PHYS G280: CALCULUS BASED PHYSICS: ELECTRICITY/MAGNETISM

Item	Value
Curriculum Committee Approval Date	04/04/2023
Top Code	190200 - Physics, General
Units	4 Total Units
Hours	108 Total Hours (Lecture Hours 54; Lab Hours 54)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	No
Basic Skills	Not Basic Skills (N)
Repeatable	No
Open Entry/Open Exit	No
Grading Policy	Standard Letter (S)
California General Education Transfer Curriculum (Cal-GETC)	• Cal-GETC 5A Physical Science (5A) • Cal-GETC 5C Laboratory Activity (5C)
Intersegmental General Education Transfer Curriculum (IGETC)	• IGETC 5A Physical Science (5A) • IGETC 5C Laboratory Activity (5C)
California State University General Education Breadth (CSU GE-Breadth)	• CSU B1 Physical Science (B1) • CSU B3 Laboratory Activity (B3)

Course Description

This course in calculus-based physics covers the topics of electric charge, electric fields, potential dielectrics, DC circuits, magnetic fields, magnetic forces, electromagnetic induction, electromagnetic oscillators, and waves. Transfer Credit: CSU; UC: Credit Limitation: PHYS G120, PHYS G125 and PHYS G185, PHYS G280, PHYS G285 combined - maximum credit, 1 series; Deduct credit for duplication of topics. C-ID: PHYS 210. **C-ID:** PHYS 210.

Course Level Student Learning Outcome(s)

1. Course Outcomes
2. Solve problems involving the laws of electromagnetism using calculus.
3. Employ simple wiring techniques to construct electrical circuits using resistors, capacitors, and inductors for both DC and AC circuits from circuit diagrams.
4. Use various electrical meters, including ammeters, voltmeters, ohmeters, and the oscilloscope to make measurements.

Course Objectives

- 1. Solve problems involving electromagnetic theory using calculus.
- 2. Solve problems using circuit theory using calculus.
- 3. Solve problems involving magnetic fields using calculus.
- 4. Solve problems involving electromagnetic induction and Faraday's law using calculus.
- 5. Solve problems involving Maxwell's equations using calculus.
- 6. Collect data with appropriate sensors and meters to the appropriate significant figures.
- 7. Assemble DC, AC, and RC circuits.
- 8. Measure capacitance, resistance, current, and voltage.
- 9. Measure a magnetic field.
- 10. Construct a voltmeter and an ammeter.

Lecture Content

Electrostatics Charge: Coulomb's law Electric field Line of force Field strength Gauss's law Electric potential Capacitors and dielectrics Current electricity Current Resistance EMF Ohm's law Circuits Electromagnetism Magnetic fields Field near conductors Ampere's law Biot-Savast's law Force on a current Hall effect Induction Faraday's law Lenz's law Inductance Magnetic materials Electromagnetic oscillators LC oscillators Forced oscillation and resonance Maxwell's equations Electromagnetic waves Poynting vector

Lab Content

Analyze data in graphical form consistent with theoretical equations. Perform statistical error analysis and propagation of error analysis. Measure the capacitance and resistance in RC circuits. Perform experiments involving resistance, current, and voltage (Ohm's law and Kirchhoff's laws, and Wheatstone Bridge circuit). Measure the magnetic field of a solenoid. Perform measurements of AC circuits using AC meters and an oscilloscope. Construct voltmeters and ammeters from galvanometers.

Method(s) of Instruction

- Lecture (02)
- DE Live Online Lecture (02S)
- Lab (04)
- DE Live Online Lab (04S)

Reading Assignments

Textbook readings and instructor hand-outs.

Writing Assignments

Regular homework assignments that stress problem solving ability. Lab notebooks that contain a written analysis of each lab exercise.

Out-of-class Assignments

Regular homework assignments.

Demonstration of Critical Thinking

Students demonstrate critical thinking by analyzing given physical situations (reading word problems and interpreting them), applying the basic laws of physics toward the solution of such problems, deducing valid conclusions from their results, and then explaining these results in terms of non-mathematical ideas. From data collected in the lab, students verify and "discover" the basic laws of physics, and use graphs to predict the results of other experiments.

Required Writing, Problem Solving, Skills Demonstration

Regular homework assignments stress problem solving ability. Exams test each student's ability to solve such problems. The laboratory portion of the course is designed to give students practice in making measurements and using lab equipment. Proficiency in the use of lab equipment is deomonstrated by students using lab equipment while being observed by the instructor. Lab notebooks are used to document calculations and an analysis of each experiment.

Eligible Disciplines

Physics/Astronomy: Master's degree in physics, astronomy, or astrophysics OR bachelor's degree in physics or astronomy AND master's degree in engineering, mathematics, meteorology, or geophysics OR the equivalent. Master's degree required.

Textbooks Resources

1. Required Tipler, P. Mosca, G.. Physics for Scientists and Engineers, 6th ed. Macmillan Learning, 2020

Manuals Resources

1. PASCO Scientific. PASCO Scientific's Physics Labs with Computers, PASCO Scientific , 01-01-2023

Other Resources

1. Scientific or graphing calculator 2. Instructor prepared hand-outs