SPRING GROVE AREA SCHOOL DISTRICT

PLANNED COURSE OVERVIEW

Course Title: Advanced Placement Physics 2	**Length of Course:** 30 cycles
Grade Level(s): 11-12	**Periods Per Cycle:** 9
Units of Credit: 1.5 credits	**Length of Period:** 43 minutes
Classification: Elective	**Total Instructional Time:** 193.5 hours

Course Description

The AP Physics 2 course is designed to be taken after successfully completing the AP Physics 1 course. This course is designed to prepare students for the College Board Advanced Placement Exam which is administered in May, therefore it is fast paced and rigorous. The course will be presented at a pace similar to AP Physics 1. In addition, AP Physics 2 will offer a variety of in depth laboratory experiences with the use of electronic data gathering equipment such as the Labquest. Prerequisites: Successful completion of AP Physics 1, with a passing grade of 85% or teacher recommendation.

Instructional Strategies, Learning Practices, Activities, and Experiences

Practice AP Exams & Essays	Bell Ringers	Teacher Demonstration
Formal Assessments	Class Discussion	Detailed Laboratory Experiments
Guided Practice	Flexible Groups	Inquiry Laboratory Experiments
Online Tutorials/Resources	APL Strategies	Textbook Reading
Critical Thinking	Posted Objectives and agenda	Homework

Assessments

Quizzes	AP Physics 2 exam by the College Board	Practice exams
Chapter exams	Lab reports	Homework problem sets

Materials/Resources

Text – Physics by Giancoli (Prentice Hall)

Adopted: 5/19/14
Revised:

<table>
<tr><th colspan="2">Electricity and Magnetism</th></tr>
<tr><th>CONTENT/KEY CONCEPTS</th><th>OBJECTIVES/STANDARDS</th></tr>
<tr><td>Electrostatics
1. Charge and Coulomb’s Law
2. Electric field and electric potential (including point charges)
3. Gauss’s law
4. Fields and potentials of other charge distributions</td><td>1. State from memory the magnitude and sign of the charge of an electron and a proton and also state the mass of both particles.
2. Apply Coulomb’s law to determine the magnitude of the electric force between point charges separated by a distance r and state whether the force will be one of attraction or repulsion.
3. State from memory the law of conservation of electric charge.
4. Distinguish among insulators, conductors, and semiconductors and give examples of each.
5. Explain the concept of an electric field and determine the resultant electric field at a point some distance from two or more point charges.
6. Determine the magnitude and direction of the electric force on a charged particle placed in an electric field.
7. Sketch the electric field lines in the region between charged objects.
8. Use Gauss’s law to determine the magnitude of the electric field in problems in which static electric charge is distributed on a symmetrical surface.
9. Write from memory the definitions of electric potential and electric potential difference.
10. Distinguish among electric potential, electric potential energy, and electric potential difference.
11. Draw the electric field pattern and equipotential line pattern that exist between charged objects.
12. Determine the magnitude of the potential at a point a known distance from a point charge or an arrangement of point charges.
13. State the relationship between electric potential and electric field and determine the potential difference between two points a fixed distance apart in a region where the electric field is uniform.
14. Determine the kinetic energy in both joules and electric volts of a charged particle that is accelerated through a given potential difference.
15. Explain what is meant by an electric dipole and determine the magnitude of the electric dipole moment between two point charges.</td></tr>
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Electricity and Magnetism	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
Conductors, capacitors, dielectrics 1. Electrostatics with conductors 2. Capacitors a. Capacitance b. Parallel plate c. Spherical and cylindrical 3. Dielectrics	1. Given the dimensions, the distances between two plates, and the dielectric constant of the material between the plates, determine the magnitude of the capacitance of a parallel-plate capacitor. 2. Given the capacitance, the dielectric constant, and either the potential difference or the charge stored on the plates of a parallel-plate capacitor, determine the energy and the energy density stored in the capacitor.
Electric circuits 1. Current, resistance, power 2. Steady-state direct current circuits with batteries and resistors only 3. Capacitors in circuits a. Steady state b. Transients in RC circuits	1. Explain how a simple battery can produce an electric current. 2. Define current, ampere, voltage, resistance, resistivity, and temperature coefficient of resistance. 3. Write the symbols used for electric current, resistance, resistivity, temperature coefficient of resistivity, and power and state the units associated with each quantity. 4. Distinguish between conventional current and electron flow and between direct current and alternating current. 5. Given the length of the wire and its cross-sectional area, resistivity, and temperature coefficient of resistivity, determine the wire's resistance at room temperature and at some higher or lower temperatures. 6. Use Ohm's law to solve simple dc circuit problems. 7. Use the equations for electric power to determine the power and energy dissipated in a resistor and to calculate the cost of this energy to the consumer. 8. Distinguish between the rms and peak values for current and voltage and apply these concepts in solving problems involving a simple ac circuit.

