

Physics

Department Faculty

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Department Goals

Physics is a discipline with ancient origins in early Greek thought, and it has led the way, to a large degree, in shaping and guiding the growth of science from that time until the present day. In our major program and in our service to other departments, the Physics Department at Covenant College seeks to provide a solid grounding in the discipline of physics while at the same time providing a foundation for understanding the relation of physics to such disciplines as philosophy and theology. In our major program we seek to prepare students for graduate school or for teaching in secondary school, by providing a good conceptual grasp of the discipline itself and also of issues related to other disciplines. Goals for service programs are to prepare pre-engineering students for the dual degree program on a level suitable for study at Georgia Tech, pre-med students for the MCAT and others for the various disciplines in which physics will be used. For both science and non-science majors, we hope to impart a sense of awe over the beauty and wonderfulness of God's world and over His glory and faithfulness as He upholds the regularities we observe in the physical sciences.

Teacher Certification

Students who desire teacher certification in Physics should complete a B.A. degree with a major in Physics, then enroll in the one-year Master of Arts in Teaching program at Covenant College. To ensure eligibility for entry to the M.A.T. program, it is recommended that you complete the Education Minor. (See page 78.) Two of the courses in the minor, EDU 222 Educational Psychology and EDU 361 Education of Exceptional Children, are *required* for admission to the program. This program leads to grades 6-12 teacher certification through the state of Georgia and through the Association of Christian Schools International (ACSI).

See Dr. Jim Drexler in Brock Hall 303 (jdrexler@covenant.edu) for more information.

Requirements for a Major in Physics

The core requirements are the same as those listed for baccalaureate degrees in general (see page 24), with the exception that mathematics and natural science lab courses are satisfied with non-department courses required for the major. While not required, it is recommended that either PHI

101. Introduction to Philosophy or PHI 283. Philosophy of Science be taken to satisfy the humanities distribution requirement.

Core requirements	51
Electives.....	6

Major and Supporting Course Requirements

COS 130. Computer Programming Methodology	4
MAT 145-146. Calculus I, II.....	8
MAT 247. Calculus III.....	4
MAT 258. Differential Equations.....	4
MAT 310. Linear Algebra.....	3
Chemistry or Biology electives	8
Supporting course subtotal	31
PHY 231-232. General Physics I, II 'W'	8
PHY 233. Optics and Modern Physics.....	4
PHY 321. Statics	3
PHY 322. Dynamics	3
PHY 341. Electromagnetism I.....	3
PHY 351-352. Quantum Mechanics I, II	6
PHY 450. Advanced Physics Lab.....	3
PHY 490. Science Seminar 'S'	1
PHY 491. Perspectives on Science.....	2
PHY 492. Senior Integration Paper	2
Physics elective	3
Major course subtotal	38
Total hours for the major	69
Total degree hours	126

Requirements for Minor in Physics

PHY 231-232. General Physics I, II	8
PHY 233. Optics and Modern Physics.....	4
PHY 491. Perspectives on Science	2
Physics electives.....	6
Total hours for the minor.....	20

Physics Courses

131-132. General College Physics I, II

This is a non-calculus based course covering the essentials of mechanics, waves, sound, heat, electricity, magnetism and light with an introduction to modern physics. Both a conceptual foundation and problem solving abilities are emphasized. Prerequisite: MAT 141-142 or equivalent, or permission of the instructor. Three hours lecture. Three hours laboratory. Laboratory fee: \$15. Four hours each.

231. General Physics for Scientists and Engineers I

This is the first of three semesters of the traditional calculus-based physics sequence for scientists and engineers. This course covers motion and Newton's laws, energy, momentum, rigid-body mechanics, gravitation, simple harmonic motion, waves and sound. Prerequisite: MAT 145 or permission of instructor. Three hours lecture. Three hours laboratory. Laboratory fee: \$15. Four hours. 'W' LAB

232. General Physics for Scientists and Engineers II

This is the second semester of the calculus-based physics sequence for scientists and engineers, covering fluids, solids, thermodynamics, electricity, magnetism and electromagnetic radiation. Prerequisite: PHY 231, co-requisite: MAT 247 or permission of the instructor. Three hours lecture. Three hours laboratory. Laboratory fee: \$15. Four hours. 'W'

233. Optics and Modern Physics

This is a continuation of the calculus based physics sequence covering optics and the two "twin pillars" of modern physics: relativity and quantum theory, including simple kinematic and dynamic investigations in special relativity, the twin paradox, a derivation of $E = mc^2$, the historical developments of quantum theory, the Schrödinger equation and the solution to the hydrogen atom. Prerequisites: PHY 232, MAT 247 or the permission of the instructor. Three hours lecture. Three hours laboratory. Laboratory fee: \$15. Four hours.

