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

**Course Outline for PHYS 8B**

**GENERAL PHYSICS II**

**Effective: Fall 2010**

I. CATALOG DESCRIPTION:
PHYS 8B — GENERAL PHYSICS II — 5.00 units

Introduction to electricity and magnetism, circuits, Maxwell's equations and electromagnetic waves.

4.00 Units Lecture 1.00 Units Lab

**Prerequisite**
PHYS 1A - General Physics I
with a minimum grade of C
and

MATH 3 - Multivariable Calculus

**Grading Methods:**
Letter Grade

**Discipline:**

| | MIN |
|---|---|
| **Lecture Hours:** | 72.00 |
| **Lab Hours:** | 54.00 |
| **Total Hours:** | 126.00 |

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. PHYS1A
B. MATH3
1. Perform vector algebra in two and three space and interpret the results geometrically especially the dot and cross products and apply them to problems in space geometry (e.g., orthogonal projection, vector equations of lines and planes);
2. Transform points and equations among rectangular, cylindrical, and spherical coordinates and sketch their graphs as well as quadric surfaces;
3. Parameterize curves using vector functions of one variable and analyze them (e.g., find unit tangent, unit normal, curvature);
4. Sketch the graphs of functions of two variables using level curves, traces in coordinate planes, symmetry, etc.;
5. Extend the concepts of limits, continuity, differentiability and differential of single variable functions to functions of two or more variables;
6. Compute limits, partial derivatives, total differential, gradient, directional derivatives and interpret them geometrically and in terms of rate of change;
7. Apply partial derivatives and/or gradients to problems involving tangent planes and linear approximation, and optimization, especially using Lagrange multipliers;
8. Compute double and triple integrals directly or using change of variables and explain the geometric interpretation of Jacobians;
9. Apply differential operators, gradient, divergence, curl and Laplacian to scalar and vector field and interpret the results;
10. Compute line integrals using parameterizations for curves;
11. Parameterize surfaces using vector functions of two variables, and compute their areas;
12. Compute surface integrals of scalar functions and vector functions using parameterization for surfaces;
13. Interpret the theorems of Green, Stokes and divergence physically as well as mathematically (as the generalizations of the Fundamental Theorem of Calculus), and use them to compute line and surface integrals;
14. Find scalar potentials for conservative vector fields.

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. Electric forces and fields for varying charge distributions
2. Gauss's law
3. Electric potential and electric potential energy
4. Capacitance

5. Single- and multi-loop dc circuits
6. Magnetic forces and fields
7. Sources of magnetic fields
8. Electromagnetic induction
9. Inductance
10. Ac circuits
11. Maxwell's equations
12. Electromagnetic waves
13. Polarization of EM waves

B. operate standard laboratory equipment, including computer based data acquisition systems, such as:
1. Oscilloscope: CRT and digital
2. Function Generator
3. DC Power Supply
4. Digital Multi-Meter (DMM)
5. Basic Circuit Components, such as: (a.) Circuit Board (Bread Board) (b.) Resistor (c.) Capacitor (d.) Inductor
6. Current Balance
7. Inductance Coils
8. Electronics Workbench

C. add the following error analysis components to lab reports:
1. derive an expression for experimental percent uncertainty and compare with percent difference between theoretical (or accepted) and experimental values
2. propagation of error through calculations
3. include the tolerance of electrical equipment in error propagation

D. 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. Electric Fields
1. Properties of Electric Charges
2. Charging Objects by Induction
3. Coulomb's Law
4. The Electric Field
5. Electric Field of a Continuous Charge Distribution
6. Electric Field Lines
7. Motion of Charged Particles in a Uniform Electric Field

B. Gauss's Law
1. Electric Flux
2. Gauss's Law
3. Application of Gauss's Law to Various Charge Distributions
4. Conductors in Electrostatic Equilibrium
5. Formal Derivation of Gauss's Law

C. Electric Potential
1. Potential Difference and Electric Potential
2. Potential Differences in a Uniform Electric Field
3. Electric Potential and Potential Energy Due to Point Charges
4. Obtaining the Value of the Electric Field from the Electric Potential
5. Electric Potential Due to Continuous Charge Distributions
6. Electric Potential Due to a Charged Conductor
7. The Millikan Oil-Drop Experiment
8. Applications of Electrostatics

D. Capacitance and Dielectrics
1. Definition of Capacitance
2. Calculating Capacitance
3. Combinations of Capacitors
4. Energy Stored in a Charged Capacitor
5. Capacitors with Dielectrics
6. Electric Dipole in and Electric Field
7. An Atomic Description of Dielectrics

E. Current and Resistance
1. Electric Current
2. Resistance
3. A Model for Electrical Conduction
4. Resistance and Temperature
5. Superconductors
6. Electrical Power

