

**PHY 099/Orientation to Physics**

**0 course unit**

(every fall)

Required as an entry course of all first-year and transfer students enrolled in majors offered by the Department of Physics. Topics covered include degree requirements, general information about the college and services offered, career opportunities in physics, academic standards and integrity, study habits, time management, and resume development. General and personal advisement relative to pursuit of the major and the degree is also included.

**PHY 120/Introduction to Geology**

**1 course unit**

(with laboratory)

(every semester)

Geological concepts, principles, and processes as they relate to the relationship between people and their environment are emphasized. Topics include: minerals and rocks, components of the hydrologic cycle, dynamic earth processes, and regional studies.

**PHY 121/Principles of Physics**

**1 course unit**

(with laboratory)

(every fall)

Not for science or mathematics majors

Centered around the basic laws of physics, emphasis is on a conceptual understanding of the natural world regarding concepts which comprise it and their connections and relationships to each other. Topics include force, motion, momentum, energy and gravitation. Laboratory emphasis is given through hands-on activities.

**PHY 122/Selected Principles of Physics**

**1 course unit**

(with laboratory)

(occasionally)

*Restriction:* Not for science or mathematics majors

Centered around selected principles related to the laws of physics. Emphasis is on a conceptual understanding of these topics as they relate to everyday life. Topics may include projectiles and satellite motion, air travel, alternative energy, wave motion, physics of sports, physics of automobiles, ballistics, photography, light, color, lenses and mirrors, eclipses, magnets, holograms, tides, radio and TV, rockets, electricity and physics of amusement parks.

**PHY 161/Introduction to Astronomy**

**1 course unit**

(with laboratory)

(every semester)

A study of the knowledge gained in our investigation of the universe from an historical perspective. Topics included are the Earth and its motions; time and the calendar, the seasons, the properties, origin, and evolution of (1) the solar system, and (2) stars and stellar systems, including galaxies; and cosmology. Laboratory sessions will involve an investigation of observable celestial phenomena, including celestial coordinates, the diurnal motions of the stars, the orbital motions of the planets, the phases of the Moon, and eclipses, through the use of interactive computer software, and the TCNJ planetarium and observatory facilities. Some nighttime observing is included.

**PHY 171/Introduction to Meteorology**

**1 course unit**

(with laboratory)

(fall)

Basic weather processes and forecasting are emphasized. Topics include: the Earth-Sun System, heat balance, moisture and precipitation, air masses and fronts, storm systems, ocean circulation, climate, atmospheric optics, air pollution and satellite imagery.

**PHY 201/General Physics I** **1 course unit**  
(with laboratory)  
(every semester)

*Pre- or Corequisite:* MAT 125 or MAT 127

Calculus-based introductory physics, first course of a two semester sequence. Topics covered include motion, Newton's Laws, Conservation principles, rotational motion and oscillatory behavior. Problem solving is an integral part of the course. Conceptual understanding is reinforced using interactive computer-based techniques, demonstrations, and laboratory experiences.

**PHY 202/General Physics II** **1 course unit**  
(with laboratory)  
(every semester)

*Prerequisite:* PHY 201

*Pre- or Corequisite:* MAT 128

Second part of two semester Calculus-based introductory course in electricity and magnetism, optics, and topics in modern physics. The important laws of physics in these areas and problem solving are emphasized. Problem solving is an integral part of the course. Conceptual understanding is reinforced using interactive computer-based techniques, demonstrations, and laboratory experiences.

**PHY 220/Advanced Geology** **1 course unit**  
(with laboratory)  
(alternate years)

*Prerequisites:* PHY 120

Brittle and ductile rock deformation will be explored in this structural geology course. We will examine how and why rocks deform, and highlight the relationship between rock deformation and plate tectonics. Topics include: stress, strain, rheology, faulting, and jointing. This course requires completion of PHY 120 or permission of instructor. Field trips to nearby sites are required.

**PHY 261/Stellar Astronomy** **1 course unit**  
(alternate years)

This course is a study of the knowledge gained from the investigation of the stellar universe, including beyond the solar system. Topics include: the properties, structure, and evolution of stars, star clusters, galaxies and cosmology. An emphasis will be placed on the methodology employed by astrophysicists to investigate the stellar world. The course will also include additional time involved with the use of software in the computer lab.

