PHYS 0105 - GENERAL PHYSICS I

Catalog Description

Formerly known as PHYS 2A (PHYS 105 and 105L, combined)
Prerequisite: Completion of MATH 27 or equivalent with grade of "C" or better
Corequisite: Concurrent enrollment in PHYS 105L
Advisory: Eligibility for ENGL 11 strongly recommended
Hours: 72 lecture
Description: Noncalculus introduction to the principles of mechanics, properties of matter and heat. Emphasis on applications relevant to several majors, including premedical, predental, optometry, forestry, architecture, and biological science. (combined with PHYS 105L, C-ID PHYS 105) (CSU, UC-with unit limitation)

Course Student Learning Outcomes

- CSLO #1: Solve problems associated with Newtonian mechanics and thermodynamics using trigonometry and algebra.
- CSLO #2: Identify which physical concepts associated with linear motion, rotational motion, and thermodynamics explain physical phenomena.
- CSLO #3: Develop an overlying and rigorous process to evaluate the behavior of physical systems obeying Newtonian mechanics and thermodynamics.

Effective Term

Fall 2022

Course Type

Credit - Degree-applicable

Contact Hours

72

Outside of Class Hours

144

Total Student Learning Hours

216

Course Objectives

A thorough understanding of physics requires the student to evaluate data and synthesize ideas to solve conceptual and numerical problems. The list of objectives below is intended to assist the student in this endeavor. Thus students in Physics 105 are expected to:
One-dimensional and 2-dimensional Kinematics:
1. Describe the fundamental physical quantities associated with motion (position, displacement, distance, speed, velocity and acceleration) including their definitions and their interrelationships.
2. Use the definitions of position, velocity and acceleration to solve both numerical and conceptual problems regarding the motion of point-like objects.
3. Describe the four kinematic equations of motion for constant acceleration.
4. Apply the four kinematic equations of motion (e.g. bodies undergoing free-fall near the surface of the earth, uniformly accelerated motion in the horizontal direction).
5. Describe the differences between vector and scalar quantities.
6. Use right triangle trigonometry to resolve vectors into their components.
7. Use right triangle trigonometry to calculate the magnitude and direction of a vector from its components.
8. Apply vector concepts to describe (mathematically and conceptually) the motion of point like objects in more than one dimension.
9. Apply vector concepts to solve projectile motion problems.
Dynamics:
1. Define and describe the concepts of force and mass.
2. State Newton's three laws of motion.
3. Distinguish between mass and weight, and describe the relationship between mass and inertia.
4. Describe the steps involved in free-body analysis.
5. Apply Newton's 2nd Law and free-body analysis to a wide variety of problems involving forces acting on point-like objects.
6. Describe the laws of friction and the differences between the static and kinetic frictional force.
7. Apply Newton's 2nd Law and free-body analysis to a wide variety of problems involving frictional forces acting on point-like objects.
8. Use Newton's 3rd law to solve a variety of conceptual problems of forces acting on point-like objects.
Mechanical Energy:
1. Define and describe work both mathematically and conceptually.
2. Calculate work for constant forces.
3. Define kinetic energy.
4. State the Work-Energy Theorem and apply it to solve problems involving the motion of point-like objects.
5. Define and describe potential energy and a conservative force.
6. State the Principle of the Conservation of Mechanical Energy and apply it to solve a wide variety of problems involving the motion of point-like objects.
7. Explain how work and energy involve the interplay of a system with surroundings.
Momentum:
1. Define both mathematically and conceptually momentum.
2. Define the Impulse-Momentum Theorem and apply it to solve problems involving collisions of point-like objects.
3. State the Principle of the Conservation of Momentum and apply it to solve a wide variety of problems involving the collisions of point-like objects.
Rotational Motion:
1. Describe the fundamental quantities of rotational motion (position, displacement, distance, speed, velocity and acceleration) including their definitions and their interrelationships.
2. Define centripetal acceleration.
3. Explain the relationship between radial acceleration and centripetal force.
4. Apply the definition of centripetal acceleration, free-body analysis, and energy conservation to solve a wide variety of problems involving the point-like bodies in circular motion.
5. State Newton's Universal Law of Gravitation.
6. Apply the Universal Law of Gravitation to solve a wide variety of problems involving orbiting motion.
7. Define the gravitational field.
8. Define the concepts of torque, center of mass, and rotational inertia.

