Las Positas College
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Course Outline for PHYS 1D

GENERAL PHYSICS IV

Effective: Spring 2019

I. CATALOG DESCRIPTION:
PHYS 1D — 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 1B - General Physics II
with a minimum grade of C
and

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

MATH 5 - Ordinary Differential Equations
with a minimum grade of C
(May be taken concurrently)

Grading Methods:
Letter Grade

Discipline:
- Physics/Astronomy

	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. PHYS1B
1. Analyze the temperature, pressure, and volume of a system using the laws of thermodynamics.
2. Analyze physical situations involving simple and/or damped harmonic motion using concepts of force and energy.
3. Analyze the properties of traveling and standing waves using differential equations and the concept of wave superposition.
4. Analyze situations involving interference and diffraction of light waves, and apply these to situations including double slits, diffraction gratings, and wide slits.
5. Design, perform, analyze, and assess the effectiveness of simple experiments to demonstrate physical phenomena.
6. Operate standard laboratory equipment and analysis tools, including digital data acquisition systems, spreadsheet programs, and plotting programs.
7. Analyze real-world experimental data, including appropriate use of units and significant figures.
8. Relate the results of experimental data to the physical concepts discussed in the lecture portion of the class.

B. PHYS1C
1. Analyze simple static charge distributions and calculate the resulting electric field and electric potential.
2. Analyze simple current distributions and calculate the resulting magnetic field.
3. Predict the trajectory of charged particles in uniform electric and magnetic fields.
4. Analyze DC and AC circuits in terms of current, potential difference, and power dissipation for each element.
5. Design, perform, analyze, and assess the effectiveness of simple experiments to demonstrate physical phenomena.
6. Operate standard laboratory equipment and analysis tools, including digital data acquisition systems, spreadsheet programs, and plotting programs.
7. Analyze real-world experimental data, including appropriate use of units and significant figures.
8. Relate the results of experimental data to the physical concepts discussed in the lecture portion of the class.

C. MATH5
1. Create and analyze mathematical models based on ordinary differential equations;
2. Verify that a given solution satisfies a given differential equation and interpret it geometrically when appropriate;

3. Recognize certain types of differential equations and choose an appropriate method for obtaining a solution(s) in the following categories:
4. First order equations
5. Separable equations
6. Exact equations
7. First order linear equations
8. Second order linear equations with constant coefficients
9. Determine the existence of a unique solution to a first order differential equation;

IV. MEASURABLE OBJECTIVES:

Upon completion of this course, the student should be able to:

A. Apply concepts from special relativity to analyze physical situations, including time dilation, length contraction, and the Lorentz transformation. Solve basic problems involving relativistic momentum and energy.
B. Apply basic concepts of quantum mechanics to analyze basic physical setups, including a particle in a box and simple atomic models.
C. Analyze particle interactions (including absorption, emission, and scattering), using the concept of wave-particle duality.
D. Analyze situations involving semiconductors, radioactive decay, and nuclear fusion using quantum mechanical principles.
E. Analyze interactions of fundamental particles in the early universe using conservation laws and quantum theory.
F. Design, perform, analyze, and assess the effectiveness of simple experiments to demonstrate physical phenomena.
G. Operate standard laboratory equipment and analysis tools, including digital data acquisition systems, spreadsheet programs, and plotting programs.
H. Analyze real-world experimental data, including appropriate use of units and significant figures.
I. Relate the results of experimental data to the physical concepts discussed in the lecture portion of the class.

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. **Lab** -
B. **Lecture** -

C. **Discussion** -
D. **Field Trips** - to local museums, laboratories and industries conducting relevant research
E. Problem solving
F. Internet and other computer-based simulations and instructional multi-media
G. **Demonstration** -

VII. TYPICAL ASSIGNMENTS:
A. Assignments include weekly or bi-weekly homework assignments with an average of 10-15 word problems per assignment.
B. Weekly or bi-weekly practice problems may be worked on collaboratively during class, for practice only.
C. Weekly laboratory activities take place which may involve direct experimentation, computer analysis, theoretical calculations, and written lab reports.

VIII. EVALUATION:
Methods/Frequency

A. Exams/Tests
several times a semester, or as desired by instructor
B. Quizzes
several times a semester, or as desired by instructor
C. Papers
one or more times per semester, or as desired by instructor
D. Oral Presentation
one or more times per semester, or as desired by instructor
E. Projects
one per semester, or as desired by instructor
F. Class Participation
as desired by instructor
G. Class Work
as desired by instructor
H. Home Work
weekly or biweekly
I. Lab Activities
weekly

IX. TYPICAL TEXTS:
1. P. Tipler and R. Llewellyn *Physics for Scientists and Engineers: A Strategic Approach with Modern Physics.* 4th ed., Pearson Education, 2017.
2. R. Knight *University Physics.* 14th ed., Pearson Education, 2016.
3. D. C. Baird *Fundamentals of Physics (Extended).* 10th ed., Wiley, 2013.
4. Las Positas College Physics 1D Laboratory Manual, available online in PDF format.

X. OTHER MATERIALS REQUIRED OF STUDENTS:
A. Programmable scientific calculator capable of graphing
B. Campus print card