235. Modern Physics II

This is a course dealing with a survey of modern physics concepts and how quantum mechanics is applied in a variety of areas. After a coverage of statistical physics, applications are considered in molecular, solid state, nuclear, and elementary particle physics. Topics in astrophysics and cosmology will also be considered. This course should be taken by all those who desire certification for teaching physics on the secondary level. Prerequisite: PHY 233. Three hours.

321. Statics

A study of equilibrium conditions with forces and torques in two- and three-dimensional space. Topics included are statics of particles, moments and equivalent systems of forces, equilibrium of rigid bodies, distributed forces, analysis of structures, forces in beams, friction, stress and strain, axially loading, torsion and bending of beams. Prerequisites: PHY 231 and MAT 146. Three hours.

322. Dynamics

A study of non-equilibrium conditions with forces and torques in two- and three-dimensional space. Topics included are kinematics of particles and rigid bodies in plane motion, relationships of acceleration, velocity, angular acceleration and angular velocity, curvilinear motion, relative motion and acceleration, equations of motion, work

and energy, and impulse and momentum principles. Prerequisite: PHY 321. Three hours.

328. Thermodynamics

Thermodynamics concepts are introduced before studying work interactions, steady-state, transient energy, mass conservation, entropy and the second law. Second-law analyses are applied to thermodynamic systems. Selected gas cycles and vapor cycles are studied. Prerequisites: MAT 247 and PHY 232, or the permission of the instructor. Three hours.

330. Circuits and Electronics

An introduction to electric circuit elements and electronic devices and a study of circuits containing such devices. Both analog and digital systems are considered. Prerequisite: PHY 232. Co-requisite: MAT 348. Three hours.

341. Electromagnetism I

Overview of electricity and magnetism; topics may include static and quasistatic electromagnetic fields in vacua and in dielectric and magnetic media, electromagnetic waves and radiation. Prerequisite: PHY 232. Three hours.

351-352. Quantum Mechanics I, II

A study of elementary principles of quantum mechanics, including two state systems, the Schrödinger equation, one-dimensional problems, the harmonic oscillator, angular momentum, Hilbert spaces, matrix mechanics, spin and perturbation theory. Prerequisite: PHY 233 or permission of the instructor. Three hours each semester.

375. Gravity

A study of Einstein's general theory of relativity, a theory which connects gravity with the geometric structure of spacetime. In this course we will begin with a review of the special theory of relativity, and then gradually introduce changes to the background geometry of spacetime until we work up to the general equations of the theory. Along the way we will study various solutions to the equations, which will include spherically symmetric stars, black holes, gravitational waves, and models for cosmology. Prerequisites: PHY 233 and MAT 258 or permission of the instructor. Three hours.

410. Solid State Physics

This course examines properties of the crystalline state and the free-electron; band theories of metals, insulators, and semiconductors. Co-requisite: PHY 351 or permission of the instructor. Three hours.

421. Advanced Mechanics

Advanced topics in mechanics are examined possibly including: coupled oscillations, calculus of variations, generalized coordinates, Lagrangian and Hamiltonian dynamics, rigid-body motion, and/or motion in non-inertial

reference frames. Prerequisites: PHY 321-322 or permission of the instructor. Three hours.

431-432. Special Topics in Physics

A concentration in selected fields of study in physics. Prerequisite: senior standing or permission of instructor. Three or four hours each.

441. Statistical Mechanics

A study of the basic concepts and techniques in the statistical mechanical description of thermodynamics. Prerequisites: PHY 231-233 and COS 130, or permission of the instructor. Three hours.

450. Advanced Physics Lab

Students complete an individual research project conducted and reported under supervision of a faculty member. Six hours laboratory. Laboratory fee: \$15. Three hours.

461. Research in Physics: Thin Films

A semester of research into thin films can be carried out by qualified students. This course includes learning the operation of film production equipment as well as characterization of thin films. This course can be taken more than once for credit, but cannot be counted as a physics elective for the major or minor. Prerequisite: Permission of the instructor. Three hours per semester.

480. Science Seminar

See PHY 490 for a description. This zero credit option is for those who wish to place the course on their official schedule, so as to avoid being scheduled for work-study or some other obligation during the time of science seminar. Students who are not giving a talk should not take the course for credit. Pass/Fail. Repeatable. Zero hours.

490. Science Seminar

Majors are expected to take science seminar, either PHY 480 or PHY 490, at least once as a junior and once as a senior, and are required to take the course one time for credit to satisfy the 'S' requirement. All physics majors are expected to participate at some level. The course consists of presentations reviewing current literature, advanced physics lab reports, senior integration papers, and other topics of current interest in science. Repeatable. One hour. 'S'

491. Perspectives on Science

This course studies historical, philosophical and theological considerations in relation to science. This includes an examination of major shifts in scientific thinking from the Early Modern period to the present with critique from a Christian perspective. Prerequisites: PHY 231-233 and junior standing. Two hours.

492. Senior Integration Paper in Physics

See page 27.