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Magnetic Fields 1. Forces on moving charges in magnetic fields 2. Forces on current-carrying wires in magnetic fields 3. Fields of long current-carrying wires 4. Biot–Savart Law and Ampere's Law	1. Define and write the symbol for emf. 2. Determine the equivalent resistance of resistors arranged in series, parallel, or in series-parallel combination. 3. Use Ohm's law and Kirchhoff's rules to determine the current through each resistor and the voltage drop across each resistor in dc circuits with one or more loops. 4. Distinguish between the emf and the terminal voltage of a battery and calculate the terminal voltage given the emf, internal resistance of the battery, and external resistance in the circuit. 5. Know the symbols used to represent a source of emf, a resistor, a voltmeter, and an ammeter and how to interpret a simple circuit diagram. 6. Determine the equivalent capacitance of capacitors in series or in parallel or the equivalent capacitance of a series-parallel combination. 7. Determine the charge on each capacitor and the voltage drop across each capacitor in a circuit where capacitors are arranged in series, parallel, or in a series-parallel combination. 8. Calculate the time constant of an RC circuit. Determine the charge on the capacitor and the potential difference across the capacitor at a particular moment of time and the current through the resistor at a particular moment in time. 9. Describe the basic operation of a galvanometer and calculate the resistance that must be added to convert a galvanometer into an ammeter or a voltmeter.

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CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
Electromagnetism 1. Electromagnetic induction (including Faraday's Law and Lenz's Law) 2. Inductance (including lr and lc circuits) 3. Maxwell's equations	1. Determine the magnitude of the magnetic field produced by both a long, straight, current-carrying wire and a current loop. Use the right-hand rule to determine the direction of the magnetic field produce by the current. 2. Explain what is meant by ferromagnetism and include in the explanation the concept of domains and the Curie temperature. 3. State the conventions adopted to represent the direction of a magnetic field, the current in a current-carrying wire, and the direction of motion of a charged particle moving through a magnetic field. 4. Apply the right-hand rule to determine the direction of the force on either a charged particle traveling through a magnetic field or a current-carrying wire placed in a magnetic field. 5. Determine the torque on a current loop arranged in a magnetic field and explain galvanometer movement. 6. State Ampere's law and understand when to apply it. 7. Explain how a mass spectrometer can be used to determine the mass of an ion and how the device can be used to separate isotopes of the same element. 8. Determine the magnitude of the magnetic flux through a surface. 9. Use Faraday's Law to determine the magnitude of the induced emf in a closed loop due to a change in the magnetic flux through the loop. 10. Use Faraday's Law to determine the induced emf in a straight wire moving through a magnetic field. 11. State and use Ohm's Law and Lenz's Law to determine the magnitude and direction of the induced current. 12. Explain the principle of the electric generator. 13. Explain how an eddy current can be produced in a piece of metal. 14. Explain how a transformer can be used to step up or step down the voltage. 15. Explain what is meant by mutual and self inductance. 16. Write the equations for the average induced emf in a solenoid in which the current is changing. 17. Write the equation for the energy stored in an inductor's magnetic field and the energy stored per unit volume. 18. Distinguish among resistance, capacitive reactance, inductive reactance and impedance in an LR, LC or LRC circuit. 19. Give a nonmathematical summary of Maxwell's equations. 20. Describe how electromagnetic waves are produced. 21. Draw a diagram representing the field strengths of an electromagnetic wave produced by a sinusoidally varying emf. 22. Calculate the velocity of electromagnetic waves in a vacuum.

