Advanced Placement Physics 1&2

General Information and Course Policies

Course Objectives

This course is designed to prepare the student for the Advanced Placement Physics 1 and Advanced Placement Physics 2 examinations.

General Procedures and Class Activities

- The class will meet for one or two periods every other day. During this time there will be a variety of activities taking place. Some of the activities include, but are not limited to: laboratory work, class discussion, demonstrations, projects, problem solving activities, quizzes and tests.

- Various activities will require the student to use critical thinking skills. These activities will require the student to make predictions and calculations for theoretical models based principles covered during class. Many of these activities will require the student to use physics applets and simulation software on the internet, which can be found on the instructor's home page.

Prerequisites and Mathematical Competency

- The techniques for problem solving heavily rely upon mathematics in this course. The student is expected to have successfully completed Honors or General Chemistry, and be competent in the following areas of mathematics:
- ***Algebra (including solving systems of equations)***
- ***Trigonometry***
- ***Logarithms and exponential functions***
- ***Scientific Notation and Unit Conversion***
- ***Graphical Analysis of Data***

A Scientific calculator is required
Programmable calculators with graphing capabilities are highly recommended.

Evaluation and Grading

The instructor will use a point system in this course
The student will be graded upon the following activities:

Activity	**Point Value**
Class assignments*	**5 - 20**
Laboratory Activities*	**5 - 50**
Homework	**5-15**
Quizzes*	**5-20**
Projects	**15-50**
Exams*	**80-140**

*** If absent, the student must make up the quiz, test or assignment the following day and present the instructor with an excused absence pass from his/her homeroom teacher, or receive a zero on that assignment**

The student's percentage for each nine week period will be calculated using the following formula:

$$\text{Grade} = \frac{\text{Number of points earned by student}}{\text{Total Number of points possible}} \times 100\ \%$$

The Student's final grade for the course will be the average of the four nine week grades.

Scoring System

89.5-100 A
79.5-89.4 B
69.5-79.4 C
59.5-69.4 D
59.4 and below E

Course Policies

- **Following an absence from class, the student must present the instructor with an excused admission pass from his/her home room teacher. Notes from home will not be accepted. Unexcused absences will result in discipline procedures consistent with the Student Hand Book.**
- **Three unexcused tardiness in any one nine week period will result in a detention being administered**
- ***The instructor has the right to administer an alternate version of a make - up test or quiz that will be given to the student following an excused absence from an exam.***
- ***An unexcused absence or tardy from a test or quiz will result in the student receiving a zero on that assignment and discipline procedures as outlined above.***
- ***Cheating on an exam or quiz or other assignment is an automatic failure of that assignment.***
- ***All assignments, tests and quizzes are due on the day given by the instructor.***

- ***If absent, the student must make up the quiz or test the following day and present the instructor with an excused absence pass from his/her homeroom teacher, or receive a zero on that assignment as noted above.***

Outline of Topics

Topic
Classical Mechanics 9 Weeks
• Introduction to the course • Review of math skills
Vectors
• Vectors and vector math • Vectors and scalars • Graphical and trigonometric methods of vector addition • Subtraction of vectors

• Multiplication by a scalar
Motion in One Dimension and Kinematics
• One dimensional motion • Reference frames • Distance and displacement • Average speed, average velocity, and instantaneous velocity • Constant acceleration • Kinematics equations for constant acceleration
• Free fall
• Graphical analysis of motion • Position, velocity, and acceleration time graphs
Motion in Two Dimensions and Projectile Motion
• 2D Motion : Introduction
• Projectile motion: Special case of 2-d motion
• Relative Motion
Newton's Laws of Motion and Dynamics
• Motion and Force : Dynamics • Definition of a Force • Newton's first law • Inertia • Mass
• Weight: the force of gravity • Contact forces • The normal force • Free body diagrams and analysis
• Friction • Motion on an inclined plane with and without friction
• Conditions for equilibrium
• Equilibrium with torque
• Kinematics and dynamics of uniform circular motion

• A car rounding a curve • Banked curves • Unbanked curves
• Non – uniform circular motion
• Newton's universal law of gravitation • Calculation of the gravitational field near the earth's surface
• Satellite motion
• Kepler's Laws of Planetary Motion • Newton's synthesis of Kepler's third law
• Types of forces in nature
Work, Energy and Power
• Work and energy • Work by a constant force • The dot product
• Work done by a varying force
• Kinetic energy • Work energy theorem
• Gravitational potential energy • Elastic potential energy and springs
• Conservative and non – conservative forces
• Conservation of mechanical energy
• Problem solving using conservation principles
• Dissipative forces
• Power
Systems of Particles and Linear Momentum
• Momentum and its relation to force • The relationship between momentum and impulse • Conservation of momentum
• Collisions and impulse
• Conservation of momentum in collisions
• Elastic collisions in one dimension • (energy and momentum)

