Las Positas College
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Course Outline for PHYS 2B

INTRODUCTION TO PHYSICS II

Effective: Spring 2018

I. CATALOG DESCRIPTION:
PHYS 2B — INTRODUCTION TO PHYSICS II — 4.00 units

This algebra-based course is an introduction to the basic principles of electricity, magnetism, and modern physics. Topics include electrostatics, magnetism, circuits, electromagnetic waves, optics, relativity, atomic physics, and nuclear physics.

3.00 Units Lecture 1.00 Units Lab

Prerequisite
PHYS 2A - Introduction to Physics I
with a minimum grade of C

Grading Methods:
Letter Grade

Discipline:
- Physics/Astronomy

	MIN
Lecture Hours:	54.00
Lab Hours:	54.00
Total Hours:	108.00

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. PHYS2A

IV. MEASURABLE OBJECTIVES:

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

A. Analyze simple static charge distributions and calculate the resulting electric field and electric potential.
B. Explain the physical location and motions of charged particles within objects in the presence of an electric or magnetic field.
C. Analyze simple current distributions and calculate the resulting magnetic field.
D. Predict the trajectory of charged particles in uniform electric and magnetic fields.
E. Analyze DC circuits in terms of current, potential difference, and power dissipation for each element.
F. Analyze basic situations involving reflection and refraction, and use this analysis to predict the path of a light ray.
G. Analyze situations involving interference and diffraction of light waves, and apply these to situations including double slits, diffraction gratings, and wide slits.
H. Describe the limitations of classical physics and begin to develop an awareness of the importance of modern physics (i.e. quantum theory and special relativity) in the natural world.
I. Analyze particle interactions (including absorption, emission, and scattering), using the concept of wave-particle duality.
J. Analyze situations involving semiconductors, radioactive decay, and nuclear fusion using quantum mechanical principles.
K. Analyze interactions of fundamental particles in the early universe using conservation laws and quantum theory.
L. Analyze real-world experimental data, including appropriate use of units and significant figures.
M. Relate the results of experimental data to the physical concepts discussed in the lecture portion of the class.
N. Design, perform, analyze, and assess the effectiveness of simple experiments to demonstrate physical phenomena.
O. Operate standard laboratory equipment and analysis tools, including digital data acquisition systems, spreadsheet programs, and plotting programs.
P. Write comprehensive laboratory reports that describe the scientific basis of the experiment, clearly explain the experimental procedure, present a complete mathematical analysis of data and uncertainties, and evaluate the effectiveness of the experiment based on calculated uncertainties.

V. CONTENT:
A. Electric Forces and Electric Fields
1. Properties of electric fields
2. Insulators and Conductors
3. Coulomb's Law
4. The Electric Field

5. Electric Field Lines
6. Conductors in Electrostatic Equilibrium
7. The Milikan Oil Drop Experiment
8. The Van de Graff Generator
9. Electric Flux and Gauss's Law

B. Electric Energy and Capacitance
1. Potential Difference and Electric Potential
2. Electric Potential and Potential Energy due to point charges
3. Potentials and Charged Conductors
4. Equipotential Surfaces
5. Applications
6. Capacitance
7. The Parallel Plate Capacitor
8. Combinations of Capacitors
9. Energy Stored in a Charged Capacitor
10. Capacitors with Dielectrics

C. Current and Resistance
1. Electric Current
2. A Microscopic View: Current and Drift Speed
3. Current and Voltage Measurements in Circuits
4. Resistance and Ohm's Law
5. Resistivity
6. Resistance and Temperature
7. Superconductors
8. Electrical Energy and Power
9. Electric Activity in the Heart

D. Direct Current Circuits
1. Sources of EMF
2. Resistors in Series
3. Resistors in Parallel
4. Kirchhoff's Rules and Complex DC Circuits
5. RC Circuits
6. Household Circuits
7. Electrical Safety
8. Conduction of Elecrtical Signals by Neurons

E. Magnetism
1. Magnets
2. Earth's Magnetic Field
3. Magnetic Fields
4. Magnetic Force acting on a Current-Carrying Conductor
5. Torque on a Current Loop and Electric Motors
6. Motion of a Charged Particle in a Uniform Magnetic Field
7. Magnetic Force on a Long Straight Wire and Ampere's Law
8. Magnetic Force Between Two Parallel Conductors
9. Magnetic Field of a Current Loop
10. Magnetic Field of Solenoid
11. Magnetic Domains

F. Induced Voltages and Inductance
1. Induced EMF and Magnetic Flux
2. Faraday's Law of Induction
3. Motional emf
4. Lenz's Law
5. Generators
6. Self-Inductance
7. RL Circuits
8. Energy Stored in a Magnetic Field

G. Alternating Current Circuits and Electromagnetic Waves
1. Resistors in an AC Circuit
2. Capacitors in an AC Circuit
3. Inductors in an AC Circuit
4. The RLC Series Circuit
5. Power in an AC Circuit
6. Resonance in a Series RLC Circuit
7. The Transformer
8. Maxwell's Predictions
9. Hertz's Confirmation of Maxwell's Predictions
10. Production of Electromagnetic Waves by Antenna
11. Properties of Electromagnetic Waves
12. The Spectrum of Electromagnetic Waves
13. The Doppler Effect for Electromagnetic Waves

