AP Physics C: Syllabus

Personal Philosophy

Physics is the oldest and most fundamental branch of science. I feel that physics connects to all aspects of our daily lives through the explanations of motion, forces, and energy. Modern students depend on various technologies in their daily lives which are rooted in applied principles of physics. Teaching AP Physics provides me with the opportunity to teach students of the connections between physics and their world, hopefully inspiring them to desire to investigate further.

Course Overview

This Advanced Placement Physics C course is designed to encompass both AP Physics C: Mechanics and AP Physics C: Electricity and Magnetism. Together this course is intended to be equivalent to two-semesters of college introductory physics for science and engineering students. All ABET accredited colleges require engineering majors to take calculus based physics during their 1st year of college. The course is intended to provide students with the conceptual framework, application of concepts, and analytical skills for problem solving required for understanding the diverse science of physics. Classes meet 4 times in a six day cycle for 86 minutes for four terms (120 days). Due to AP examinations being taken during term 4, the content is planned to be covered in 3 terms, with term 4 being utilized for examination preparations and additional topics as time permits. This makes it possible to do all of the 10 labs in the *AP Physics Lab Guide*, as well as, additional labs. The required course topics are planned to finish prior to the exam, allowing for additional topics to be covered and review sessions to be conducted. Additional review sessions may be held during several evenings in April and May.

The general areas covered in this course include Mechanics, Electricity, and Magnetism. Emphasis will be placed on developing an understanding of the practical application rather than on memorizing terms and technical details of the material. The Mechanics units will provide the framework of analytical skills necessary for problem solving with any concept presented. All units will verify the connections between various concepts. For example, in Electrostatics, the connection between Mechanics and Electrostatics will be made through problems such as why two electrons are repelled by columbic forces since it is greater than the gravitational attraction between the electrons due to their mass. All units emphasize that physics is a component of engineering and technology.

Units are also organized around the four goals of developing student abilities from the AP Physics Curricular requirements. (Read, understand, and interpret physical information; Describe and explain a sequence of steps in the analysis of a physical problem; Use basic mathematical reasoning; and Perform experiments and interpret the results of observations) Units include textbook readings, supplemental handouts and hands on demonstrations, quizzes, projects, and labs. Most labs are student directed with limited directions provided as opposed to prescribed or “cookbook” labs. Students’ knowledge of each unit is assessed with a unit test. Unit tests are designed in the AP Physics Exam style, and include multiple-choice and free-response questions.

Students are encouraged to focus on understanding important relationships, problem solving process, laboratory process, and applications of concepts to technology. Student testing is focused on their abilities to explain, analyze, and interpret physical phenomena. Prior to an exam, we discuss as a class how the topic relates to and fits within the progression of material in the course. This will illustrate how each topic connects as we go through all topics of the course.

Examples of Skills Development

1. **Read, understand, and interpret physical information- verbal, mathematical, and graphical**

   Ex: Scientific Journal Articles will be assigned for reading. Students will be required to write 2 to 3 page summaries which explain the articles as well as any connections to material presented in class to date.

2. **Describe and explain the sequence of steps in the analysis of a particular physical phenomenon or problem**

   Ex: Students will be required to develop written explanations for demonstrations done in class as well as written explanations of problem solving method for occasional assigned problems.

3. **Use basic mathematical reasoning- arithmetic, algebraic, geometric, trigonometric, or calculus, where appropriate- in a physical situation or problem**

   Ex: Utilize mathematical concepts during problem solving during homework and in class. Students will on occasion be required to use their mathematical skills to attempt independent derivations of formulas used in class.

4. **Perform experiments and interpret the results of observations, including making an assessment of experimental uncertainties**

   Ex: Each lab activity will require independent performance of experiments and interpretation of data. Students will be record all observations, including uncertainties in measurement, systematic errors, etc. All uncertainties will be accounted for and discussed in lab reports.

Course Objectives

- To develop a conceptual framework for physics, not memorizing facts.
- To develop an ability to understand calculus as it applies to physics
- To gain lifelong appreciation of science as a process.
- To become proficient in designing, conducting, and analyzing experiments while using laboratory equipment effectively.
- To recognize connections between the major topics of physics.
- To develop the essential skills of critical thinking and scientific problem solving that are required for scientific excellence.
- To successfully complete the AP Physics C: Mechanics and AP Physics C: Electricity and Magnetism Exams.

Texts

Giancoli, Douglas C., J. Reece. *Physics for Scientists and Engineers with Modern Physics*, 4th Edition, Pearson: Prentice Hall (2009).

Course Planner

I organize my course into eleven units summarized in the following syllabus. Students are given the syllabus in June before leaving for summer vacation, along with their summer assignment. We spend approximately two to three weeks on each unit.