• Inelastic collisions in one dimension
• Two dimensional inelastic collisions
• Center of mass
Rotational Kinematics and Rotational Dynamics
• Rotational motion
• Rotational Kinematics and rolling motion
• Torque
• Torque and rotational inertia • Newton's second law applied to torque and rotational motion
• Rotational kinetic energy
• Angular Momentum and its Conservation
• Equilibrium Conditions with incorporating torque
Simple Harmonic Motion
• Simple Harmonic motion • Graphical analysis of position, velocity, and acceleration time graphs for simple harmonic motion • Energy in the simple harmonic oscillator • The sinusoidal nature of SHM Reference circle
The simple pendulum
Fluids 1.5 Weeks
• Density and specific gravity • Pressure • Pressure due to depth in a hydrostatic fluid • Atmospheric pressure and gauge pressure • Pascal's principle
• Buoyancy and Archimedes' principle
• The Equation of continuity
• Bernoulli's Equation • Applications of Bernoulli's equation

Heat, Kinetic Theory and Thermodynamics 3 Weeks
• Temperature and kinetic theory • Atomic theory of matter • Temperature and thermometers • Thermal equilibrium and the zero th law of thermodynamics
• Thermal expansion of solids and liquids
• Anomalous behavior of water below 4 degrees centigrade
• The gas laws and absolute temperature
• The Ideal Gas Law • The Kinetic Theory of Gasses
• Heat as thermal energy transfer • Distinction between temperature, heat and internal energy • Internal energy of an ideal gas
• Specific heat • Calorimetry – solving problems
• Latent heat
• Heat transfer Conduction, Convention, Radiation
• The laws of Thermodynamics • The First Law of Thermodynamics • Work and thermodynamic processes • Isobaric, Isochoric, Isothermal and Adiabatic processes • The analysis of a thermodynamic cycle and its relation to the First Law of Thermodynamics
• The Second Law of Thermodynamics • Heat Engines • Diesel,Otto, and Stirling Cycles • Efficiency of an Engine • The Carnot Cycle • The Efficiency of a Carnot Engine
• Refrigerators, and Heat Pumps
• Entropy, and the Second Law of Thermo dynamics

Waves and Sound 2 Weeks
Types of waves
• Sound • Speed of sound
• Intensity of a sound wave • Sound level (decibels)
• Reflection and interference of waves • Standing waves on a string (resonance) • Refraction and diffraction
• Sources of sound • Vibrating strings and columns of air • Resonance in columns of air
• Interference of sound waves • Beats
• The Doppler effect
Optics 3 Weeks
• The Electromagnetic spectrum • Measuring the speed of light
• Light: Geometric Optics • The ray model
• Reflection of light
• Index of refraction
• Snell's law
• Total Internal reflection
• Formation of images from spherical mirrors and ray tracing
• Thin lens , ray tracing • The Lens Equation • Problem solving
• Lenses in combination
• The Lens Maker's Equation
• The Wave Nature of Light • Huygen's principle and diffraction
• Young's double slit experiment
• Dispersion of Light
• Single slit diffraction
• The Diffraction grating

• Interference of light in thin films
• Polarization of light
Electrostatics and Electric Circuits 5 Weeks
• Electric charge • Static electricity • Conservation of charge • Atoms, insulators and conductors • Induced charge
• Coulomb's law • Problem solving using Coulomb's law
• The Electric Field • The Electric Field due to multiple point charges • Electric Field lines • Electric field and conductors
• The Electric potential and potential difference • Definition of Potential difference
• The relationship between the electric potential and the electric field • The Gradient • Equal potential Surfaces • The Electron Volt
• The Electric potential due to a point charge
• Capacitance • Dielectrics
• Storage of electric energy
• Electric currents • Electromotive Force (EMF) • The battery • Electric current • Ohm's law and resistance • Resistively
• Electric power • Power in household circuits
• Alternating current • Peak and RMS values
• Resistors in series and in parallel
• Kirchhoff's rules for circuit analysis

• Problem solving applying Kirchhoff's rules to multiple loop circuits with multiple EMF's • Internal Resistance
• Capacitors in series and parallel
• Circuits containing resistors and capacitors in combination
Magnetism ***Magnetostatics and Electromagnetic Induction*** 2.5 Weeks
• Magnetic fields • Electric currents produce magnetism
• Force on a current in a magnetic field • Force on a charged particle in a magnetic field • Right hand rule to determine the direction of a magnetic force
• Magnetic field due to a straight wire • Right hand rule to determine the direction of a magnetic field produced by a current • Force between two parallel wires
• Torque on a current loop • The magnetic moment
• Electromagnetic induction • Induced emf • Emf induced in a moving conductor • Magnetic Flux • Faraday's law of induction • Lenz's law • Problem solving using Faraday's law of induction in combination with lenz's law
Modern Physics 2 Weeks
• Quantization of energy • The photon • The Photoelectric Effect
• Compton Effect
• Wave particle duality