**PHY 306/Mathematical Physics** **1 course unit**  
(every semester)

*Prerequisites:* PHY 201 and MAT 128

A study of the mathematical methods used by experimental and theoretical physicists to solve a variety of physical problems. Topics include complex numbers, multiple integrals, curvilinear coordinates, matrix algebra, vector and tensor calculus, Fourier analysis, ordinary and partial differential equations, boundary value problems, special functions and advanced numerical techniques. Mathematica and/or Fortran will be used for both algebraic and numerical computations.

**PHY 311/Analog and Digital Electronics** **1 course unit**  
(spring)

*Prerequisite:* PHY 202

Fundamentals of analog and digital circuits. Topics in analog electronics include circuit analysis, alternating current circuits, transient signals, frequency filters, diodes, transistors, and op-amp circuits. Topics in digital electronics include logical networks, flip-flops, analog-to-digital-to-analog converters, microcomputers, and transducer applications. Laboratory activities are hands-on with intensive use of

oscilloscopes, frequency generators, analog components, transducers and robots. A robotics competition is a capstone experience for this course.

**PHY 316/Biomedical Physics** **1 course unit**

(alternate years-spring)

*Prerequisite:* PHY 202

Fundamentals of analog and digital circuits. Topics in analog electronics include circuit analysis, alternating current circuits, transient signals, frequency filters, diodes, transistors, and op-amp circuits. Topics in digital electronics include logical networks, flip-flops, analog-to-digital-to-analog converters, microcomputers, and transducer applications. Laboratory activities are hands-on with intensive use of oscilloscopes, frequency generators, analog components, transducers and robots. A robotics competition is a capstone experience for this course.

**PHY 321/Modern Physics** **1 course unit**

(with laboratory)

(fall)

*Prerequisite:* PHY 202, MAT 128

Study of modern physics concepts pertaining to the microscopic universe, thereby giving the student a better understanding of the macroscopic universe. Fundamental concepts of modern physics are covered, including topics in special theory of relativity, wave-particle duality, quantization of energy, Schrodinger equation, potential wells, and atomic physics. Experimental basis for modern physics is also discussed.

**PHY 390/Methods of Teaching Science** **1 course unit**

(every fall)

Research and presentations of topics relating to issues in modern science education with special emphasis on the first-year teacher. Topics include evolution of scientific concepts, presentations and evaluations of demonstrations, classroom management and techniques with an emphasis on preparation for Student Teaching.

**PHY 391/Independent Study in Physics** **variable course units**

(every semester)

*Prerequisites:* Junior/Senior standing in physics and permission of faculty mentor and department chair  
A student, in collaboration with a faculty member, will study an advanced topic in physics or a related field.

**PHY 393/Independent Research I** **1 course unit**

(every semester)

*Prerequisite:* Junior standing in Physics with a minimum 2.5 GPA and approval of supervising faculty member and department chair

Independent study in a selected area of Physics, Geology, Meteorology or Astronomy through the use of scientific journals, source books and experimentation. This course is reserved for students of junior standing, with a GPA of 2.5 or higher.

**PHY 401/Classical Mechanics** **1 course unit**

(alternate years)

*Prerequisites:* PHY 306 or MAT 229 and PHY 321

Newtonian mechanics is studied rigorously using advanced mathematical and numerical techniques. Topics treated include kinematics, dynamics, harmonic oscillations, central forces, many particle systems, rigid bodies, Lagrangians, and Hamiltonians. Scientific programming is used extensively in problem solving.

**PHY 411/Options and Wave Motion** **1 course unit**  
(fall)

*Prerequisites:* PHY 306 or MAT 229

A study of the properties of light and its interaction with matter. Topics include geometrical and physical optics, polarization, optical instruments, holography, laser physics, and quantum optics at an intermediate level. Laboratory work involves designing experiments to verify physical models and use of photonics research equipment. The course provides the foundation for imaging, laser physics and optical spectroscopy techniques.

**PHY 413/General Relativity and Cosmology** **1 course unit**  
(occasionally)

*Prerequisite:* PHY 306 or MAT 229

Modern formulation of Einstein's General Relativity. This course emphasizes field equations and the solutions applicable to astrophysical problems, including topics relating to black holes, gravitational lensing, and gravitational radiation. Additional topics include the dynamics of the universe--Standard Cosmology. The course provides a strong background suitable for higher studies in theoretical physics, astronomy, or mathematics.

