Las Positas College
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Course Outline for PHYS 8D

GENERAL PHYSICS IV

Effective: Fall 2010

I. CATALOG DESCRIPTION:
PHYS 8D — GENERAL PHYSICS IV — 3.00 units

Introduction to relativity and modern physics, including: introduction to quantum theory; atomic, molecular, nuclear and particle physics; condensed matter physics; astrophysics and cosmology.

2.00 Units Lecture 1.00 Units Lab

Prerequisite
PHYS 1C - General Physics III
with a minimum grade of C

Grading Methods:
Letter Grade

Discipline:

	MIN
Lecture Hours:	36.00
Lab Hours:	54.00
Total Hours:	90.00

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: 1

III. PREREQUISITE AND/OR ADVISORY SKILLS:
Before entering the course a student should be able to:

A. PHYS1C

IV. MEASURABLE OBJECTIVES:
Upon completion of this course, the student should be able to:

A. analyze and solve a variety of problems often using calculus in topics such as:
   1. special relativity;
   2. quantum physics;
   3. atomic physics;
   4. condensed matter physics;
   5. nuclear physics;
   6. particle physics;
   7. cosmology.
B. operate standard laboratory equipment, such as:
   1. Radiation Monitor
   2. Spectrum Tubes and HV Power Supply
   3. Spectrometer
   4. Critical Potentials Tube
   5. Photo-Electric Effect Module
   6. Chamber Works (particle interaction simulator)
C. understand the requirements for published work, and begin to write laboratory reports that emulate this style and level of professionalism.
D. show increased independence in laboratory, as evidenced by the ability to modify and design laboratory experiments as necessary to better understand the results of experimentation.

V. CONTENT:
A. Relativity
   1. The Principle of Galilean Relativity
   2. The Michelson-Morley Experiment
   3. Einstein's Principle of Relativity
   4. Consequences of the Special Theory of Relativity
   5. The Lorentz Transformation Equations
   6. Relativistic Linear Momentum and the Relativistic Form of Newton's Laws
   7. Relativistic Energy

8. Equivalence of Mass and Energy
9. Relativity and Electromagnetism

B. Introduction to Quantum Physics
1. Blackbody Radiation and Planck's Hypothesis
2. The Photoelectric Effect
3. The Compton Effect
4. Atomic Spectra
5. Bohr's Quantum Model of the Atom
6. Photons and Electromagnetic Waves
7. The Wave Properties of Particles

C. Quantum Mechanics
1. The Double Slit Experiment Revisited
2. The Uncertainty Principle
3. Probability Density
4. Particle in a Box
5. The Schrödinger Equation

D. Atomic Physics
1. Early Models of the Atom
2. The Hydrogen Atom Revisited
3. The Spin Magnetic Quantum Number
4. The Wave Functions for Hydrogen
5. The Other Quantum Numbers
6. The Exclusion Principle and the Periodic Table
7. Atomic Spectra
8. Atomic Transitions

E. Molecules and Solids
1. Molecular Bonds
2. The Energy and Spectra of Molecules
3. Bonding in Solids
4. Band Theory of Solids
5. Free-Electron Theory of Metals
6. Electrical Conduction in Metals, Insulators and Semiconductors

F. Nuclear Structure
1. Some Properties of Nuclei
2. Nuclear Magnetic Resonance and Magnetic Resonance Imaging
3. Binding Energy and Nuclear Forces
4. Nuclear Models
5. Radioactivity
6. The Decay Process
7. Natural Radioactivity
8. Nuclear Reactions

G. Nuclear Fission and Fusion
1. Interactions Involving Neutrons
2. Nuclear Fission
3. Nuclear Reactors
4. Nuclear Fusion

H. Particle Physics and Cosmology
1. The Fundamental Forces in Nature
2. Positrons and Other Antiparticles
3. Mesons and the Beginning of Particle Physics
4. Classification of Particles
5. Conservation Laws

VI. METHODS OF INSTRUCTION:
A. **Lecture** -
B. **Field Trips** - to local museums, laboratories and industries conducting relevant research
C. Laboratory experimentation
D. Problem solving
E. **Demonstration** -
F. **Discussion** -
G. Internet and other computer-based simulations and instructional multi-media

VII. TYPICAL ASSIGNMENTS:
A. Homework assignments from textbook 1. Assigned Problems (not to be turned in): a. Chapter 40 – Problems 1, 7, 15, 25, 31, 35, 41, 63 2. Homework Assignment (to be turned in): a. Chapter 40 – Problems 8, 16, 32 B. Laboratory reports (individual and group), including computer-based data acquisition and analysis 1. The Franck-Hertz Experiment: In this laboratory you will verify that the spectrum of helium is discrete, i.e. that the energy levels of the electrons are quantized. You will then estimate the transition energies of helium. 2. Grating Spectrometer: In this laboratory you will determine the grating constant of the diffraction grating from the spectrum of hydrogen, use this information to determine the wavelength of three lines in the mercury spectrum and compare them with unknown wavelengths to the indentify two unknown gasses from their spectra. C. Special exercise worksheets, problem review, and computer simulations and tutorials; both individual and group activities 1. Web assignment: Investigating Particles and Interactions. Submit your answers in the boxes provided and show your work on a separate page. 2. Complete Web Independent Study Assignment #1, listed in on-line syllabus. Work together in groups of two or three and turn in with report on laboratory: The Photoelectric Effect.

VIII. EVALUATION:
A. **Methods**

1. Exams/Tests
2. Quizzes
3. Projects
4. Home Work

B. **Frequency**

1. Frequency of Evaluation
   a. Recommend tri-weekly quizzes and final exam (or) two midterm (unit) exams and final exam (or) quizzes and/or unit exams with the collaborative project replacing the replacing the final examination.
   b. Weekly or bi-weekly homework assignments (as described above)

c. Weekly or bi-weekly laboratory reports (as described above)
d. Two or more collaborative laboratory assignments per semester (as described above)
e. One or more computer assignments (as described above)
f. One collaborative project (optional, as described above)

IX. TYPICAL TEXTS:

1. R. Knight *Physics for Scientists and Engineers.* 2nd ed., Pearson Education, 2009.
2. P. Tipler and R. Llewellyn *Modern Physics.* 5th ed., W.H. Freeman & Company Publishers, 2008.
3. D. C. Baird *Experimentation: An Introduction to Measurement Theory and Experiment Design..* 3rd ed., Prentice-Hall Inc, 1995.
4. Las Positas College Physics 8D Laboratory Manual, available online in PDF format.

X. OTHER MATERIALS REQUIRED OF STUDENTS:

A. Programmable scientific calculator capable of graphing
B. Campus print card