

AP[®] Physics C: Electricity and Magnetism: Syllabus 3

Syllabus 1058824v1



Scoring Components	Page(s)
SC1 The course provides in depth instruction in electricity and magnetism and provides instruction in electrostatics.	2–3
SC2 The course provides in depth instruction in electricity and magnetism and provides instruction in conductors.	3
SC3 The course provides instruction in electricity and magnetism in depth and provides instruction in capacitors.	4
SC4 The course provides in depth instruction in electricity and magnetism and provides instruction in dielectrics.	4
SC5 The course provides in depth instruction in electricity and magnetism and provides instruction in electric circuits.	4
SC6 The course provides in depth instruction in electricity and magnetism and provides instruction in magnetic fields.	5
SC7 The course provides in depth instruction in electricity and magnetism and provides instruction in electromagnetism.	5
SC8 Introductory differential and integral calculus are used throughout the course.	2
SC9 The course utilizes guided inquiry and student-centered learning to foster the development of critical thinking skills.	2
SC10 Students spend a minimum of 20% of instructional time engaged in laboratory work.	2–6
SC11 A hands-on laboratory component is required.	2–6
SC12 Each student should complete a lab notebook or portfolio of lab reports.	2

School Calendar and Schedule

The academic year runs from mid-August until late May. The class meets for 53 minutes each day except Wednesday, when it meets for 35 minutes.

Student Prerequisites

All students must have had a prior physics course, such as AP Physics B or general physics, and must be co-enrolled in integral calculus, as calculus is used extensively throughout the course.

Textbooks

Distribute to the students *Physics for Scientists and Engineers* by Serway and Beichner, 5th edition, 2000. **[SC8]** Make a classroom set of Halliday and Resnick, 4th edition, available for additional problems. Also make teacher-generated notes available.

SC8—Introductory differential and integral calculus are used throughout the course.

Technology

Use an electronic student response system for daily review. Make laptop computers equipped with data acquisition hardware and software available for laboratory use. Provide wireless access to the Internet in the laboratory. The instructor maintains a website for student use from home.

SC9—The course utilizes guided inquiry and student-centered learning to foster the development of critical thinking skills.

Assessments

In addition to the assessments detailed in each unit, give a summative exam consisting of multiple-choice and free-response components at the end of the unit. Also give frequent quizzes for formative assessment.

SC10—Students spend a minimum of 20% of instructional time engaged in laboratory work.

Grade homework for completion and spot-check for correctness.

Place a major emphasis on lab work. Labs are usually designed for the students to discover concepts with a minimum of teacher input. Encourage and guide students to develop their own hypotheses, experiments, and conclusions. **[SC9]** Students often share results between each other in order to discuss their conclusions and error analysis. Hands-on laboratory experiments comprise 20 percent of class time. **[SC10 & SC11]**

SC11—A hands-on laboratory component is required.

Spend additional time on computer simulation-based laboratories. Require students to complete lab reports for all labs and to collect the lab reports in a lab notebook. **[SC12]**

SC12—Each student should complete a lab notebook or portfolio of lab reports.

Have small groups carry out inquiry-based formative-assessment exercises each week.

In April, students take a full-length practice AP Exam.

SC1—The course provides in depth instruction in electricity and magnetism and provides instruction in electrostatics.

Unit 1: The Electric Field (1 week) [SC1]

Objectives

- Charge and Coulomb's law
- The electric field
- Point-charge distributions

- Continuous charge distributions
- Motion of charged particles in an electric field

Student Activities

Electroscope lab: Construction and discovery, among other things, of how to charge the electroscope (+ and –). **[SC10 & SC11]**

Simulation lab: Using the E-field plotter program, students construct point-charge distributions and examine the resulting computer-generated electric field.

SC10—Students spend a minimum of 20% of instructional time engaged in laboratory work.

Assessments

- Written procedure and informal assessment of results

SC11—A hands-on laboratory component is required.

Unit 2: Gauss’s Law (1 ½ weeks) [SC1 & SC2]**Objectives**

- Electric flux
- Gauss’s law (general)
- Gauss’s law and various continuous charge distributions

SC1—The course provides in depth instruction in electricity and magnetism and provides instruction in electrostatics.

Student Activities

Students derive electric fields associated with charged conductors and non-conductors and produce appropriate graphs.

SC2—The course provides in depth instruction in electricity and magnetism and provides instruction in conductors.

Assessments

- Worksheet graded

Unit 3: Electric Potential (1 ½ weeks) [SC1]**Objectives**

- Electric potential and potential difference
- Potential differences in uniform electric fields
- Potential and point charges
- Potential and continuous charge distributions

Student Activities

Simulation lab: Using the E-field plotter or another computer program, students construct charge distributions consisting of point charges, and examine the resulting computer-generated potential surfaces.

