

PHYS 4B: GENERAL PHYSICS (CALCULUS)

Foothill College Course Outline of Record

Heading	Value
Units:	6
Hours:	5 lecture, 3 laboratory per week (96 total per quarter)
Prerequisite:	PHYS 4A.
Corequisite:	Completion of or concurrent enrollment in MATH 1C.
Degree & Credit Status:	Degree-Applicable Credit Course
Foothill GE:	Non-GE
Transferable:	CSU/UC
Grade Type:	Letter Grade (Request for Pass/No Pass)
Repeatability:	Not Repeatable

Description

Classical electricity and magnetism.

Course Objectives

The student will be able to:

- A. Discuss basic electrostatics and electric potential, and solve related problems.
- B. Analyze resistance, capacitance, and DC circuits, computing associated quantities.
- C. Discuss magnetic fields and forces, and solve related problems.
- D. Explain electromagnetic induction and inductance, and solve related problems.
- E. Extrapolate their understanding of DC circuits and circuit elements to AC circuits.
- F. Explain electromagnetic waves.
- G. Assess the limitations of physical laws and make mathematical approximations in appropriate situations.
- H. Understand how physical laws are established and the role of scientific evidence as support.

Course Content

- A. Discuss basic electrostatics and electric potential, and solve related problems.
 - 1. Concept of charge
 - 2. Conductors and insulators
 - 3. Concept of electric force
 - a. Coulomb's law
 - 4. Concept of electric field
 - a. Electric field lines
 - b. Electric field from a point charge and superposition principle
 - c. Calculating the electric field from charge distributions
 - 5. Gauss's law
 - a. Electric flux
 - b. Applications of Gauss's law
 - 6. Concept of electric potential
 - a. Equipotential surfaces
 - b. Electric potential from a point charge and superposition principle
 - c. Calculating the electric potential from charge distributions

- d. Electric potential energy
- B. Analyze resistance, capacitance, and DC circuits, computing associated quantities.
 - 1. Concept of resistance
 - a. Current
 - b. Resistivity
 - c. Resistance
 - d. Series and parallel configurations
 - e. EMF
 - 2. Concept of capacitance
 - a. Capacitors
 - b. Capacitance
 - c. Dielectrics
 - d. Series and parallel configurations
 - e. Energy stored
 - 3. Concepts involving DC circuits
 - a. Kirchhoff's rules
 - b. Ammeters and voltmeters
 - c. RC circuits
 - C. Discuss magnetic fields and forces, and solve related problems.
 - 1. Concept of magnetism
 - a. Permanent magnets
 - 2. Concept of magnetic fields
 - a. Magnetic field lines
 - b. Magnetic flux
 - c. Magnetic field of moving charges and currents
 - 3. Concept of magnetic force
 - a. Motion of charged particles in magnetic fields
 - b. Force between current carrying wires
 - c. Applications of charged particle motion in magnetic fields
 - 4. Concept of torque on a current loop
 - a. DC motor
 - 5. Ampere's law
 - a. Applications of Ampere's law
 - D. Explain electromagnetic induction and inductance, and solve related problems.
 - 1. Concept of induction
 - a. Faraday's law
 - b. Lenz's law
 - 2. Concept of motional EMF
 - 3. Concept of inductance
 - a. Inductors
 - b. Energy stored
 - c. Self-inductance
 - d. Mutual inductance
 - 4. Concepts involving inductors in circuits
 - a. RL circuits
 - b. LC circuits
 - c. LRC circuits
 - E. Extrapolate their understanding of DC circuits and circuit elements to AC circuits.
 - 1. Concept of phasors
 - 2. Concept of reactance
 - 3. Concept of resonance
 - 4. Transformers
 - F. Explain electromagnetic waves.
 - 1. Maxwell's equations
 - 2. Electromagnetic spectrum
 - G. Assess the limitations of physical laws and make mathematical approximations in appropriate situations.
 - 1. Physical laws as ideal models
 - 2. Methods of approximation

H. Understand how physical laws are established and the role of scientific evidence as support.

1. Historical development of a sampling of physical laws
2. Use of student-collected data in labs to confirm physical laws

Lab Content

A. Suggested laboratory experiments (most experiments should rely upon data generated by student's measurements of physical phenomena):

1. Introduction to measurement uncertainty and error analysis
2. Introduction to electronics lab equipment
3. Mapping electric fields via equipotentials
4. The electric field of a dipole
5. Ohm's law and circuits
6. Measurement of the time constant in an RC circuit
7. Charge to mass ratio of an electron
8. Magnetic field of a solenoid
9. Measurements of inductance
10. Resonance in a driven RLC circuit
11. Construction of an electric motor
12. Experimental design

Special Facilities and/or Equipment

A. Physics laboratory with equipment for teaching introductory electricity and magnetism.

Method(s) of Evaluation

- A. Weekly problem sets
- B. Periodic midterm tests
- C. Laboratory performance
- D. Final examination

Method(s) of Instruction

- A. Lecture
- B. Discussion
- C. Cooperative learning exercises
- D. Electronic discussions/chat
- E. Laboratory
- F. Demonstration

Representative Text(s) and Other Materials

Moebs, Ling, and Sanny. [University Physics](#). OpenStax, 2017.

Types and/or Examples of Required Reading, Writing, and Outside of Class Assignments

A. Homework problems: Homework problems covering subject matter from text and related material ranging from 10-40 problems per week. Students will need to employ critical thinking in order to complete assignments.

B. Lecture: Five hours per week of lecture covering subject matter from text and related material. Reading and study of the textbook, related materials and notes.

C. Labs: Students will perform experiments and discuss their results in either the form of a written lab report or via oral examination. Reading and understanding the lab manual prior to class is essential to success.

Discipline(s)

Physics/Astronomy