

## PHYC 122 General Physics 2

### Course Description

A continuation of PHYC 120. Topics include heat and laws of thermodynamics, Coulomb's law and the electric field, Ampere's law and the magnetic field, introduction to Maxwell's equation, DC and AC circuits; the nature, propagation, and properties of light; and lens systems. An optional introduction to selected topics in modern physics may be included. (5 credit hours)

Prerequisite: PHYC 120.

Parallel: MATH 162.

### Course Objectives

PHYC 122 serves not only as a foundation course for students pursuing a major or minor in physics, it also serves a similar purpose for students majoring in other areas in which physics provides a conceptual framework for developments within those disciplines. Thus PHYC 122 serves a broader cross-section of students than just physics majors. In this broader sense, PHYC 122 functions as a component of the general studies program at Ball State. The following course objectives are designed to instruct students in the acquisition of the broad-based competencies of the general studies program as well as the development of foundation skills needed for the further study of physics at a more advanced level.

The students will learn factual knowledge. This knowledge may be applied in other fields and/or provide a basis for studies at a more sophisticated level in other coursework taken by students as they progress through their college careers and continue the life-long education process.

The students will learn the basic fundamentals of precise scientific communication. This will enable the students to communicate more effectively later in life with other professionals such as scientists, engineers, lawyers, medical personnel, government leaders, and business officials to name a few. For example, the fundamental physical systems of units as applied to the descriptions of mass, length, time, force, energy, power, temperature, electrical terms, optical phenomena, acoustics, atomic-nuclear systems, etc., are introduced and developed in the PHYC 120 and 122 course sequence.

The students will learn problem solving techniques. One of the most important aspects of the introductory physics course is to provide students with extensive experiences in analyzing problems and synthesizing solutions. Contemporary applied problems with political, environmental, and technical implications are investigated from the scientific perspective. This approach will assist the students in developing their abilities to think analytically and reason critically.

The students will acquire training in the scientific methods of observation and recording of data. This will be accomplished in the laboratory portion of the course in which the students test their ideas concerning physical phenomena and explore new ones. To obtain experience handling equipment and to gain confidence in their ability to compute reliable answers in the laboratory are additional objectives associated with the laboratory component of the course.

Students will learn to apply the mathematical skills that are prerequisite (or co-requisite) for the course. It is assumed that the students who enroll in this course have specific abilities in mathematics. This calculus-based physics course will challenge students with these mathematical skills and interests beyond any previous high school physics experience.

**Course Rationale**

The PHYC 122 course and the prerequisite course (PHYC 120) in the two-semester sequence require first-year college calculus as a prerequisite or co-requisite. Therefore, students taking PHYC 122 as part of their general studies program requirement will possess introductory calculus. In this course they will apply these skills to solving problems that relate to everyday life. In addition, students will develop problem solving skills and a scientific vocabulary while using the scientific method and gaining factual scientific knowledge. Although a one-year high school physics is not a prerequisite for PHYC 122, the placement of his course in the general studies program is intended to challenge college students beyond their high school physics experience.

**Course Content, Format, and Bibliography**

*Content*

The course content is selected from the following sample schedule for the fifteen weeks of Instruction. (Note: The number of exams may vary depending on the instructor. Likewise, problem solving abilities are developed through homework problem assignments, and this number varies depending on the instructor.)

**OUTLINE OF TOPICS:**

- Thermal Physics
  - Temperature
  - Heat and laws of thermodynamics
  - Ideal gases
- Electric Fields
  - Electric charge
  - Atomic structure
  - Coulomb's Law
  - Electric Field and superposition
  - Conductors and insulators
- Gauss' Law
  - Electric lines of force
  - Flux from a point charge
  - Applications of Gauss' Law
- Electric Potential
  - Potential difference
  - Work and energy in electrostatics
  - Calculation of potentials
  - Equipotential surface

- Potential gradient and computation of electric fields
- The electron volt and particle accelerators
- Electric Circuit Elements
  - Electromotive force
  - Electric current
  - Resistance, resistivity, and Ohm's Law
  - Work and power in electric circuits
  - Capacitors and capacitance
  - Parallel and series capacitors
  - Energy stored in capacitors
  - The RC circuit
- DC Circuits and Instruments
  - Resistors in series and parallel
  - Kirchhoff's rules
  - Ammeters and voltmeters
  - The potentiometer
  - Bridge circuits
  - Electrical safety
- Magnetic Fields
  - Magnetism
  - Magnetic field plotting
  - Force on charged particles in magnetic field
  - Force on a current-carrying conductor in a magnetic field
  - Torque on a current loop
  - Meters and motors
  - Thomson's e/m and mass spectroscopy
- Sources of Magnetic Fields
  - Ampere's law
  - Applications of Ampere's law
  - Biot-Savart law
- Magnetic Induction Effects
  - Motional EMFs
  - Faraday's law and Lenz' law
  - Mutual inductance and self-inductance
  - Energy associated with an inductor
  - LR and LC circuits
  - Induced EMFs and electric fields
- Magnetic and Dielectric Properties of Materials
  - Electric dipoles
  - Dielectrics and dielectric constant
  - Gauss' law and Coulomb's law for dielectrics
  - Magnetic properties
  - Diamagnetism, paramagnetism, and ferromagnetism
  - Hysteresis

Magnetic field of the earth

AC Circuits

RMS quantities

Single element circuits and vectors

R-L-C series circuits

Power in AC circuits

Series resonance

Power transmission and transformers

Electromagnetic Waves

Speed and types of electromagnetic waves

Energy in electromagnetic waves

Sinusoid electromagnetic waves and relations between E and B

Maxwell's equations

Radiation from an antenna

Geometrical Optics

Nature and propagation of light

Refraction and reflection

Huygen's principle

Dispersion in a prism

Image formation and plane mirrors

Curved mirrors

Thin lenses

The lensmaker's equation

Optical instruments

The eye

Physical Optics

Young's interference

Intensity distribution for the double slit

Interference in thin films

Newton's rings

Michelson interferometer

Single-slit diffraction

Diffraction grating

Holography

Polarization

Double refraction

Optical instruments and Rayleigh criterion

Modern Physics (Optional)

Special relativity theory

Bohr model of the atom

The wave nature of particles

Cosmology

*Format*

The general format by which PHYC 122 is taught consists of lectures (including demonstrations and problem solving) and laboratory. Students are expected to attend four lecture periods per week plus one laboratory session. During the laboratory session they complete an experiment related to subject matter discussed in the lecture periods.

*Bibliography*

“University Physics with Modern Physics” by Young and Freedman, 13<sup>th</sup> edition.

“Physics for Scientists and Engineers” by Serway & Jewett, 8<sup>th</sup> Edition

Textbook: Bauer, Wolfgang & Westfall, Gary, University Physics Vol. 2, with Mastering Physics, McGraw Hill, ISBN 97800733667958 and PHYS 122 Lab Manual