Educational Goals for Physics Students & Assessable Learning Outcomes

PHY 240 FUNDAMENTALS OF PHYSICS I / 3 credits

Principles of Newtonian mechanics, sound propagation, heat transfer, and thermodynamics employing differential and integral calculus. Prerequisite: MTH 210 or permission of instructor.

General Education Objectives (proposed)

1. Students can apply critical thinking to pose and answer questions.
2. Students can use the processes and methods of science and mathematics to demonstrate how reproducible results give rise to the discovery of fundamental laws and the development of theories.
3. Students can articulate a basic knowledge of current scientific understanding of the universe and the scientific and mathematical laws that govern it.
4l Students can summarize, interpret, analyze, and critically evaluate data and reports relating to the natural sciences and mathematics.

Physics Program Objectives

There are several general goals of the Physics program that students completing the physics program should have. A non-exhaustive list of these program objectives include:

(a) Ability to perform a mathematical formulation of a physical system
(b) Ability to discuss (mathematically and linguistically) a physical system drawing upon a well-developed foundation built upon physical fundamentals.
(c) Ability to formulate complex arguments based upon physical foundations and which are testable by experimentation.
(d) Ability to produce technologically enabled students with an understanding of the basis for experimental design.

A non-exhaustive list of intended learning outcomes follows

(a) Ability to convert units.
(b) Ability to work with algebraic and functional vectors.
(c) Ability to describe 1-dimensional motion in the presence of uniform and non-uniform accelerations. Accelerations described include position-dependent, velocity dependent, time dependent and mass dependent accelerations.
(d) Ability to describe 2-dimensional motion in the presence of uniform and non-uniform accelerations. Accelerations described include position-dependent, velocity dependent, time dependent and mass dependent accelerations.
(e) Ability to use Newton’s laws of motion in algebraic and differential form.
(f) Ability to construct and use free-body diagrams in problem formulation.
(g) Ability to apply principles of energy conservation for conservative and non-conservative systems.
(h) Ability to work with Newton’s law of gravitation and gravity in general as an example of a conservative force.
(i) Ability to provide mathematical analysis necessary to describe systems undergoing uniform circular motion.
(j) Ability to apply principles of momentum conservation to physical systems.
(k) Ability to provide mathematical analysis necessary to describe systems undergoing non-uniform circular motion in the presence of uniform external torques.
(l) Ability to provide mathematical analysis necessary to describe systems undergoing simple harmonic oscillation and the effect of linear restoring forces upon systems.

(m) Ability to provide mathematical analysis necessary to describe systems undergoing simple harmonic oscillation and to understand the differential equation leading to simple harmonic oscillation and its connection to linear restoring forces.
(n) Ability to provide mathematical analysis necessary to describe pulses, waves, traveling harmonic waves, transverse and longitudinal oscillations. Perform basic differentials of the wave equation in limited circumstances[3].
(o) Ability to work with Archimedes' principle and Bernoulli's equation[4].
(p) Ability to model the non-leaky ideal gas thermodynamically[5] and to expand this theory to cover systems with more than one degree of freedom.
(q) Calorimetry and linear expansion.
(r) Ability to apply the four laws of thermodynamics.
(s) Ability to apply black body radiation[6], Newton's law of cooling and the greenhouse effect.