PHYS 0215R - PROBLEM SOLVING FOR PHYSICS 215

Catalog Description

Formerly known as PHYS 4Z
Corequisite: Concurrent enrollment in PHYS 215
Hours: 18 lecture
Description: Optional problem solving course to accompany PHYS 215. Includes thermodynamics, mechanical waves, optics, and modern physics.(CSU, UC-with unit limitation)

Course Student Learning Outcomes

- CSLO #1: Solve problems associated with thermodynamics and waves using calculus, trigonometry, and algebra.
- CSLO #2: Identify which physical concepts associated with thermodynamics or waves explain physical phenomena.
- CSLO #3: Develop an overlying and rigorous process to evaluate the behavior of physical systems obeying wave properties and the laws of thermodynamics.

Effective Term

Fall 2022

Course Type

Credit - Degree-applicable

Contact Hours

18

Outside of Class Hours

36

Total Student Learning Hours

54

Course Objectives

Student will accomplish the following utilizing content from Physics 215:
1. Identify the basic concepts affecting a physical system, by using a diagram, a graph, a list, or an equation.
2. Build a conceptual model of a physical system and explain the system using the model in a written or oral format.
3. Apply the proper mathematical (algebra, trigonometry, calculus) techniques to solve basic problems in physics.
4. Develop a set of rules or strategies for problem solving that may be applied to solve a new set of problems.

General Education Information

- Approved College Associate Degree GE Applicability
- CSU GE Applicability (Recommended-requires CSU approval)
- Cal-GETC Applicability (Recommended - Requires External Approval)
- IGETC Applicability (Recommended-requires CSU/UC approval)

Articulation Information

- CSU Transferable
- UC Transferable

Methods of Evaluation

- Classroom Discussions
  - Example: The class is divided into small groups to solve a problem illustrating problem solving techniques required to complete Physics 215 homework assignments. Evaluation of problem solutions will take place by oral presentation to the instructor or the class. They can also be evaluated through solutions turned in at the end of class. Evaluations will be based on a rubric that reflects the problem solving skills reflected in several or all of the course objectives.. Sample Problem: A student carries a small oscillator and speaker as she walks very slowly down a long hall. The speaker emits a sound of frequency of 680Hz that is reflected from the walls at each end of the hall. The student notes that as she walks along, the sound intensity she hears passes through a series of maxima and minima. What distance must she walk to pass from one minimum to the next?
- Skill Demonstrations
  - Example: Students are asked to develop solutions an assigned problem for presentation to the class. The presentation is evaluated on the basis of problems solving strategy and correctness. Sample Problem: Hovering over the pit from hell, the devil observes that as a politician falls past (at terminal velocity), the frequency of his scream decreases from 842Hz to 820Hz (assume vsound =340m/s). a. What is the speed of the politician? b. The politician's scream reflects from the bottom of the pit. Find the frequency of the echo as observed by the politician. c. Find the frequency of the echo observed by the devil.

Repeatable

No

Methods of Instruction

- Lecture/Discussion
- Distance Learning

Lecture:

1. A brief presentation on effective strategies for solving (conceptual and numerical) problems involving Heat Engines and the Second Law of Thermodynamics is provided. The instructor solves an example problem in great detail. Students are then asked to discuss relevant concepts and problem solving strategies needed to solve Physics 215 homework assignments.
2. The instructor facilitates In class group problem activities are administered to assess student understanding in topics such as thermodynamic cycles, constructive and destructive interference, or the particle in a one dimensional or three dimensional box. 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.

Distance Learning

1. The instructor uses a slide presentation or a live/recorded video session (with closed captioning) to highlight processes for calculating thermodynamic quantities (e.g. temperature, pressure,

volume, change in entropy, work etc.) of cyclical thermodynamics systems. If the presentation is synchronous, the instructor uses break out rooms and the polling feature in the LMS video conferencing software to ask multiple-choice questions that highlight the relevant concepts that are involved in the analysis of these physical systems. The instructor reviews the responses and possibly provides some prodding or explanation. Then students discuss their reasoning for their response with their peers and commit to the same or a different response. The instructor reviews the responses again and repeats the process as needed. Once the questioning is completed, the instructor will have students apply the process to a specific cyclical process (e.g. Stirling cycle, Otto cycle, Brayton cycle etc.) As students work on the problem the instructor facilitates problem solving process. If the presentation is asynchronous, students are prompted (via discussion board) to answer questions that highlight the relevant concepts that are involved in the analysis of these physical systems. In this case, questions will be more open ended in nature rather than multiple-choice. A worksheet will also be assigned where students are required to apply the process to a specific geometric configuration of sound sources. The students will work on the worksheet in virtual groups. The completed worksheet will be submitted via LMS.

Typical Out of Class Assignments

Reading Assignments

1. Read the chapter on Heat Engines and the Second Law of Thermodynamics in the textbook. Be prepared to participate in class discussion. 2. Read and study the handout on the derivation of the approximation to the double slit interference condition $d\sin\theta=m\lambda$ for. Be prepared to discuss the approximation method that was used in the example.

Writing, Problem Solving or Performance

1. Prepare for presentation to the class a detailed solution to the following problem: A typical coal-fired power plant generates 1000MW of usable power at an overall thermal efficiency of 41%. a. What is the rate of heat input to the plant? b. The plant burns anthracite coal, which has a heat of combustion of 2.65x10^7 J/kg. How much coal does the plant use per day, if it operates continuously? c. At what rate is heat ejected into the cool reservoir, which is a nearby river? d. The river's temperature is 291.2 K before it reaches the power plant and 291.6 K it has received the plants waste heat. Calculate the river's flow rate in cubic meters per second. e. By how much does the river's entropy increase each second? 2. Complete the homework assignment on the Schroedinger equation for Physics 215. Document the strategies that were required to solve each problem. Be prepared to present discuss your problem solving strategies in class.

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

Required Materials

- University Physics
  - Author: Young and Freedman
  - Publisher: Pearson/Addison Wesley
  - Publication Date: 2020
  - Text Edition: 15th
  - Classic Textbook?:
  - OER Link:
  - OER:
- Physics for Scientists and Engineers - Technology Update
  - Author: Serway and Jewitt
  - Publisher: Cengage
  - Publication Date: 2019
  - Text Edition: 10th
  - Classic Textbook?:
  - OER Link:
  - OER:

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