

## **PHYSICS COURSE DESCRIPTIONS**

### **PHYS 101: INTRODUCTION TO ASTRONOMY (4)**

A course in astronomy dealing with the physical principles and scientific investigation of objects in our solar system. The course will emphasize the study of stars, star systems, cosmology, and relativity; and how knowledge is acquired of celestial objects to develop models of our universe. Will include observation of nearby stars. Open to first -year students and the nonscientist. No prerequisite.

### **PHYS 108: BASIC ELECTRONICS (4)**

A course that combines a lecture and lab approach. Basic electronic concepts, static electricity to solid-state electronics will be taught in lectures. Analog and digital circuit fundamentals will be emphasized in the laboratory sections. Open to first-year students. No prerequisite.

### **PHYS 121: INTRODUCTION TO OCEANOGRAPHY/HYDROGEOLOGY (4)**

In this course we discuss the principles of physical, chemical, biological, and geological oceanography and hydrogeology. The course explores the dynamics and evolution of the oceans/ocean basins. Also, the course examines the occurrence, characteristics, movement, quality, development, and contamination of the Earth's water systems. These principles will be applied to water pollution, toxic waste, deforestations, soil erosion, biodiversity, and global warming. Also listed as ES 121. Open to first-year students.

### **PHYS 137: ENVIRONMENTAL PHYSICS (4)**

Noncalculus-based general physics that supports the B.S. degree in Environmental Science. This course covers thermal physics of living systems, thermal and fluid physics of the atmosphere, and electromagnetic theory of light, radioactivity, and electrical power generation and transmission. Prerequisite: MATH 140. Also listed as ES 137. Open to first-year students.

### **PHYS 150: SPECIAL TOPIC - ENERGY, ENVIRONMENT, AND CLIMATE (4)**

This course will develop the physical idea of energy, its manifestations, transformations, and conservation laws. We will examine how energy availability determines the nature of environmental and human systems, how our utilization of energy has transformed the human experience, and how it threatens now to transform our natural environment and climate. We will examine in detail the nature of the current energy-climate connection and potential future scenarios for social and environmental progress. Also listed as ES 150.

### **PHYS 150: SPECIAL TOPIC – HOW THINGS WORK – SAILING AND SKY DIVING (4)**

This interactive course studies the motion of objects through a hands-on, inquiry-based method for non-scientists, centering on the phenomena of sailing and sky diving. There is little formal lecturing, instead concepts are developed by direct experimentation. Open to first-year students. Prerequisite: q.

### **PHYS 150: SPECIAL TOPIC - THE PHYSICS OF EVERYDAY LIFE (4)**

This interactive introduction course is designed to take the mystery out of common physical phenomena. With demonstrations, games and fun experiments we will use the laws of physics to answer: why does your body want to fly off a car when you make a sharp turn? Why do you see a rainbow after it rains? In addition, you will learn how electricity works, how magnets exert their pull, and gain a number of practical skills, such as how to design and install lights in your room. This class is for science and non-science majors. Open to first-year students.

**PHYS 150: SPECIAL TOPIC – TELESCOPES AND TIME MACHINES (4)**

This course will study the history, design, and construction of the modern optical telescope for astronomical imaging. Students will engage in the design and construction of their own telescope and use telescopes as observational platforms for scientific imaging and “time travel.” Course materials fee: \$200 (students will keep the telescopes they build). Open to first-year students and the non-scientist.

**PHYS 151, 152: PHYSICAL PRINCIPLES I, II (4, 4)**

Noncalculus-based general physics with an emphasis on problem-solving, primarily intended for science and pre-medical students. PHYS 151 covers Newtonian mechanics, thermal physics, fluid physics, and wave motion. Topics in PHYS 152 include electricity, magnetism, DC/AC circuits, light and optics, special relativity, and quantum physics. Open to first-year students. Prerequisites: MATH 121-122 or MATH 140.

**PHYS 151L, 152L: PHYSICAL PRINCIPLES I, II LAB (2, 2)**

Open to first-year students. Prerequisite: q. Corequisite: PHYS 151 or 152.

