PHYS 12: INTRODUCTION TO MODERN PHYSICS

Foothill College Course Outline of Record

Heading	Value
Effective Term:	Summer 2023
Units:	5
Hours:	5 lecture per week (60 total per quarter)
Prerequisite:	Intermediate Algebra or equivalent.
Advisory:	Not open to students with credit in PHYS 12H.
Degree & Credit Status:	Degree-Applicable Credit Course
Foothill GE:	Non-GE
Transferable:	CSU/UC
Grade Type:	Letter Grade (Request for Pass/No Pass)
Repeatability:	Not Repeatable

Student Learning Outcomes

- Students will demonstrate an understanding of the foundational problems that lead to the development of quantum mechanics.
- Students will demonstrate an understanding of how Einstein's theories of relativity changed our understanding (through measurables) of space, time, and mass.

Description

Non-mathematical introduction to the ideas of modern physics, intended for majors in the physical sciences. Introduction to the history and ideas of physics, focusing on three areas of modern physics: thermodynamics and the concept of entropy, Einstein's special and general theories of relativity, and quantum mechanics. The key ideas in these areas are explained using demonstrations, analogies, and examples drawn, whenever possible, from the student's own experience. Examine the impact these physics ideas have had on other fields, such as poetry, literature, and music. No background in science or math is assumed.

Course Objectives

The student will be able to:

a. Demonstrate an understanding of the scientific method
b. Discuss the three topics which are the focus of the course (thermodynamics, relativity, and quantum mechanics) in descriptive terms, and explain why they represent a change from our classical understanding
c. Give examples of the influences these ideas have had on other areas of human thought
d. Show an understanding of the contributions made to physics by Albert Einstein

Course Content

a. The nature of science and the scientific method
    i. The role of experiment in science
    ii. How scientific paradigms shift and evolve
b. Classical physics
    i. The beginnings of physics—Galileo and the experimental method
    ii. Newton's ideas about motion
    iii. Reference frames
c. The special theory of relativity
    i. Time dilation, Lorentz-FitzGerald contraction, and the guillotine problem
    ii. The role of mass and energy
    iii. Space travel as an illustration of special relativity theory
d. The general theory of relativity
    i. The "warping" of space-time
    ii. Black holes
    iii. Cosmology and general relativity (covered only briefly)
e. Thermodynamics
    i. Heat and temperature
    ii. Blackbody radiation
    iii. Max Planck and the quantization of energy
f. Quantum mechanics
    i. The nature of light—a historical development: waves vs. particles
    ii. The photoelectric effect
    iii. The nature of matter—waves vs. particles
    iv. Probabilistic interpretations of nature: does God play dice with the universe?
    v. The many-worlds interpretation (briefly)
    vi. EPR paradox
g. Einstein, science, and the rest of human culture
    i. The impact/role of science in "everyday life"
    ii. Science and morality

Lab Content

Not applicable.

Special Facilities and/or Equipment

1. A lecture hall with good audio-visual facilities, a large table with electrical connections, and lights which can be darkened.
2. Physics demonstration equipment, such as an electroscope, projectable wave table for demonstrating interference, spectrum tubes, gratings, etc.

Method(s) of Evaluation

Methods of Evaluation may include but are not limited to the following:

Objective type examinations: quizzes, a midterm, a final
Term paper may or may not be required

Method(s) of Instruction

Methods of Instruction may include but are not limited to the following:

Lecture
Discussion
Small group cooperative activities

Representative Text(s) and Other Materials

Einstein, Albert. Relativity: The Special and the General Theory - 100th Anniversary Edition, annotated ed.. 2019.

Parker, Barry. Einstein's Brainchild. 2000.

Priwer, Shana, and Cynthia Phillips. The Everything Einstein Book. 2003.

Some of these books are from the popular press, which is appropriate for this course. These publishers do not operate on the same publishing cycles as academic textbook publishers. Additionally, much of the science has not changed since the 1930s, and as such older resources are still reliable.

Articles and web readings to bring information up-to-date, as needed.

Types and/or Examples of Required Reading, Writing, and Outside of Class Assignments

a. Reading in the required texts about the history of physics ideas and the key concepts in modern physics
b. Assignments include reading the required texts, update handouts, and some fiction inspired by the science students are studying

Discipline(s)

Physics/Astronomy