DEPARTMENT OF PHYSICS AND ASTRONOMY

## PHYC 120 General Physics 1

### Course Description

First course in calculus-based physics for students in pre-engineering, the physical sciences, or mathematics.  Topics include Newtonian mechanics, work and energy, motion, impulse and momentum, elasticity and wave motion, sound, and hydrostatics and hydrodynamics.  Prerequisite or parallel: MATH 161 or 165. (5 credit hours)

### Course Objectives

Since physics is one of the principal foundations of the sciences, the course is designed to teach students the fundamental principles governing all macroscopic physical systems, to acquaint students with the basic factual knowledge concerning the physical world, and to impart a rudimentary scientific vocabulary. PHYC 120 is the first course of a calculus-based general physics course for students in physics, engineering, teacher preparation, mathematics, and other technical disciplines.  In addition to preparing students to take more advanced courses, the course provides a general knowledge base for work in many disciplines that consider or deal with the attributes, functions, processes, responses, interactions, and applications of real systems of varying complexity in the physical world, from projectiles to manufacturing machines to human beings.

This course provides an appropriate factual knowledge of the scientific discipline that will lead to intelligent decision-making in an increasingly complex and scientific society.  In discussing the discoveries of the physical laws of nature, the personalities, history, societal context, and cultural environment of the field are often described.

Critical thinking skills and a rational problem-solving methodology are extensively practiced by students in this course through the performance and analysis of laboratory experiments, quizzes, numerical and conceptual homework problems, and class exercises that include live and video demonstrations and computer simulations.

By completion of the course, students in PHYC 120 are expected to:

Identify and correctly utilize the basic physical laws and their mathematical formulation, which are studied throughout the term to perform quantitative calculations;

Use the techniques of differential and integral calculus, algebra, and other math skills to the derive analytical expressions;

Perform laboratory work to measure physical quantities, appropriately reduce the data to meaningful form, and make comparisons of results with theory;

Present formal written reports summarizing experimental work in the laboratory;

Interpret and analyze written problems by identifying the key parameters that are given and what is expected as a solution; and

Determine the appropriate set of concepts and expressions to use, solve the problem, and present the results in written form.

The requirements of formal written lab reports, the use of spreadsheets and calculators in data reduction and analysis and in problem solutions, and the presentation of physics at this level all provide the opportunity for students to gain basic academic and intellectual tools, to improve their ability to communicate, and gain a basic understanding of the foundations of our technological civilization. Through laboratory work and discussions in class, students gain an understanding of how physicists ask questions, develop theories that explain, and devise experiments to obtain information about natural phenomena. Throughout the course, students become aware of considerable scientific knowledge that forms the part of physics that is the focus of PHYC 120.

**Course Rationale**

PHYC 120 is the first course of a calculus-based general physics course for students in physics, engineering, teacher preparation, mathematics, and other technical disciplines. In addition to preparing students to take more advanced courses, the course provides a general knowledge base for work in many disciplines that consider or deal with the attributes, functions, processes, responses, interactions, and applications of real systems of varying complexity in the physical world, from projectiles to manufacturing machines to human beings.

Problem-solving and laboratory skills are essential for success in the disciplines for which PHYC 120 is a required course. Through "doing," students learn the formalism of scientific inquiry through experimental design, measurement, analysis and discovery of functional relationships (or model-building). The course develops basic academic and intellectual tools, and that it enables students to gain a firm understanding of how the scientific community asks, investigates, and answers scientific questions. The precise communication of scientific information among professionals is vital to the recognition and resolution of many technical issues.

**Course Content, Format, and Bibliography**

*Content*

Course content consists of material from the following outline of topics:

Overview of Physics

     Why study physics?

     SI Units and scales

     Problem-solving strategy

Motion in One Dimension

     Position, displacement

     Velocity

     Acceleration

     Motion with constant acceleration

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Vectors

    Notation

    Addition and subtraction

    Dot product

    Cross product

Motion in Two and Three Dimensions

    Three-dimensional coordinate systems

    Velocity and acceleration in a plane

    Projectile motion

    Relative motion

    Motion in a circle

Forces

    Newton's Laws

    Weight, mass, friction, tension, centripetal force

    Applying Newton's Laws

Work and Energy

    Work and potential energy

    Kinetic energy

    Conservation of Energy

    Non-conservative forces and conservation of energy

Momentum and Collisions

    Impulse

    Conservation of linear momentum

    Collisions; inelastic and elastic collisions

    Collisions in two dimensions

Rotational Motion

    Angular kinematics

    Moment of inertia

    Kinetic energy; torque

    Rolling motion

    Conservation of angular momentum

Static Equilibrium

> Conditions for equilibrium, stability

> Examples of static equilibrium

Gravitation

> Newton's Law of Gravitation

> Kepler's Laws

Solids and Fluids

> States of matter

> Tension, compression, shear forces

> Pressure

> Archimedes's Principle

> Fluid flow

Oscillations

> Simple harmonic motion

> Pendulum motion

> Damped and forced harmonic motion

> Resonance

Wave Motion

> Mathematical description of waves, wave equation

> Energy, power, and intensity of waves

> Superposition and interference of waves

> Standing waves

Sound

> Pressure waves; sound intensity and interference

> Doppler effect

> Resonance and music

*Format*

This course incorporates laboratory experiments, lectures, textbook readings, quizzes, and homework assignments to accomplish course goals outlined above.

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*Bibliography*

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Fundamentals of Physics, 9th Ed., D. Halliday, R. Resnick, and J. Walker. John Wiley and Sons, ISBN 9780470469088.

Physics for Scientists and Engineers, 8th Ed., R. A. Serway and J. W. Jewett, Brooks/Cole, ISBN-13: 9781439048450.

Textbook: University Physics, W. Bauer and G. Westfall, McGraw Hill, ISBN 97800733667941, and PHYC 120 Lab Manual