**PHY 416/Thermodynamics** **1 course unit**  
(fall)

*Prerequisite:* PHY 202, 306 and CSC 215 or CSC 220

A study of the interrelationships between temperature, thermal energy, work, and entropy and the interactions of physical systems. The main topics covered are thermodynamic coordinates, equations of state, the laws of thermodynamics, adiabatic processes, heat engines, kinetic theory, and statistical thermodynamics.

**PHY 421/Electromagnetic Theory I** **1 course unit**  
(fall)

*Prerequisites:* PHY 306, MAT 326, CSC 215 or CSC 220

A study of the theory and laws of classical electromagnetism and development of the basic concepts and equations of electrostatics. Topics to be addressed are: applications of Coulomb's Law, nature of the electric field, applications of Gauss' Law, potential, theory, dielectric theory, conductors in electromagnetic fields, energy of the electromagnetic field, and special methods in electrostatics.

**PHY 422/Electromagnetic Theory II** **1 course unit**  
(spring)

*Prerequisite:* PHY 421

A continuation of PHY 421 dealing with electric currents and magnetic fields, Biot-Savart Law, Faraday Induction Law, magnetic potential, Maxwell's Equations, and electromagnetic waves.

**PHY 426/Particle and Nuclear Physics** **1 course unit**  
(alternate years)

*Prerequisites:* PHY 321, CSC 215 or CSC 220

A continuation of PHY 421 dealing with electric currents and magnetic fields, Biot-Savart Law, Faraday Induction Law, magnetic potential, Maxwell's Equations, and electromagnetic waves.

**PHY 431/ Quantum Mechanics** **1 course unit**  
(alternate years)

*Prerequisites:* PHY 306, 321 and CSC 215

Fundamental concepts of quantum mechanics and applications to problems in modern physics. Wave mechanics and wave mechanical properties of matter studied using the Schroedinger approach. Problem solving and computer projects are integral parts of the course.

**PHY 436/Condensed Matter**

**1 course unit**

(occasionally)

*Prerequisites:* PHY 306 or MAT 229 and PHY 321

Fundamental concepts of condensed matter and applications to problems in current theoretical and applied physics are presented. Topics covered include crystal structure, lattice vibrations, phonons, thermal properties of matter, free electron theory of metals, band theory, semiconductors, superconductors, optical properties of solids and magnetism. Problem solving and computer projects are integral parts of the course.

**PHY 451/Experimental and Analytical Physics**

**1 course unit**

(alternate years)

*Prerequisites:* PHY 306, PHY 321, CSC 215 or CSC 220

A team-taught course where students take part in experiments or projects of high caliber comparable to actual research in the areas of expertise of the participating faculty members. The course consists of 1 lecture hour and 3 hours of laboratory per week. The lecture hour will be used to acquaint the students with the theory and principles of physics fundamental to the experiments to be done, and the methods to apply in analyzing data from the NSA data archives. Individual experiments may take more than one week to complete. Students will be expected to devote time every week to compiling the results into a formal report equivalent to a paper to be submitted for publication in a journal. Emphasis will be given to in-depth writing and literature search. Papers may be presented and discussed at departmental colloquia.

**PHY 466/Astrophysics**

**1 course unit**

(occasionally)

*Prerequisites:* PHY 321 and CSC 215

The study of the knowledge gained from the investigation of the stellar universe and the physics applied thereto. This includes atomic structure, radiative process, spectroscopy, thermostatics of excitation and ionization equilibria, photometry, radiation transport, absorption, and scattering theory. Also covered are the principles of stellar structure and evolution; the structure and evolution of star clusters, galaxies and cosmology. An emphasis will be placed on the methodology employed by astrophysicists to investigate the stellar world.

**PHY 490/Student Teaching: Physics**

**2 course units**

(every semester)

*Prerequisites:* PHY 390 and meeting all criteria for admission to student teaching, including completion of all required courses and Physics requirements.

Student teaching during one semester of the senior year with an approved teacher in a public school under supervision of the cooperating teacher and college supervisors.

**PHY 493/Independent Research II**

**variable course units**

(every semester)

*Prerequisite:* Senior standing in physics and permission of faculty mentor and department chair  
This writing-intensive experience will consist of the student, in collaboration with a faculty mentor, studying an advanced research topic. A scientific talk and written research-quality paper will be submitted to the department at the end of the semester.