department Chair. B.S. and Ph.D., University of North Texas; Additional study, Oak Ridge Associated Universities.

**Glenn A. Marsch** (1996). Associate Professor of Physics. B.S., Clemson University; Ph.D., Florida State University. Additional study, Iowa State University, Lawrence Livermore National Laboratory, University of California at San Francisco, Calvin College, and Vanderbilt University.

**David A. Ward** (1992, 1999). Professor of Physics, B.S. and M.A., University of South Florida; Ph.D., North Carolina State University.

The programs in physics at Union University seek to effectively serve all students within the institution, recognizing that each student's needs may be different, with different career goals. The curriculum is designed to provide basic content for students classified as physics majors/minors, non-science majors, engineers, pre-professionals, and those preparing for a teaching career in secondary school. The physics faculty seek to help students understand the physical world (the universe) by examining the laws which govern all things, the methods by which the cosmos can be studied, and physics' relationships to other aspects of human experience. The faculty endeavor to create an atmosphere in which students are challenged to acquire problem-solving skills using advanced mathematics and modern methods in science. Students are encouraged to develop in-depth analytical skills and an inquiring attitude toward scientific inquiry while maintaining a Christian worldview. The physics curriculum provides the liberal arts students with a working knowledge of science and meets the needs of students who wish to:

- pursue a teaching career in elementary or secondary school;
- enter engineering, one of the health professions, or an allied health field;
- become a professional/industrial physicist; or
- continue study of physics or a related field at the graduate level.

### Physics

It is the purpose of the department to help the student understand the workings behind many of the physical phenomena that occur around him/her every day and to stimulate his/her interest in realizing and utilizing the powers of analysis in all aspects of life. The courses are designed to provide basic content for students classified as physics majors/minors, non-science majors, pre-professionals, and those preparing to teach physics in high school. Included also are courses of general interest open to all students.

#### I. Major in Physics—38 semester hours

- A. Physics 231-232, 311, 313, 314, 317, 325, 395\*, 420, 430, 424, 498
- B. Prerequisites in Math: 211, 212, 213, 314

\*Must be approved Special Studies

#### II. Major in Engineering Physics—73 semester hours

- A. Prerequisites: CHE 111, 113; CSC 115; CSC 245 or 255; ECF 211; MAT 211, 212, 213, 314; MAT 315 or 208
- B. PHY 231, 232, 311, 313, 314, 325, 400—26 hours
- C. EGR 101, 105, 210, 250, 270, 275, 290, 343, 352; 420 or 450; 205 or 470; 491, 498—40 hours
- D. EGR 262 or PHY 317—4 hours
- E. EGR/PHY 360—3 hours

F. Exempt from the requirement of a minor

**III. Major in Physical Science—48 hours**

- A. Chemistry 111-112, 211, 221, + three hours CHE electives ..... 16
- B. Physics 112, 231-232, 311, 310 or 301, + 2 hours PHY elective ..... 24
- C. Biology 8 hours ..... 8

**IV. Minor in Physics—24 semester hours**

Physics 231-232, 311, + 10 hours of Physics electives except PHY 111, 112, 301, 310

**V. Teacher Licensure in Physics (Grades 7-12)**

- A. Complete the requirements shown above for the Physics major.
- B. Professional Education: EDU 150, 250, 326, 418, 433, PSY 213, 318, SE 225.
- C. Complete the applicable portions of the Praxis II.
- D. For additional information, see the Director of Teacher Education.

**Course Offerings in Physics (PHY)**

( ) Hours Credit; F-Fall; W-Winter; S-Spring; Su-Summer

**111. Principles of the Physical Sciences (4) F, W, S, Su**

Introduction to physics and chemistry for non-science majors including their historical, philosophical, and social significance. Exercises are indicative of various scientific methods. Knowledge of basic algebra is assumed. Science credit will not be given after completion of a course in either CHE or PHY. Three lectures, one 2-hour laboratory/week.

**112. Earth and Space Science (4) F, W, Su**

Prerequisite: PHY 111. Reciprocal credit: GEO 112.

Earth science and astronomy: their nature, history, divisions, and relation to other sciences. The physical laws of nature will be examined as they apply to physical geography, meteorology, and astronomy. Three lectures, one 2-hour laboratory/week.

**213-4. Introduction to Physics (4) 213—F—Odd, 214—S—Even**

Prerequisite: MAT 111-2.

The first semester involves the study of classical mechanics, wave motion, fluid flow, sound, temperature, and heat. The second involves the study of electricity, magnetism, light, optics, and modern physics. Three lectures, one 3-hour lab/week.

**231-2. General Physics with Calculus (5) 231—F, 232—S**

Pre- or Corequisite: MAT 211-2.