**PHYS 197F: FIRST-YEAR SEMINAR - CONTRIBUTION OF SCIENCE TO GLOBAL ISSUES (4)**

In today’s world, over one billion people live in poverty, are plagued with disease, and live without enough food or clean water. Environmentally, things are not promising; there is global warming, pollution levels are higher than ever, the polar ice caps are melting and disappearing at an ever faster rate, the overall global temperature is rising, and natural disasters are becoming rampant. Politically, more countries than ever are in turmoil because of greed, corruption, power, and ignorance. As a result, many people are dying. Against this backdrop, human innovative and technological advances in the past 50 years far outpace advances made in the past 2,000 years. Even though such technological advances have enabled countries to be economically connected, allowing for unparalleled economic, business, and political growth, so many problems still exist in today’s world. In this course, we will explore how science can either be part of the problem or contribute to solving global issues. Selected seminar topics will focus on compelling questions related to the contribution of science to these global, economic, environmental, business, and political issues. Also listed as CHEM 197F. Placement to be determined during the summer.

**PHYS 201, 202: ANALYTIC PHYSICS I, II (4, 4)**

A rigorous calculus-based introduction to classical mechanics, gravitation, and electricity and magnetism. Open to first-year students with advanced placement. Prerequisites: MATH 241 and 242, but may be taken concurrently with permission.

**PHYS 201L, 202L: ANALYTIC PHYSICS I, II LAB (2, 2)**

Open to first-year students with advanced placement. Corequisite: PHYS 201 or 202.

**PHYS 221: SURVEY OF PHYSICS AND THE ENVIRONMENT (4)**

This course explores physics concepts and their connectedness to society and environmental issues. Topics include fossil fuel and nuclear energy, alternative energy sources, energy efficiency, climate change, earth’s water systems, biodiversity, and others. Also listed as ES 221. Prerequisite: q and ES 117. Open to first-year students.

**PHYS 241: GEOLOGY AND EARTH HISTORY (4)**

Planet Earth’s development as an integrated physical, chemical, and biological system over the past 4.6 billion years. Topics include: the origins of the solar system, Earth, and Moon; forces driving Earth’s chemical and geological differentiation; plate tectonics; origins of life and humans; Earth’s system dynamics; humans as geological agents; and Earth’s climate system. Also listed as ES 241. Open to first-year students. Prerequisite: q

**PHYS 250: SPECIAL TOPIC -- ALTERNATIVE ENERGY SOURCES AND SUSTAINABILITY IN THE 21ST CENTURY (4)**

Alternative energy is energy not based on the burning of fossil fuels or the splitting of atoms. There is tremendous interest in this field of study because of effects of pollution from the burning of fossil fuels and from the byproducts of nuclear waste. This course explores alternative energy sources such as solar, wind power, geothermal, tides, and hydroelectricity. Also, the course examines the effects of waste from burning fossil fuels and nuclear waste on global climate. We will explore passive solar homes and students will design experiments to harness solar energy to generate electricity in a manner that is less damaging to the environment. No prerequisite. Open to first-year students.

**PHYS 250: SPECIAL TOPIC - AN INTRODUCTION TO ENVIRONMENTAL DATA COLLECTION & ANALYSIS (4)**

This course offers an introduction to physical measurement theory as applied in the environmental sciences. Course topics will include the physics of measuring devices, device selection, calibration, accuracy and precision, field-deployment of instrumentation, the planning of a measurement campaign, and techniques for data post-processing and analysis. The course will be student-directed, project-based, and will involve extensive field-work. Also listed as ES 250. Prerequisites: *q* and ES 117 or PHYS 151 or PHYS 201, or permission.