• Wave nature of matter • Models of the atom • The Bohr model • De Broglie's hypothesis applied to atoms
• Nuclear physics • Structure of the nucleus • Binding energy
• Nuclear reactions

Special Relativity 1Week
• Galilean-Newtonian relativity • The Michelson-Morely experiment • Postulates of the special theory of relativity
• Simultaneity
• time dilation
• length contraction
• relativistic addition of velocities
• Relativistic energy and kinetic energy
• relativistic momentum and mass

Summary of Laboratory Activities

Title: Graphical Analysis of One Dimensional Motion
Description: Using simulation software the students make position vs. time graph of an object undergoing uniform acceleration. They will use graphing software to analyze the slope of the tangent lines to create a velocity-time graph and calculate the acceleration from the slope.
Duration: 1 period
Approximate Time of Year: Late August –Early September

Title: Projectile Motion
Description: The students are required to determine the initial velocity of a PASCO ball launcher. From that information they are required to reset the angle to hit various targets.
Duration: 2 periods
Approximate Time of Year: September

Title: Applications of Newton's Laws
Description: The students are required to calculate the coefficient of kinetic friction between a wood block and an inclined plane using a PASCO track system and a photogate. The second part of the lab involves attaching the block to a counter weight and pulley system, and calculating how much counter weight is necessary to place the system in equilibrium.
Duration: 2 periods
Approximate Time of Year: end of September

Title: Uniform Circular Motion
Description: Using a fire polished glass tube with a mass attached to a string at one end, and a counter weight attached, the students verify the relationship between velocity and centripetal force.
Duration: 2 periods
Approximate Time of Year: early October

Title: Potential Energy of a spring system
Description: Using a vertical spring system, the students investigate the nature of Hooke's law and how much energy is stored in the system
Duration: 1 period
Approximate Time of Year: October

Title: Torque and Moments of Inertia
Description: using a rotating system and counter weight the students investigate the relationship of Newton's second law for rotating rigid bodies.
Duration: 1 period
Approximate Time of Year: November

Title: Thermal Energy
Description: using a calorimeter and ice the students investigate the thermal energy of a system reaching an equilibrium temperature
Duration: 2 periods
Approximate Time of Year: early December

Title: Ohm's law
Description: Using a resistor, potentiometer, volt and ammeter the student calculates the resistance using graphical analysis.
Duration: 1 period
Approximate Time of Year: End of January

Title: Kirchhoff's Rules for Circuit analysis

Description: Using several resistors, the student is required to setup a multiple loop circuit with two or more EMF's. Using a multi meter the student is required to measure the current through each branch of the circuit, and the potential difference across various points. The students will then compare their experimental results with the theoretical values they calculated using Kirchhoff's loop and junction rules.
Duration : 1 period
Approximate time of Year: End of January

Title: Virtual Electronics Lab: Multiple Loop Circuits
Description: Using Simulation software, the student builds multiple loop and EMF circuits, and uses Kirchhoff's laws to calculate current.
Duration: 3-4 periods
Approximate Time of Year: early February

Title: Resistor - Capacitor Circuits
Description: Using a resistor Capacitor circuit and volt meter the student will analyze the growth and decay of voltage and current in that type of circuit
Duration: 2 periods
Approximate Time of Year: February

Title: Snell's law
Description: Using a PASCO optics kit the students record the refracted angle and incident angle for a piece of semicircular glass prism. Using graphical analysis the students determine the index of refraction, and in the process verify Snell's law.
Duration: 1 period
Approximate Time of Year: March

Title: Multiple Lens System
Description: Using a PASCO optics kit the students will set up a multiple lens system to locate the position of the final image. They will verify their experimental results with their theoretical prediction.
Duration: 1-2 periods
Approximate Time of Year: March

Title: Double slit Interference
Description: Using a laser of known wavelength and a PASCO optics kit the students determines the slit separation based on the observed interference pattern
Duration: 2 periods
Approximate Time of Year: March

Title: Single Slit Diffraction
Description: Using a laser of known wavelength and a PASCO optics kit the students determines the slit with of a single slit and determines the with of a human hair using the same laser.
Duration:1-2 periods
Approximate Time of Year: Early April

Title: Diffraction Grating
Description: Using a laser of known wavelength and a PASCO optics kit the students determines the spacing for the diffraction grating. Then they will use the same grating to determine the wavelengths for red, green and blue light.
Duration:1-2 periods
Approximate Time of Year: April