The first semester involves the study of classical mechanics, wave motion, fluid flow and sound. The second involves the study of temperature and heat, electricity, magnetism, light, optics, and modern physics. Four lectures, one laboratory/week.

**301. Perspectives in Science (4) F, W**

Prerequisite: PHY 111-2.

The study of science from a historical and philosophical perspective in an interdisciplinary manner, exploring the complementarity of physical and biological sciences, while addressing relationships to other disciplines such as art, religion, and politics. Examines the role of science in global issues and life issues. Three lecture, 2 lab hours/week.

**310. Energy, Environment, and Society (4) W, S**

Prerequisite: PHY 111.

A non-technical course for the general student presenting a broad view of energy and its relationship to man and the environment. Topics: past and future demands, energy sources, storage and transportation of energy, environmental considerations, conservation, politics, economics, and national policy. Three lecture, 3 lab hours/week.

**311. Modern Physics (4) F—Even Years**

Prerequisite: MAT 212 & PHY 232.

An introduction to special relativity, quantum mechanics, atomic, and nuclear physics. The laboratory involves investigations in radioactivity, as well as performing some of the classic experiments of modern physics. Three lectures, one 3-hour lab/week.

**313. Intermediate Mechanics (3) F—Odd Years**

Prerequisite: PHY 232 & MAT 212.

Introduction to rectilinear and curvilinear dynamics of particles and rigid bodies, both Lagrangian and Hamiltonian formulations of mechanics will be developed and applied.

**314. Intermediate Electricity and Magnetism (3) S—Even Years**

Prerequisite: MAT 212 & PHY 232.

Electric and magnetic fields both in media and a vacuum. Maxwell's equations are used to determine electromagnetic fields produced by a variety of charge and current distributions.

**317. Introductory Electronics (4) S—Odd Years**

Prerequisite: MAT 212. Reciprocal credit: EGR 262.

The field of electronics from DC and AC circuit theory, to the semiconductor devices. Digital electronics are also introduced. Three lectures, one 3-hour lab/week.

**325. Thermodynamics & Statistical Mechanics (3) F—Odd Years**

Prerequisites: MAT 212 & PHY 232.

An intermediate survey of heat and thermodynamics including the concepts of temperature and heat, the laws of thermodynamics, thermodynamics potentials, the Maxwell relations and statistical methods applied to the thermodynamics of various states of matter, including gases, liquids, and quantum fluids.

142

**360. Mathematical Methods in Science and Engineering (3) S—Odd Years**

Prerequisite: MAT 213, PHY 232 Reciprocal Credit: EGR 360

A survey of mathematical topics important in scientific and engineering fields including ordinary and partial differential equations, orthogonal functions, matrices Fourier analysis, integral transforms and complex variables. Application of computer software.

**400. Optics and Lasers (3) S—Even Years**

Prerequisite: MAT 213, PHY 232

Analyze the behavior of electromagnetic radiation, emphasizing geometrical optics and instrumentation. The role of optics in spectroscopic measurements will be highlights by discussing polarization and diffraction. Includes an introduction to laser physics and operations using systems, including excimer and neodymium-YAG lasers.

**420. Quantum Mechanics (3) S—Even Years**

Prerequisites: PHY 311 & MAT 314.

Fundamental principles of quantum mechanics, methods of calculation, and solutions to Schrodinger's equation. Applications to atomic, molecular, and nuclear physics with an introduction to operator notation. Three lecture hours/week.

**424. Physics Research (1-3) S**

Prerequisite: PHY 311.

The student's knowledge is integrated by application of a simple piece of original work to include a literature search and summary paper on a topic of current interest in physics. Under the supervision of a faculty member, this work may be done off site at a national laboratory or comparable research facility.

**430. Experimental Physics Laboratory (3) F—Even Years**

Prerequisite: PHY 311 & MAT 213.

Modern experimentation, research, data acquisition and analysis. The theory, practice and reporting of research in a scientific format is demonstrated through experiments in atomic, nuclear, solid state, thermodynamics, and optics. One lecture, 4 lab hours/week.

**498. Seminar (1-3) S**

Prerequisite: 20 hours of physics and junior/senior standing.

Skills in scientific and technical presentations, written and oral, will be polished. To be used at the discretion of the department for majors/minors only.

---

**180-280-380-480. Study Abroad Programs (1-4) As Needed**

All courses and their application must be defined and approved prior to travel.

**195-6-7. Special Studies (1-4) On Demand**

Lower-level group studies which do not appear in the regular departmental offerings.

**395-6-7. Special Studies (1-4) On Demand**

Upper-level group studies which do not appear in the regular departmental offerings.

**495-6-7. Independent Study (1-4) On Demand**

Individual study under the guidance of a faculty member(s).

**499. Seminar (1-3) As Needed**

To be used at the discretion of the department.