F. Direct Current Circuits
1. Electromotive Force
2. Resistors in Series and Parallel
3. Kirchhoff's Rules
4. RC Circuits
5. Electrical Meters
6. Household wiring and Electrical Safety

G. Magnetic Fields
1. Magnetic Fields and Forces
2. Magnetic Force acting on a Current-Carrying Conductor
3. Torque on a Current Loop in a Uniform Magnetic Field
4. Motion of a Charged Particle in a Uniform Magnetic Field
5. Applications Involving Charged Particles Moving in a Magnetic Field
6. The Hall Effect

H. Sources of the Magnetic Field
1. The Biot-Savart Law
2. The Magnetic Force Between Two Parallel Conductors
3. Ampère's Law
4. The Magnetic Field of a Solenoid
5. Magnetic Flux
6. Gauss's Law in Magnetism
7. Displacement Current and the General Form of Ampère's Law
8. Magnetism in Matter

9. The Magnetic Field of the Earth

I. Faraday's Law
1. Faraday's Law of Induction
2. Motional emf
3. Lenz's Law
4. Induced emf and Electric Fields
5. Generators and Motors
6. Eddy Currents
7. Maxwell's Equations

J. Inductance
1. Self-Inductance
2. RL Circuits
3. Energy in a Magnetic Field
4. Mutual Inductance
5. Oscillations in an LC Circuit
6. The RLC Circuit

K. Alternating Current Circuits
1. AC Sources
2. Resistors in an AC Circuit
3. Inductors in an AC Circuit
4. Capacitors in an AC Circuit
5. The RLC Series Circuit
6. Power in an AC Circuit
7. Resonance in a Series RLC Circuit
8. The Transformer and Power Transmission
9. Rectifiers and Filters

L. Electromagnetic Waves
1. Maxwell's Equations and Hertz's Discoveries
2. Plane Electromagnetic Waves
3. Energy Carried by Electromagnetic Waves
4. Momentum and Radiation Pressure
5. Production of Electromagnetic Waves by and Antenna
6. The Spectrum of Electromagnetic Waves

VI. METHODS OF INSTRUCTION:
A. Collaborative projects (instructor's option)
B. Internet and other computer based simulations and instructional multi-media
C. Laboratory experimentation
D. **Demonstration** -
E. **Discussion** -
F. **Lecture** -
G. Problem solving

VII. TYPICAL ASSIGNMENTS:
A. Weekly homework assignments from textbook 1. Assigned problems (not to be turned in): a. Chapter 31 – Questions 3, 7 8 b. Chapter 31 – Problems 6, 12, 24, 25, 29, 33, 38, 62, 78, 90 2. Homework problems (to be turned in): a. Chapter 31 – Problems 28, 51, 53, 86 b. Chapter 32 – Problems 2, 3 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, computer simulations and tutorials; both individual and group assignments 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. 3. From the Physlet Physics manual, complete Exploration 22.2: Explore the Effect of Multiple Charges, Exploration 22.4: Dipole Symmetry, Exploration 22.5: Pendulum Electroscope, and Exploration 22.6: Run Coulomb's Gauntlet. Turn in your work with the Chapter 23 homework set. D. Collaborative projects (optional) Research a topic in applied electricity and magnetism. As a group, present the results of your research in a paper, and a presentation to the class. Groups are strongly encouraged to post papers on the WWW. In lieu of a formal paper, however, groups can also conduct an experiment, write a computer simulation, or build a device. As with the paper, you will be required to present the special project to the class.

VIII. EVALUATION:
A. **Methods**

1. Exams/Tests
2. Quizzes
3. Oral Presentation
4. Home Work
5. Lab Activities

B. **Frequency**

1. Frequency
a. Recommend tri-weekly quizzes and final exam (or) two midterm (unit) exams and final exam.
b. Weekly or bi-weekly homework assignments (as described above)
c. Weekly or bi-weekly laboratory assignments (as described above)

IX. TYPICAL TEXTS:
1. R. Knight *Physics for Scientists and Engineers.* 2nd ed., Pearson Education, 2009.
2. Christian and Belloni *Physlet Physics: Interactive Illustrations, Explorations, and Problems for Introductory Physics.* 1st ed., Pearson Education, 2004.
3. D.C. Baird *Experimentation: An Introduction to Measurement Theory and Experiment Design. .* 3rd ed., Prentice-Hall Inc, 1995.
4. Las Positas College Physics 8B Laboratory Manual, available online in PDF format.

X. OTHER MATERIALS REQUIRED OF STUDENTS:

A. A programmable scientific calculator capable of graphing
B. A campus print card