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

Methods of Evaluation may include but are not limited to the following:

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

Method(s) of Instruction

Methods of Instruction may include but are not limited to the following:

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