AP Physics Lab Guide Experiment: Electric Power and Batteries (1 and 2)

Students derive electric potentials for continuous charge distributions and produce appropriate graphs. **[SC10 & SC11]**

Assessments

- Informal assessment and worksheet graded

Unit 4: Capacitance (1 week) [SC3 & SC4]

Objectives

- Capacitance
- Gauss’s law and capacitance
- Combination of capacitors
- Energy stored in capacitors
- Dielectrics

Student Activities

Students develop and practice the procedure for using Gauss’s law to analyze parallel plate, and cylindrical and spherical capacitors.

Capacitor lab: Using two identical commercial capacitors and one D-cell, create series and parallel circuits to charge the capacitors. Measure the voltage across the plates of each capacitor when connected to the cell and when disconnected. Discharge the capacitors through lightbulbs for a qualitative assessment of energy stored. **[SC10 & SC11]**

Assessments

- Worksheet completion
- Lab report showing circuits and describing results

Unit 5: DC Circuits (2 weeks) [SC5]

Objectives

- Ohm’s law
- Resistivity
- Electrical power
- Electromotive force and internal resistance
- Equivalent resistance
- Kirchhoff’s rules
- RC circuits

Student Activities

AP Physics Lab Guide Experiment: Ohm’s Law (1 and 2) **[SC10 & SC11]**

Resistivity lab: In this inquiry-based lab, students construct resistors from carbonized paper. They measure resistance and calculate resistivity given the resistor dimensions. **[SC10 & SC11]**

SC3—The course provides instruction in electricity and magnetism in depth and provides instruction in capacitors.

SC4—The course provides in depth instruction in electricity and magnetism and provides instruction in dielectrics.

SC10—Students spend a minimum of 20% of instructional time engaged in laboratory work.

SC11—A hands-on laboratory component is required.

SC5—The course provides in depth instruction in electricity and magnetism and provides instruction in electric circuits.

Multi-loop circuit lab: Students construct multi-loop circuits or are provided with simulations of such circuits. Students use programmable calculators to solve equations simultaneously to analyze the current in each loop. **[SC10 & SC11]**

AP Physics Lab Guide Experiment: RC Time Constant: Students construct RC circuits with known resistors and capacitors. Students use computers with data acquisition hardware and software to analyze the circuit. Time constant and amount of charge stored on the capacitor must be obtainable from graphs generated. **[SC10 & SC11]**

Assessments

- Lab reports with circuit diagrams and calculations

SC10—Students spend a minimum of 20% of instructional time engaged in laboratory work.

SC11—A hands-on laboratory component is required.

Unit 6: Magnetostatics (2 weeks) [SC6]

Objectives

- Magnetic force on moving charges and currents
- Path of moving charge in a magnetic field
- Hall effect
- Biot-Savart law
- Parallel conductors
- Ampere’s law
- Solenoids and toroids

SC6—The course provides in depth instruction in electricity and magnetism and provides instruction in magnetic fields.

Student Activities

Magnetic force lab: Students construct a device that shows the existence of a magnetic force on a current-carrying wire using common lab equipment. **[SC10 & SC11]**

Hall-effect lab: Students show the Hall effect using computers and data acquisition technology. **[SC10 & SC11]**

Solenoid lab: Students measure a magnetic field inside a solenoid and its variation with current. Students calculate how many layers of wire wrap around the solenoid core. **[SC10 & SC11]**

Assessments

- Assessment of student demo and explanation during activity
- Lab reports containing data table and calculations

Unit 7: Magnetic Induction (2 weeks) [SC7]

Objectives

- Magnetic flux
- Gauss’s law of magnetism
- Faraday’s law of induction

SC7—The course provides in depth instruction in electricity and magnetism and provides instruction in electromagnetism.

- Lenz's law
- Induced *emf* and electric fields
- Generators and motors
- Maxwell's equations

Student Activities

Faraday's law of induction lab: Provide students with two solenoids (one of which fits inside the other), an iron bar, computers, and voltage sensors to illustrate Faraday's law. [SC10 & SC11]

Motor/generator presentation lab: Students dissect a small electric motor or generator and, using digital photographs or other diagrams, produce a PowerPoint presentation describing how it works. [SC10 & SC11]

SC10—Students spend a minimum of 20% of instructional time engaged in laboratory work.

SC11—A hands-on laboratory component is required.

Assessments

- Lab report of data and explanation of results
- Assessment of PowerPoint presentation

Unit 8: Inductance (1 ½ weeks)

Objectives

- Self-inductance
- RL circuits
- Energy in magnetic fields
- Mutual inductance
- Electronic oscillations in LC circuits
- The RLC circuit

Student Activities

Differential equation worksheet: Students will use differential equations for electronic oscillator; similarities with mechanical oscillators.

Synthesized music presentation lab: Students do an Internet investigation and create a PowerPoint lesson describing how electronic music is produced. Alternatively, they may dissect a cheap piece of electronic equipment and describe how it works. [SC10 & SC11]

Assessments

- Worksheet completion
- Assessment of presentation