Physics

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.

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 would be taken to satisfy the humanities distribution requirement.

Core requirements 51
Electives 6

Major and Supporting Course Requirements

Chemistry or Biology electives 8
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
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 instructor. Three hours lecture. Three hours laboratory. Laboratory fee: $15. Four hours each. LAB

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'

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 denamic investigations in special relativity, the twin paradox, a derivation of $E = m c^2$, the historical developments of quantum theory, the Schroedinger equation and the solution to the hydrogen atom. Other topics may include curved space-time, black holes, gravitational waves, elementary particles, topics in solid state, nuclear and molecular physics. Prerequisites: PHY 232, MAT 247 or the permission of the instructor. Three hours lecture. Three hours laboratory. Laboratory fee: $15. Four 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.

342. Electromagnetism II
Continuation of PHY 341. Prerequisite: PHY 341. Three hours.

351-352. Quantum Mechanics I, II
A study of elementary principles of quantum mechanics, including Schroedinger equation, one-dimensional problems, harmonic oscillator, angular momentum, Hilbert spaces, matrix mechanics, spin and perturbation theory. Prerequisite: PHY 233 or permission of the instructor. Three hours each semester.

405. Mathematical Methods of Physics
A study of topics in applied mathematics possibly including complex variables, special functions, partial differential equations, Fourier series, group representation theory, numerical and approximation methods, and Green functions. Prerequisite: MAT 258. Four 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. 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. 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.

480. Science Seminar
See PHY 490 for a description.
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 the historical, philosophical and theological considerations on 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 26.