PHYS 12: INTRODUCTION TO MODERN PHYSICS

Foothill College Course Outline of Record

Heading	Value
Units:	5
Hours:	5 lecture per week (60 total per quarter)
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 focus 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. describe the basic ideas of classical Newtonian physics, including Newton's three laws and Newton's law of gravity,
C. 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,
D. give examples of the influences these ideas have had on other areas of human thought,
E. show an understanding of the contributions made to physics by Albert Einstein.

Course Content

A. Introduction to Science and the Cosmos
1. The nature of science and the scientific method
2. A grand tour of the physical universe
3. Forces in the universe
4. Matter and energy
B. Classical Physics
1. The beginnings of physics--Galileo and the experimental method
2. Newton's laws: the constitution of the universe
3. Work, energy, power
4. Classical gravitation
C. Thermodynamics and Entropy
1. Heat and temperature
2. The laws of thermodynamics
3. Entropy and the second law of thermodynamics
4. The arrow of time and the ultimate fate of the universe
5. Reflections in literature
D. The Life and Time of Albert Einstein
1. Brief biographical overview
2. Einstein's views of science and the world
E. The Special Theory of Relativity
1. Time dilation, Lorentz-FitzGerald contraction, and the guillotine problem
2. The role of mass and energy
3. Space travel as an illustration of special relativity theory
F. The General Theory of Relativity
1. The "warping" of space-time
2. Black holes
3. Time machines in science: using general relativity
4. Cosmology and general relativity (covered only briefly)
G. Einstein, Relativity and the Rest of Human Culture
1. Images of Einstein in popular culture and the public view of scientist
2. Relativity in fiction
H. Quantum Mechanics
1. The nature of light--a historical development: waves versus particles
2. The nature of matter--waves versus particles
3. The uncertainty principle and its implications
4. Probabilistic interpretations of nature: does God play dice with the universe?
5. The many-worlds interpretation (briefly)
6. Quantum mechanics in literature
I. Recent Developments
1. Stephen Hawking and his work combining relativity and quantum mechanics
2. Quantum black holes

Lab Content

Not applicable.

Special Facilities and/or Equipment

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

Method(s) of Evaluation

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

Method(s) of Instruction

Lecture, discussion, and small group cooperative activities.

Representative Text(s) and Other Materials

Parker, Barry. Einstein's Brainchild. Amherst, NY: Prometheus Books, 2000.

Priwer, Shana, and Cynthia Phillips. The Everything Einstein Book. Avon, MA: Adams Media, 2003.

Spielberg, N., and B. Anderson. Seven Ideas That Shook The Universe. MJF Books, 2004.

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

Although these texts are older than the suggested "5 years or newer" standard, they remain seminal texts in this area of study.

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