Las Positas College
3000 Campus Hill Drive
Livermore, CA 94551-7650
(925) 424-1000
(925) 443-0742 (Fax)

Course Outline for PHYS 2B

INTRODUCTION TO PHYSICS II

Effective: Fall 2004

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

Electro-Circuits, electromagnetic waves, optics and modern 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:

	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 and solve a variety of problems in topics such as:
1. DC Circuits
2. Magnetic Forces and Fields
3. Sources of Magnetic Fields
4. Electromagnetic Induction
5. Inductance
6. AC Circuits
7. Maxwell's Equations
8. Electromagnetic Waves
9. Polarization of Electromagnetic Waves
10. Geometric Optics
11. Light Waves
12. special relativity
13. quantum physics
14. atomic physics
15. condensed matter physics
16. nuclear physics
17. particle physics

B. operate standard laboratory equipment, including computer based data acquisition systems, such as:
1. Current Balance
2. Inductance Coils
3. Electronics Workbench
4. Optics Bench and Accessories
5. Rive Ray Box and Accessories
6. He-Ne Laser
7. Michelson Interferometer
8. Radiation Monitor
9. Spectrum Tubes and HV Power Supply
10. Spectrometer
11. Critical Potentials Tube

12. Photo-Electric Effect Module
13. Chamber Works (particle interaction simulator)

C. show increased independence in laboratory, as evidenced by the ability to set-up and perform the experiment based on the instructions in the laboratory manual, and to analyze laboratory data and present experimental results, all without extensive input on the part of the instructor.

V. CONTENT:

A. 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

B. 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

C. 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

D. 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

E. 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

F. 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

G. 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

H. 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

I. 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

J. 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

K. 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

L. 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

M. 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

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

VII. TYPICAL ASSIGNMENTS:
A. Weekly homework assignments from textbook 1. Assigned Problems (not to be turned in): a. Chapter 22 – Questions 3, 7 8 b. Chapter 23 – Problems 6, 12, 24, 25, 29, 33, 38, 62, 78, 90 2. Homework Assignment (to be turned in): a. Chapter 22 -- Problem 63 b. Chapter 23 – Problems 3, 9, 13, 17, 25, 27, 31, 43, 47; B. Laboratory reports (individual and group), including computer-based data acquisition and analysis 1. Magnetic Force on Current Carrying Wires: In this laboratory, you will explore the magnetic force on a current-carrying wire, and how that force varies with current, length of wire, strength of magnetic field, and angle. 2. Electromagnetic Induction: In this laboratory, you will work to understand the relationship

between current, magnetic field, and voltage induced by changing magnetic flux. C. Special exercise worksheets, problem review, and computer simulations and tutorials; both individual and group activities 1. Web assignment: Motion of a Charged Particle in a Magnetic Field. Complete sections (a) through (c) and turn in with report for laboratory Tangent Galvanometer. 2. Complete Web Independent Study Assignment #1 listed in on-line sylabus. Work together in groups of two or three and turn in with report for laboratory RLC Circuits.

VIII. EVALUATION:

A. **Methods**

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

B. **Frequency**

1. Frequency
   a. Recommend bi-weekly or tri-weekly quizzes and final exam (or) two or three midterm (unit) exams and final exam.
   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. Two or more computer assignments per semester (as described above).
2. Typical Problems
   a. Homework Problems
      1. (intermediate) Suppose an electron is released from rest in a uniform electric field whose magnitude is . (a) Through what potential difference will it have passed after moving 1.00 cm? (b) How fast will the electron be moving after it has traveled 1.00 cm?
      2. (challenging) Suppose that a luminous sphere of radius R1 (such as the Sun) is surrounded by a uniform atmosphere of radius R2 and index of refraction n. When the sphere is viewed from a location far away in vacuum, what is its apparent radius? You will need to distinguish between the two cases (a) R2 > nR1 and (b) R2 < nR1.
   b. Quiz Problems
      1. A cylindrical solenoid of 1000 turns is placed in a region where a magnetic field is perpendicular to the solenoid (i.e. the field is normal to the cross sectional area of the solenoid). The radius of the solenoid is 1.0 cm, and its length is 5.0 cm. (a) Determine the inductance of the solenoid.
      2. At which location will the electric field between the two parallel plates of a charged ideal capacitor be the strongest in magnitude? (a) near the positive plate (b) near the negative plate (c) midway between the plates (d) outside the plates (e) nowhere, the field is constant between the plates.
      3. When electrons fill a subshell in which the orbitals have equal energy, the order in which the orbitals are filled is such that (a) a minimum number of electrons has unpaired spins. (b) a minimum number of electrons has intrinsic angular momentum. (c) a maximum number of electrons has unpaired spins. (d) a maximum number of electrons first fills the next energy level. (e) the maximum number of electrons has the same set of quantum levels.
   c. Exam Problems
      1. Referring to the following diagram, calculate the following: (a) The value of R that cause the 2.0 A of current to flow through the 2.0 ? when the right hand switch is open and the left hand switch is closed. Assume the battery is an ideal source of emf. (b) The total power delivered by the battery to the circuit described in part (a). (c) The charge on the capacitor when both switches are closed. (d) How long it will take for the capacitor to discharge its maximum charge when the left switch is opened and the right switch is closed.
      2. A 50-turn circular coil (radius = 15 cm) with a total resistance of 4.0 ??is placed in a uniform magnetic field directed perpendicularly to the plane of the coil. The magnitude of this field varies with time according to B = A sin??t), where A = 80 ?T and a = 50? rad/s. What is the magnitude of the current induced in the coil at t = 20 ms?
      3. Show that the time required for an electron in the nth Bohr orbital of the hydrogen atom to circle the nucleus once is , where

IX. TYPICAL TEXTS:

1. R. Serway and J. Faughn *College Physics.* 6th ed., Brooks/Cole-Thompson, 2004.
2. J. Walker *Physics.*, Prentice Hall, 2002.
3. T. Urone *College Physics.* 2nd ed., Prentice Hall, 2002.
4. Las Positas College Physics 2B Laboratory Manual, available online in PDF format.

X. OTHER MATERIALS REQUIRED OF STUDENTS:

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