College Of DuPage **Implementation Date:** Fall/05

ACTIVE COURSE FILE

B. *Curricular Area: Physics Course Number: PHY2112

Course Title: Physics for Science and Engineering II

Semester Credit Hours: 5 Lecture Hours: 4 Lab Hours: 3 Clinical Hours: 0

*Changes from the present course must be accompanied by a yellow Course Revision or Deletion Form.

Course description to appear in catalog:

> Calculus-based study of electrostatics, electric fields, Gauss' Law, capacitance, current, resistance, magnetic forces and fields, electromagnetic induction, A. C. circuits, Maxwell's equations, electromagnetic waves, geometric optics and physical optics.

Prerequisite: PHY2111 with a C or better and completion of or concurrent enrollment in MATH 2233

A. General Course Objectives

Upon successful completion of this course the student should be able to do the following:

1. Calculate the forces on static electrical charges using Coulomb's Law
2. Explain the concept of a field as opposed to a force-at-a-distance
3. Calculate the electric field from a system of particles using superposition and integral methods
4. Calculate the strength of the electrical field for symmetric cases using Gauss's Law
5. Calculate the electrical potential of particle caused by the surrounding electric field
6. Explain the relationship between work, electrical potential, electrical potential energy, the electric field and the electro-static force
7. Calculate the current through and voltage drop across various elements in single and multi-loop circuits using Kirchoff's Laws
8. Calculate the capacitance of and the energy stored in an electrical capacitor
9. Explain the concepts involved in each of Maxwell's equations
10. Calculate the magnetic field caused by a moving charge
11. Calculate the force on a moving charge due to a magnetic field
12. Calculate the magnetic forces and torques on both looped and straight current carrying wires.
13. Calculate the currents caused by both mutual-inductance and self-inductance
14. Differentiate between different types of magnetic materials including diamagnetic, paramagnetic and ferromagnetic material
15. Calculate the time varying current flow and voltage drop on various parts of an electrical circuit including resistors, capacitors and inductors
16. Draw basic ray diagrams showing focal point, position of image and position of object for both lenses and mirrors
17. Relate the wave and ray methods of modeling light travel
18. Use Snell's Law to calculate refraction in lenses and surface boundaries

19. Explain the concept of interference of light.
20. Calculate minima and maxima of intensities of electromagnetic waves undergoing thin film interference
21. Explain the concept of the diffraction of light
22. Calculate minima and maxima of intensities of electromagnetic waves undergoing diffraction in both single slit and double slit situations
23. Explain the concept of polarization and calculate the effect of polarizing lenses on intensities of electromagnetic waves

B. Topical Outline

1. Electric Charge
   a. Coulomb's Law
   b. Units of charge
   c. Quantization of charge
   d. Conservation of charge
   e. Linear superposition and Coulomb's Law
   f. Definition and units for the Electric Field

2. Electro-statics
   a. Measuring and calculating electric fields
   b. Fields in special configurations
   c. Electric dipoles in electric fields

3. Gauss' Law
   a. High symmetry and Gauss' Law
   b. Applications of Gauss' Law
   c. Electric potential energy
   d. Definition and units of potential difference
   e. Calculating potential difference
   f. Relation between potential difference and the electric field

4. Capacitance
   a. Capacitors--definition, units and measurement
   b. Calculation of capacitance
   c. Capacitive circuits
   d. Energy stored in a capacitor

5. Current and Resistance
   a. Moving charges in a wire--the electric current
   b. Resistivity and resistance of a wire
   c. Ohm's Law for resistive media
   d. Energy and charge conservation in resistive circuits
   e. Batteries and circuits
   f. Resistive circuits--simple cases
   g. Kirchoff's Laws--complex resistive circuits

6. Magnetic Fields
   a. Magnetic force on a moving charge
   b. Helical motion of charges in uniform magnetic fields
   c. Measurement of momentum and voltage for moving charges--the mass spectrometer
   d. Particle accelerators--linac, cyclotrons and sychrotron

7. Magnetic Fields due to Currents
    a. Current carrying wire in magnetic fields
    b. Current loops in magnetic fields (magnetic dipoles)
    c. Electric motors
    d. Production of magnetic fields by moving charges
    e. Current elements and the Biot-Savart Law
    f. Special cases for the production of B fields
    g. Magnetic lines of force
    h. Symmetry and the production of B fields using Ampere's Law

8. Induction and Inductance
    a. Induced voltages and Faraday's Law
    b. Lenz' Law and induced voltages
    c. Mutual induction--the transformer
    d. Self induction--units of inductance
    e. Simple and complex inductive circuits

9. Maxwell’s Equations
    a. RLC circuits
    b. Damped and forced oscillations in circuits
    c. Impedance--the phasor diagram
    d. Average voltages, current, power, etc
    e. Maxwell's Equations—electric and magnetic fields and waves

10. Geometric optics
    a. Waves vs. rays
    b. The law of reflection
    c. Mirrors--plane and spherical
    d. Image formation
    e. Snell's Law of refraction
    f. Total internal reflection--light pipes
    g. Prisms and lenses--the "lens makers formula"

11. Physical optics
    a. Reflection/refractions
    b. Interference/diffraction
    c. Interference from two or more light sources
    d. Single slit diffraction
    e. The diffraction grating--wave length measurement

C. Methods of Evaluating Student:

Students will be evaluated using a combination of grades from homework, quizzes, and tests along with assessment of lab methods.

Initiator Date

Division Dean Date

Sponsor Date