PHYS A280: CALCULUS-BASED PHYSICS: ELECTRICITY/MAGNETISM WITH LAB

Item	Value
Curriculum Committee Approval Date	09/06/2023
Top Code	190200 - Physics, General
Units	5 Total Units
Hours	126 Total Hours (Lecture Hours 72; 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
Grading Policy	Standard Letter (S)
Associate Arts Local General Education (GE)	• OC Physical/Biological Sci - AA (OB)
Associate Science Local General Education (GE)	• OCC Physical/Biological Sci-AS (OSB)
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

Formerly: Calculus-Based Physics: Electricity/Magnetism. Continuation of PHYS A185. Coulomb's law, electrostatics fields, conductors and insulators. Gauss's law and electromagnetic fields. Magnetic fields and Ampere's law. Faraday's law of induction and Maxwell's equations of electromagnetic fields. Electromagnetic energy transfer by means of cables, transmission lines and transparent media. PREREQUISITE: PHYS A185 or PHYS A185H; and MATH A182H, or MATH A180/MATH A180H and MATH A185/MATH A185H, or appropriate OCC placement. Transfer Credit: CSU; UC: Credit Limitation: PHYS A120, PHYS A125, PHYS A130, PHYS A135 and PHYS A185, PHYS A280, PHYS A285 combined: maximum credit, 1 series. C-ID: PHYS 210.**C-ID:** PHYS 210.

Course Level Student Learning Outcome(s)

1. State the basic principles of electromagnetism, define important scientific terms in these areas, and provide explanations of how they apply to real-world situations.
2. Use calculus, algebra, trigonometry, and conceptual reasoning towards the solution of problems involving electromagnetism.
3. Conduct experiments using standard scientific methods, evaluate the resulting data, and construct evidence-based conclusions in a written report.

Course Objectives

- 1. State the basic principles of electromagnetism, define important scientific terms in these areas, and give an explanation of how they apply to real-world situations.
- 2. Use calculus and conceptual reasoning to solve problems involving the laws of electromagnetism.
- 3. Conduct simple experiments using standard scientific methods, evaluate the resulting data, and construct a scientific conclusion in a formal written report.

Lecture Content

Electrostatics, charge conductors and insulators, Coulombs law The electric field, conductors in an electric field, motion of charges in uniform static fields, dipoles, Millikans oil drop experiment Calculus review; Gauss theorem, Stokes theorem, multidimensional calculus, divergence and curl Electric flux, Gauss law Electric potential, potential energy of charge distributions Capacitance and capacitors, energy stored in a capacitor, energy density of the electric field, dielectrics, atomic view of dielectrics Current, current density, resistance, Ohms law, power, microscopic theory of conduction Direct current circuits, electromotive force, Kirchoffs rules, RC circuits, direct current instruments The magnetic field, force on a current-carrying conductor, torque on a current loop, the galvanometer, the motion of charged particles in magnetic fields, combined electric and magnetic fields, the Hall effect Field due to a long, straight wire, magnetic force between parallel wires, Biot-Savart law of a current element, Amperes law Electromagnetic induction, magnetic flux, Faradays law and Lenzs law, generators, the origins of the induced emf Inductance, LR circuits, energy stored in an inductor, LC oscillations, magnetic properties of matter Alternating current circuits: circuit elements in an AC circuit, phasors, RLC series circuits, transformers Displacement current, Maxwells equations, electromagnetic waves, Poynting vector, momentum and radiation pressure, Hertzs experiment, the electromagnetic spectrum, relativistic Doppler effect

Lab Content

Laboratory activities cover a range of topics directly related to the lecture portion of the class, with an emphasis on hands-on activities with "real-world" data collection and analysis, including appropriate use of error propagation, units, and significant figures. Representative experiments include investigations of: Measurement and Error Propagation Statistics Coulombs Law Gauss Law Resistor Circuits RC Circuits Amperes Law Electron Charge-to-Mass Ratio Transformers Inductors RLC Circuits

Method(s) of Instruction

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

Instructional Techniques

1. Lecture and some demonstrations will be used to present the basic concepts. 2. Various methods and strategies of problem solving are taught by thoroughly discussing typical sample problems in the class. 3. Students are provided with an environment that encourages participation with the instructor, i.e. during the office hours of the instructor, during lecture hours, as well as during the experimentation in the lab, students have the opportunity to interact with the instructor. 4. Students will perform laboratory experiments to further the understanding of applications of the theory.

Reading Assignments

2 hrs/week as assigned by instructor from texts, on-line or library research, and/or instructor handouts.

Writing Assignments

For each laboratory experiment, a conclusion has to be written which contains a critical evaluation of the laboratory results.

Out-of-class Assignments

4 hrs/week of assignments and test preparation emphasizing problem solving and concept application.

Demonstration of Critical Thinking

Weekly homework assignments Short problem quizzes Problem solving exams Comprehensive final exam Laboratory experiment reports

Required Writing, Problem Solving, Skills Demonstration

To promote critical thinking component, problem solving will be emphasized in homework and exams. For each laboratory experiment, a conclusion has to be written which contains a critical evaluation of the laboratory results.

Textbooks Resources

1. Required Young, H.D. Freedman, R.A.. University Physics with Modern Physics, 15 ed. Pearson Education, 2019

Other Resources

1. OCC PHYS 280 Laboratory Syllabus 2. Selected handouts to be provided by the instructor