9. Apply torque and free-body analysis to solve problems involving extended bodies in static equilibrium.
Solids and Fluids:
1. Define density and pressure.
2. Describe conceptually and mathematically stress and strain and their relationship.
3. Describe Young's modulus. Solve problems involving objects under tension.
4. Describe a fluid.
5. Describe the variation of pressure with depth in an incompressible fluid.
6. Explain Pascal's Principle and apply it to solve problems involving static fluids.
7. Describe Archimedes' Principle and the buoyant force.
8. Apply Archimedes' Principle to solve problems involving objects submerged in fluids.
Thermodynamics:
1. Describe and explain the concepts of temperature, heat and internal energy.
2. Conceptually and mathematically describe thermal expansion.
3. Solve problems involving the thermal expansion of isotropic materials.
4. State the Ideal Gas Law. Describe each of the concepts involved (pressure, volume, temperature, and the number of moles) and the conceptual basis for the law.
5. Apply the Ideal Gas Law to solve a wide variety of problems.
6. Define heat capacity and use a conceptual model to explain the variation of heat capacity for different materials.
7. Define latent heat.
8. State the First Law of Thermodynamics.
9. Use the 1st law to describe calorimetry.
10. Use calorimetry to find the equilibrium temperature of two or more objects placed into thermal contact.
11. Describe the modes of heat transfer (conduction, convection, and radiation) in mathematical and conceptual terms.
12. Apply the mathematical definitions of conduction and radiation to solve a wide variety of heat transfer problems.
13. Use the kinetic theory of gases to conceptually describe the Ideal Gas Law.
14. Explain the Theory of Equipartition of Energy.
15. Describe adiabatic, isobaric, isothermal, and isometric process. Sketch the behavior of ideal gases undergoing each of these processes on a pressure-volume diagram.
16. Describe the specific heats for ideal gases undergoing isometric and isobaric processes.
17. Define thermodynamic work.
18. Define efficiency.
19. Use pressure-volume diagrams to describe the quantitative functioning of heat engines utilizing ideal gases.
20. Describe the Carnot cycle.
21. Explain the 2nd Law of Thermodynamics and entropy.

General Education Information

- Approved College Associate Degree GE Applicability
  - AA/AS - Physical Sciences
- CSU GE Applicability (Recommended-requires CSU approval)
  - CSUGE - B1 Physical Science
- Cal-GETC Applicability (Recommended - Requires External Approval)
- IGETC Applicability (Recommended-requires CSU/UC approval)
  - IGETC - 5A Physical Science

Articulation Information

- CSU Transferable
- UC Transferable

Methods of Evaluation

- Classroom Discussions
  - Example: Example for Classroom Discussion Assessment or Example for Objective Exam: You want to construct a glass-mercury thermometer. How should the coefficient of linear expansion of the mercury and glass compare? A. The coefficient of expansion for glass must be much greater than that of mercury. B. The coefficient of expansion for glass must be much less than that of mercury. C. The coefficient of expansion for glass must be equal to that of mercury. D. The coefficient of expansion for glass must vary, while that of mercury is constant. 1. For the classroom discussion, an audience response system will be used to assess the discussion portion of the course. Students discuss their reasoning for their response with their peers. The results of each student's response will count toward their class participation grade. Individual students will be graded based on the following two criteria: 1. Is the student participating in the discussion? 2. Did the student get the correct response? Based on how well the class responds to the question, the instructor will ask additional questions on this topic, review this topic, or move on to the next topic.
- Objective Examinations
  - Example: 1. Example for Classroom Discussion Assessment or Example for Objective Exam: You want to construct a glass-mercury thermometer. How should the coefficient of linear expansion of the mercury and glass compare? A. The coefficient of expansion for glass must be much greater than that of mercury. B. The coefficient of expansion for glass must be much less than that of mercury. C. The coefficient of expansion for glass must be equal to that of mercury. D. The coefficient of expansion for glass must vary, while that of mercury is constant. For the classroom discussion, an audience response system will be used to assess the discussion portion of the course. Students discuss their reasoning for their response with their peers. The results of each student's response will count toward their class participation grade. Individual students will be graded based on the following two criteria: 1. Is the student participating in the discussion? 2. Did the student get the correct response? Based on how well the class responds to the question, the instructor will ask additional questions on this topic, review this topic, or move on to the next topic.
- Problem Solving Examinations
  - Example: 1. Exam problem (problem solving with rubric grading): A rock is thrown straight up with an initial velocity of 20 m/s. What maximum height (in m) will the rock reach before starting to fall downward? (acceleration due to gravity is 9.8 m/s2). 2. Quiz problem (problem solving with rubric grading): A track star in the broad jump goes into the jump at 12 m/s and launches himself at 20˚ above the horizontal. How long is he in the air before returning to Earth? (g = 9.80 m/s2).