Summer and First Term

Unit 1: Kinematics (2 Weeks)

a. Motion in One-Dimension
b. Motion in Two-Dimensions
c. Projectile Motion

- Chapter Readings:
- AP Lab #1: Diluting Gravity
- Lab: Accelerating Objects
- Summer Project: Independent Research

Unit 2: Newton's Laws of Motion (2 weeks)

a. Static equilibrium (first law)
b. Dynamics of a single particle (second law)
c. Systems of two or more objects (third law)

- Chapter Readings:
- AP Lab #2: The Coffee Filter and Air Resistance
- Lab: Atwood's Machine

Unit 3: Work, Energy, Power (3 weeks)

a. Work and work-energy theorem
b. Forces and potential energy
c. Conservation of energy
d. Power

- Chapter Readings:
- Lab : Finding your horsepower
- Lab : Roller coaster designs

Unit 4: Systems of particles, linear momentum (2 weeks)

a. Center of mass
b. Impulse and momentum
c. Conservation of linear momentum, collisions

- Chapter Readings:
- AP Lab #3: Elastic Collisions
- Lab: Inelastic Collisions

Second Term

Unit 5: Circular momentum and rotation (2 weeks)

a. Uniform circular motion
b. Torque and rotational statics
c. Rotational kinematics and dynamics
d. Angular momentum and its conservation

- Chapter Readings:
- Lab #4: Turning Point
- Lab #5: Whirligig

Unit 6: Oscillations and gravitation (3 weeks)

a. Simple harmonic motion
b. Mass on a spring
c. Pendulum and other oscillations
d. Newton's law of gravity
e. Orbital of planets and satellites

- Chapter Readings:
- AP Lab #6: Hooke's Law and Harmonic Motion
- Lab: Pendulum Lengths

Unit 7: Electrostatics (3 weeks)

a. Charge and Coulomb's law
b. Electric field and electric potential
c. Gauss's law
d. Field and potentials of other charge distributions

- Chapter Readings:

- Lab: Columbic Forces with static electricity

Unit 8: Conductor, capacitors, dielectrics (3 weeks)

a. Electrostatics with conductors
b. Capacitors
c. Dielectrics

- Chapter Readings:
- Lab: Designing tin foil capacitors

Third Term

Unit 8: Conductor, capacitors, dielectrics (finish unit)

Unit 9: Electric circuits (3-4 weeks)

a. Current, resistance, power (Ohm's law)
b. Steady-state direct current circuits with batteries and resistors
c. Capacitors in circuits
d. Kirchoff's Circuit Law with multi-loop circuits

- Chapter Readings:
- AP Lab #7: Ohm's Law
- AP Lab #8: Electric Power and Batteries
- AP Lab #9: RC Time Constants

Unit 10: Magnetic Fields (3 weeks)

a. Forces on moving charges in magnetic fields
b. Forces on current-carrying wires in a magnetic field
c. Fields of long current-carrying wires
d. Biot-Savart law and Ampere's law

- Chapter Readings:
- AP Lab #10: Magnetic Fields

Unit 11: Electromagnetism (3 weeks)

a. Electromagnetic induction
b. Inductance
c. Maxwell's Equations
d. Faraday's Law
e. Lenz's Law

- Chapter Readings:
- Lab: Inducing a current

Fourth Term

Continuation of topics as needed.
Review for Exams
Additional topics as time permits

Lab Component

Labs make up a minimum of 25% of the time students are in class and most labs run 1-2 class blocks. All ten of the AP labs are preformed and all AP labs are student conducted and hands-on. Supplemental labs and activities are used to widen the range of topics covered in a hands-on, discovery mode. Student will be required to keep separate lab notebooks. This helps to further simulate the college experience. Lab work is preformed in groups of 2 or 3. This ensures that all students develop good lab skills, learn to work in groups, and understand the importance of collaboration among scientists. All labs that come from the AP Lab Manual have some type of pre-lab discussion and post lab summary. Students are required to turn in a write-up for each lab preformed. Write-ups will vary depending on the lab. All data tables and questions in the lab manual must be filled in and answered for all ten AP labs. Many labs will require a formal lab report (i.e. title, introduction/background information, purpose, procedure, data, analysis, conclusion, and recommendations), while others only require a well-organized data summary and brief conclusion. Quality over quantity is highly stressed and students are generally given 2-3 classes to complete a lab report.

Teaching Strategies

Students begin each chapter with either a list of objectives or guided notes to help them focus on the key concepts and main points in each chapter. Lectures are generally presented as PowerPoints after students have read the chapter and include class discussions, animations, and videos. Animations and videos come from various sources (textbook CDs, internet, television) and are used to help students visualize what they have learned. Problem solving is the key component to successful understanding of the material presented. Classes will require students to develop problem solving skills through the increase in difficult of problems presented. This will begin with students being given problems relevant to the material presented, which we will walk through as a class step by step. Afterwards, students will work individually or in small groups on additional problems which build upon their example using their knowledge of the material presented. On occasions students may preform brief laboratory activities as part of their problem solving process to ensure the underlying concept is grasped. These independent problems will then be recapped, generally with students explaining their solutions to each other in front of the class. The majority of class time not spent in lab is spent in lecture and on problem solving. Quizzes are given every chapter to provide formative assessment information to both the students and me. Journal articles may be used as resources throughout the course to help connect physics concepts with the outside world. These articles are used to generate class discussions on modern and historical environmental and social concerns associated with physics.

Student Evaluation

Grades are based on the total number of points accumulated during the marking period. The majority of these points will come from tests, labs, and projects.

Typically:

Tests……	80-100 points
Labs ……	40-50 points
Projects and Journal Articles …..……	20-50 points
Quizzes ……	10-20 points
Homework ……	5-10 points