

Educational Goals for Physics Students & Assessable Learning Outcomes

There are several general goals that students completing a physics course should have. Among these general goals are

- (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.

There are several rather specific goals that students completing a physics course should have. A non-inclusive topical course by course list primary outcomes is shown below.

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.

A non-exhaustive list of 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 circumstances³.
- (o) Ability to work with Archimedes' principle and Bernoulli's equation⁴.

- (p) Ability to model the non-leaky ideal gas thermodynamically⁵ 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 radiation⁶, Newton's law of cooling and the greenhouse effect.