H. Reflection and Refraction of Light
1. The Nature of Light
2. The Ray Approximation in Geometric Optics
3. Reflection and Refraction
4. The Law of Refraction
5. Dispersion and Prisms
6. The Rainbow
7. Huygen's Principle
8. Total Internal Reflection

I. Mirrors and Lenses
1. Flat Mirrors
2. Images Formed by Spherical Mirrors
3. Convex Mirrors and Sign Conventions
4. Images Formed by Refraction
5. Atmospheric Refraction
6. Thin Lenses
7. Lens and Mirror Aberrations

J. Wave Optics
1. Conditions for Interference
2. Young's Double-Slit Experiment

3. Change of Phase Due to Reflection
4. Interference in Thin Films
5. Using Interference to Read CD's and DVD's
6. Diffraction
7. Single-Slit Diffraction
8. The Diffraction Grating
9. Polarization of Light Waves

K. Optical Instuments
1. The Camera
2. The Eye
3. The Simple Magnifier
4. The Compound Microscope
5. The Telescope
6. Resolutions of Single-Slits and Circular Apertures
7. The Michelson Interferometer

L. Relativity
1. Introduction
2. The Principle of Galilean Relativity
3. The Speed of Light
4. The Michelson-Morley Experiment
5. Einstein's Principle of Relativity
6. Consequences of the Special Theory of Relativity
7. The Lorentz Transformation Equations
8. Relativistic Momentum
9. Relativistic Addition of Velocities
10. Relativistic Energy and the Equivalence of Mass and Energy
11. Pair Production and Annihilation
12. General Relativity

M. Quantum Physics
1. Blackbody Radiation and Planck's Hypothesis
2. The Photoelectric Effect and the Particle Theory of Light
3. X-Rays
4. Diffraction of X-Rays by Crystals
5. The Compton Effect
6. Photons and Electromagnetic Waves
7. The Wave Properties of Particles
8. The Wavefunction
9. The Uncertainty Principle
10. The Scanning Tunneling Microscope

N. Atomic Physics
1. Early Models of the Atom
2. Atomic Spectra
3. The Bohr Theory of the Atom
4. Modifications of the Bohr Theory
5. DeBroglie Waves and the Hydrogen Atom
6. Quantum Mechanics and the Hydrogen Atom
7. The Spin Magnetic Quantum Number
8. Electron Clouds
9. The Exclusion Principle and the Periodic Table
10. Characteristic X-Rays
11. Atomic Transitions
12. Lasers and Holography
13. Energy Bands in Solids
14. Semiconductor Devices

O. Nuclear Physics
1. Some Properties of Nuclei
2. Binding Energy
3. Radioactivity
4. The Decay Process
5. Natural Radioactivity
6. Nuclear Reactions
7. Medical Applications of Radiation
8. Radiation Detectors

P. Nuclear Energy and Elementary Particles
1. Nuclear Fission
2. Nuclear Reactors
3. Nuclear Fusion
4. Elementary Particles
5. The Fundamental Forces in Nature
6. Positrons and Other Antiparticles
7. Mesons and the Beginning of Particle Physics
8. Classification of Particles
9. Conservation Laws
10. Strange Particles and Strangeness
11. The Eight-Fold Way
12. Quarks
13. Colored Quarks
14. Electroweak Theory and the Standard Model
15. The Cosmic Connection
16. Problems and Perspectives

VI. METHODS OF INSTRUCTION:

A. **Lab** -
B. **Lecture** -
C. Internet and other computer-based simulations and instructional multi-media
D. **Demonstration** -
E. Problem solving
F. **Discussion** -

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:

A. **Methods**

1. Exams/Tests
2. Quizzes
3. Papers
4. Oral Presentation
5. Class Participation
6. Class Work
7. Home Work
8. Lab Activities

B. **Frequency**

1. 3-5 exams per semester
2. quizzes weekly or bi-weekly, between exams as desired
3. special topic research paper, once per semester, if desired
4. oral presentations on lab work a few times per semester, if desired
5. daily class participation and classwork, if desired
6. weekly or bi-weekly homework assignments
7. weekly lab activities, with lab report papers assigned every few weeks

IX. TYPICAL TEXTS:

1. Knight, Randall, Brian Jones, and Stuart Field. *College Physics: A Strategic Approach.* 3rd ed., Pearson, 2015.
2. Giancoli, Douglas. *Physics: Principles with Applications.* 7th ed., Pearson, 2014.
3. Cutnell, John, Kenneth Johnson, and David Young. *Physics.* 10th ed., Wiley, 2015.
4. Las Positas College Physics 2B Laboratory Manual, available online in PDF format.

X. OTHER MATERIALS REQUIRED OF STUDENTS:

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