Repeatable

No

Methods of Instruction

- Lecture/Discussion
- Distance Learning

Lecture:

1. A multimedia slide presentation is used to present the topic of centripetal acceleration in detail utilizing graphics and video segments for emphasis and clarity. Example problems are demonstrated by the instructor at appropriate times throughout the class lecture or live/recorded video. Students are always encouraged to ask questions in class or in the LMS video chat throughout the presentation. (Objectives: Rotational Motion 1-4).
2. Several live or video demonstrations of rotational dynamics using actual equipment at appropriate times during the presentation provide more emphasis and clarity. Students are also given a complete set of lecture notes in advance and encouraged to ask questions throughout the presentation in class or through the LMS chat feature. (Objective: Rotational Motion 8 and 9).

Distance Learning

1. An audience response system is used to ask questions on the application of Newton's Law in order to assess the level of student understanding during lecture and recitation (problem solving session). Based on how well students respond to the questions, the instructor will ask additional questions on this topic, review this topic, or move on to the next topic. In the online format polling software will be used to administer the question for during live/recorded video sessions. (Objectives: Dynamics 1-7).
2. In class, group problem solving activities are administered to assess student understanding. The activities are also designed to get students to verbalize physical concepts to each member in the group, identify concepts that affect a physical system, and to illustrate how to build physical models. The instructors role is to facilitate the activity. In the online modality this can be accomplished asynchronously using virtual groups or synchronously using a breakout groups feature of a live meeting software. Example: Suppose you connect three vessels of equal volume. The vessels are thermally insulated. You decide to connect the three vessels by placing thin tubes of negligible volume in between each container so that gas can flow from one vessel to the next when a stopcock between them is open. Initially, the pressure and temperature in each container is at the same value Po and To, respectively. The stopcocks between the vessels are opened, and thermal insulation is removed from two of the vessels. Then two vessels are surrounded by heat reservoirs so that their temperatures are maintained at
3. 85To and 2To while the third remains at To. What is the final pressure of the system when mechanical equilibrium is reached? (Objectives: Thermodynamics 3,4)

Typical Out of Class Assignments

Reading Assignments

1. Read the material on "Work and Energy" from the text in preparation for classroom discussion. 2. Read the material and sample problems on "Momentum" from the text in preparation for the recitation (problem solving session).

Writing, Problem Solving or Performance

1. Complete online homework assignment on Newton's laws. This is an assignment created by the instructor using an online homework service that accompanies the course textbook. Sample Problem: A boat moves through the water with two forces acting on it. One is a 2000 N forward push by the water on the propeller, the other is a 1800 N resistive force due to the water on the bow. What is the acceleration of the 1000 kg boat? 2. Complete the problem solving worksheet on vectors.

Other (Term projects, research papers, portfolios, etc.)

Required Materials

- College Physics
  - Author: Serway and Vuille
  - Publisher: Cengage
  - Publication Date: 2018
  - Text Edition: 11th
  - Classic Textbook?:
  - OER Link:
  - OER:
- College Physics
  - Author: Paul Peter Urone and Roger Hinrichs
  - Publisher: OpenStax
  - Publication Date: 2020
  - Text Edition: 2nd
  - Classic Textbook?:
  - OER Link:
  - OER:

Other materials and-or supplies required of students that contribute to the cost of the course.