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	23. State the approximate range of wavelengths associated with each segment of the electromagnetic spectrum. 24. Use the equation that relates the speed of an electromagnetic wave to the frequency and wavelength. 25. Use the wave model to explain reflection of light from mirrors and refraction of light as it passes from one medium into another. 26. Use the conditions for constructive and destructive interference of waves to explain the Young's double slit experiment. 27. Solve problems involving single slit, double slit and diffraction grating. 28. Solve problems involving thin film interference. 29. Explain how the Michelson interferometer can be used to determine the wavelength. 30. Use the wave model to explain plane polarization of light and polarization by reflection. 31. Calculate the angle for maximum polarization for reflected light.

Atomic and Nuclear Physics	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
Atomic physics and quantum effects 1. Photons, the photoelectric effect, Compton scattering, x-rays 2. Atomic energy levels 3. Wave-particle duality	1. State the postulates of the special theory of relativity. 2. Explain what is meant by reference frame and distinguish between an inertial and a noninertial reference frame. 3. Explain and use the principle of simultaneity. 4. Explain what is meant by proper and relativistic time and solve problems using time dilation. 5. Explain what is meant by proper and relativistic length and solve problems using length contraction. 6. Use the principle of special relativity to determine the relative velocity of an object as measured by an observer moving with respect to the object. 7. Describe the method used by J. J. Thompson to determine the charge to mass ratio of the electron. 8. Use Wein's Law to determine the peak wavelength emitted by a black body at a given temperature. 9. Describe Planck's quantum hypothesis and calculate the energy of a photon at a given frequency or wavelength. 10. State the experimental results of the photoelectric effect. 11. Use the photon theory to determine the maximum kinetic energy of photons emitted from the surface of a metal or the threshold wavelength for the metal. 12. Use the photon theory and Compton's hypothesis to calculate the wavelength of a photon after it has been scattered as a result of a collision with an electron. 13. Use $E=mc^2$ to determine the minimum energy required for pair production. 14. Explain the significance of the principle of complementarity. 15. Use de Broglie's hypothesis to determine the wavelength of a moving particle. 16. Describe Rutherford's model of the atom and list two problems with the model. 17. Determine the wavelength of a photon emitted as an electron drops from a higher energy level to a lower energy level. 18. Determine the Bohr radius and the angular momentum of an electron in a given energy level. 19. Distinguish between the Bohr model and the quantum-mechanical model of the atom. 20. State two forms of the Heisenberg uncertainty principle and explain how the principle predicts an inherent unpredictability in nature. 21. Name the four quantum numbers required to describe the state of an electron in an atom. 22. State the Pauli Exclusion Principle and use it to determine the maximum number of electrons that fill the energy levels of atoms.

Atomic and Nuclear Physics	
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	23. Given the atomic number of a particular element, write the electron configuration for the ground state of the atom. 24. Describe two ways that X-ray photons can be produced. 25. Determine the cutoff frequency and wavelength of an X-ray photon produced by accelerating electrons through a known potential difference. 26. Determine the number of neutrons in a nuclide of known atomic number and mass number. 27. Explain what is meant by an isotope of an element. 28. Explain what is meant by the unified atomic mass unit.

Atomic and Nuclear Physics	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
Nuclear physics 1. Nuclear reactions (including conservation of mass number and charge) 2. Mass–energy equivalence	1. Calculate the energy equivalent in MeV of an atomic mass unit. 2. Calculate the binding energy of a nucleus and the binding energy per nucleon. 3. Identify the three types of radiation emitted by radioactive substances. 4. Write a general equation to represent each of the following possible radiation decays; alpha, beta and gamma. 5. Determine between the parent and daughter nucleus. 6. Calculate the disintegration energy for a given alpha decay. 7. List and apply the four conservation laws that apply to radioactive decays. 8. Write and use the equation that relates the half-life of a substance to its decay constant. 9. Explain what is meant by a nuclear reaction. 10. Write the general equation for a nuclear reaction. 11. Calculate the reaction energy for a nuclear reaction and state whether it is exothermic or endothermic. 12. Distinguish between nuclear fission and fusion and give an example of each process. 13. Explain what is meant by a self-sustaining chain reaction and how this kept under control in a nuclear reactor. 14. Explain what is meant by dosimetry. 15. Define curie, roentgen, rad gray, rem a Sievert. 16. Given the level of the activity of a radioactive sample in curies, calculate the number of decays per second and the yearly dosage in rem absorbed by a person in contact with the sample. Determine if the dosage exceeds the recommended standard. 17. Explain the terms time, distance and shielding as they are used in radiation protection from exposure.