PHYS 2C: GENERAL PHYSICS

Foothill College Course Outline of Record

Heading	Value
Units:	5
Hours:	4 lecture, 3 laboratory per week (84 total per quarter)
Prerequisite:	PHYS 2B.
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

- Labs experiments should teach the students the background science, error analysis and how to perform experiments.
- Students should demonstrate competence in Modern Physics, including Special Relativity, Wave Nature of Quantum Physics.
- Students should demonstrate competence in optics, including Relection, Refraction, Lenses, Mirrors.
- Students should demonstrate competence in waves, including Sound, E&M Waves, Interference.

Description

Lectures, demonstrations, and problems in waves; optics; introductory quantum mechanics; atomic physics; and nuclear physics.

Course Objectives

The student will be able to:
A. Analyze the properties of waves and apply mathematical formulas to physical problems.
B. Analyze and solve problems in optics.
C. Compute special relativity problems and interpret related paradoxes and special cases.
D. Explain wave-particle duality and its implications through both historical and thought experiments.
E. Discuss the concepts of quantum mechanics and solve simple problems.
F. Explain models of nuclear physics, how they relate to observed results, and solve problems concerning radioactive decay.
G. Explain current theories in particle physics.

Course Content

A. Analyze the properties of waves and apply mathematical formulas to physical problems.
1. The wave function and the propagation speed of a wave
a. Traveling waves
b. Speed of a wave on a string
c. Transverse vs. longitudinal waves
d. Energy transfer
2. Reflection, transmission, and superposition of waves
3. Sound waves, intensity, and the Doppler effect
a. Sounds as a pressure wave
b. Speed of sound
c. Periodic sound waves
1) Definition
2) Intensity
a) Decibels
b) Loudness and frequency
d. Doppler effect
1) Source moving
2) Detector moving
3) Both moving
4) Sonic booms
4. Standing waves, interference, and resonance
a. Superposition and interference
1) Destructive interference
2) Constructive interference
3) Superposition of sinusoidal waves
b. Standing waves
1) Nodes and antinodes
2) Standing waves as a function of time
3) Standing waves on a string
4) Standing waves in air columns
a) Open both ends
b) Closed one end
5) Standing waves on a membrane
c. Resonance
d. Beats
5. Electromagnetic waves and their propagation speed
B. Analyze and solve problems in optics.
1. Reflection and refraction of light
a. Ray approximation
b. Reflection
c. Refraction
1) Index of refraction
2) Snell's law
a) Huygen's principle
b) Total internal reflection
2. Geometrical optics, mirrors, lenses, and optical instruments
a. Images formed by mirrors
1) Image distance
2) Object distance
3) Magnification
4) Real vs. virtual
5) Upright vs. inverted
6) Concave vs. convex
7) Ray diagrams for mirrors
b. Images formed by lenses
1) Image distance
2) Object distance
3) Magnification
4) Real vs. virtual
5) Upright vs. inverted
6) Concave vs. convex
7) Ray diagrams for lenses
c. Optical instruments
1) The eye
2) Microscopes
3) Telescopes
3. Optical interference, diffraction, and polarization
a. Young's double slit
1) Constructive and destructive interference
2) Intensity distribution
b. Thin film interference
1) Change of phase on reflection

2) Coatings
3) Newton's rings
c. Michelson interferometer
C. Compute special relativity problems and interpret related paradoxes and special cases.
1. Frames of reference
a. Inertial vs. noninertial frames
b. Galilean tranforms
3. Einstein's postulates
a. Laws of physics same in inertial frames
b. Speed of light constant in inertial frames
4. Lorentz transformations
a. Length contraction
b. Time dilation
c. Simultaneity
d. Experimental evidence
1) Muon decay
2) Airborne atomic clocks
5. Paradoxes
6. Addition of velocities
7. Momentum
8. Energy
D. Explain wave-particle duality and its implications through both historical and thought experiments.
1. Light acting like a particle
a. Blackbody radiation
1) Definition of a black body
2) Classical attempts at solution
3) Planck's solution
b. The photoelectric effect
1) Experimental evidence
2) Einstein's solution
c. The Compton effect
2. Wave properties of particles
a. The de Broglie hypothesis
b. Electron diffraction
3. Wave-particle duality
a. Two slit experiments
1) Predictions for waves
2) Predictions for particles
3) Experimental results
b. The concept of probabilistic results
c. Discuss the concepts of quantum mechanics and solve simple problems
1. Probabilistic nature of quantum mechanics
2. Heisenberg uncertainty principle
3. Correspondence principle
E. Discuss models and solve problems pertaining to the hydrogen atom, the periodic table and condensed matter physics.
1. Bohr's model of the hydrogen atom and the hydrogen spectrum
a. Restriction of angular momentum to integer multiples of Planck's constant
b. Bohr radius
c. Energy levels and the hydrogen spectrum
d. Shortcomings of the Bohr model
2. Quantum mechanical approach
a. Schrodinger's equation
b. The need for four quantum numbers
c. Wave functions for the hydrogen atom
1) Shapes
2) Probabilities
d. Pauli exclusion principle
e. The periodic table
F. Explain models of nuclear physics, how they relate to observed results, and solve problems concerning radioactive decay.
1. Models of the nucleus
a. Stability
b. Ratio of protons to neutrons
2. Radioactivity
a. Decay and half-lives
b. Biological effects of radiation
3. Fission
4. Fusion
G. Explain current theories in particle physics.
1. Inventory of particles
a. Leptons
b. Hadrons
1) Baryons
2) Mesons
2. Conservation laws
3. Quarks

Lab Content

A. Suggested laboratory experiments:
1. Speed of sound in air
2. Standing waves (in a string or air column)
3. Index of refraction
4. Focal length
5. Lenses
6. Interference and diffraction
7. Photoelectric effect
8. The hydrogen spectra
9. Measurements of radioactivity

Special Facilities and/or Equipment

A. Physics laboratory with equipment for teaching introductory thermal physics, electricity and magnetism.
B. When taught via Foothill Global Access, on-going access to computer with email software and hardware; email address.

Method(s) of Evaluation

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

A. Weekly assignments
B. Mid-term test
C. Laboratory
D. Final examination

Method(s) of Instruction

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

A. Lecture
B. Discussion
C. Cooperative learning exercises
D. Electronic discussions/chat
E. Laboratory
F. Demonstration

Representative Text(s) and Other Materials

Urone and Hinrichs. College Physics. OpenStax, 2012.

Note: OpenStax is the main OER text in the field. The text itself has undergone regular updates since 2012, but the copyright/edition date remains 2012.

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

A. Homework problems: Homework problems covering subject matter from text and related material ranging from 10-40 problems per week. Students will need to employ critical thinking in order to complete assignments.

B. Lecture: Four hours per week of lecture covering subject matter from text and related material. Reading and study of the textbook, related materials and notes.

C. Labs: Students will perform experiments and discuss their results in either the form of a written lab report or via oral examination. Reading and understanding the lab manual prior to class is essential to success.

Discipline(s)

Physics/Astronomy