**PHYS 250: SPECIAL TOPIC – OPTICS, OPTICAL INSTRUMENTS, AND SPECTROSCOPY (4)**

The basics of optics and image formation will be introduced. Optical instruments, such as the human eye, cameras, telescopes, microscopes, laser systems, X-rays, and CT will be covered. Spectroscopy basics and spectroscopy techniques including NMR spectroscopy, Raman spectroscopy, absorption spectrum and fluorescence will be covered. Applications of optical instrumentation in biology, chemistry, and the environmental sciences. Also listed as ES 250. Prerequisite: CHEM 105 or PHYS 151 or equivalent.

**PHYS 250: SPECIAL TOPIC – WIND, WATER, AND WEATHER (4)**

This course examines the physical principles of earth's dynamic weather systems, utilizing important concepts from physics, geology, hydrology and meteorology. Students will gain a broad understanding of interactions between the atmosphere and fresh and ocean water, including global circulation systems, storms, weather forecasting, the carbon cycle and the greenhouse effect. Special emphasis will be placed on human-induced climate change. Prerequisites: ES 117, PHYS 151, PHYS 201 or permission of instructor.

**PHYS 290: INDEPENDENT STUDY (2 or 4)**

Individual study, reading, and either experimental or theoretical investigation of a physics-related topic below the advanced level. Each course occupies one term and may be offered during the summer. Up to three courses in the sequence may be taken for credit.

**PHYS 301: CLASSICAL MECHANICS (4)**

An extension of PHYS 201/202. Topics include Newton's Law, the simple harmonic oscillator, the central force problem, multi-particle system (coupled oscillators), rigid bodies, mechanics of continuous media, Lagrange and Hamiltonian Mechanics, and tensors. Prerequisites: PHYS 201 and PHYS 202.

**PHYS 302: ELECTROMAGNETISM (4)**

Intermediate-level electricity, magnetism, and the Maxwell equations of the electromagnetic field. Topics include charged-particle trajectories, the theorems of Gauss and Stokes, vector calculus, Poynting vector, wave and polarization phenomena, and electromagnetic interactions with matter. Prerequisites: PHYS 201, PHYS 202, and PHYS 250.

**PHYS 310: MODERN PHYSICS (4)**

Twentieth-century development in physics: relativity theory, the nature of space and time, the equivalence of mass and energy, introductory quantum theory, the particle nature of light, the wave nature of electrons, atomic and molecular structure, and the structure of the nucleus. Prerequisites: PHYS 201 and PHYS 202.

**PHYS 331, 332: PHYSICAL CHEMISTRY I, II (4, 4)**

Also listed and described as CHEM 331, 332.

**PHYS 331L, 332L: PHYSICAL CHEMISTRY I, II LAB (2, 2)**

Also listed and described as CHEM 331L and 332L.

**PHYS 335: QUANTUM MECHANICS (4)**

A rigorous introduction to the principles of quantum mechanics. Solutions of the Schrodinger equation, harmonic oscillator, and hydrogen atom. Operator methods are introduced and used to compose both orbital angular momentum and spin. Various approximation schemes will be studied. Also listed as CHEM 335.

Prerequisites: PHYS 301, PHYS 302, or PHYS 331, PHYS 332; MATH 254, MATH 255, and MATH 316 or the equivalents are advised as preparation.

**PHYS 390: INDEPENDENT STUDY (2 or 4)**

Individual study, reading, and either experimental or theoretical investigation of a physics-related topic at the advanced level. Each course occupies one term and may be offered during the summer. Up to three courses in the sequence may be taken for credit.

**PHYS 399: INTERNSHIP (4)**

May be proposed in any term.

**PHYS 470: PHYSICS RESEARCH SEMINAR (4)**

A participatory seminar course examining current research areas in physics. Required of senior physics majors; other junior and senior science majors may enroll with permission. All course members will present and defend their physics-related research. A critical term paper is required. Prerequisite: junior or senior standing.

**PHYS 480: SENIOR THESIS (4)**

A research paper of publication quality based upon research in physics, or a physics-related field, undertaken for one term plus Short Term during the senior year. Required of all senior physics majors.

**PHYS 490: SENIOR HONORS THESIS (4, 4)**

By invitation of the department. Application must be made with faculty prior to registration. Required both regular terms and Short Term.