CURRICULUM GUIDE

NAME OF COURSE: PHYSICS

COURSE NUMBER: SCI 402 **WRITTEN / REVISED:** SEPTEMBER, 2011

LEVEL OF COURSE: ACADEMIC **NUMBER OF CREDITS:** SIX (6)

PRE-REQUISITE: ALGEBRA II **CO-REQUISITE:** PRECALCULUS

PREFACE/BACKGROUND STATEMENTS (INCLUDES STATEMENT OF PHILOSOPHY): This course is an algebra based college level physics course designed to enhance the student's knowledge of physical science. This course also serves as preparation for the Calculus based AP Physics C.

GENERAL OBJECTIVES:
The general objectives of this course include:

1. That physics must contribute to the general intellectual development of the student.
2. That the student be a problem solver developing analytical skills.
3. That the student be given opportunity to reason, to learn to express their thoughts clearly, and be able to follow the development of ideas presented, whether orally or from the written page.
4. Physics should sharpen the students' skills as observers and experimenters.
5. The course should develop the students understanding of the laws of physics.

ASSIGNMENTS:

1. Web Assign Homework
2. Projects
3. Teacher Generated Questions

EVALUATION:

1. Quizzes & Tests
2. Lab Report
3. Mid-Term & Final Exams

CORE CURRICULUM CONTENT STANDARDS:

5.1 - Scientific Practices
- A. Understanding Scientific Explanations
- B. Generate Scientific Evidence Through Active Investigations
- C. Reflect on Scientific Knowledge
- D. Participate Productively in Science

5.2 – Physical Science
- C. Forms of Energy
- D. Energy Transfer
- E. Forces and Motion

Part I: Mechanics

Unit I: Kinematics in One Dimension **Time = 3 weeks**

Objectives:

After studying the material of this chapter, students should be able to:

1. State the meaning of the key terms and phrases used in kinematics.
2. List the SI unit and its abbreviation associated with displacement, velocity, acceleration, and time.
3. Describe the motion of an object relative to a particular frame of reference.
4. Differentiate between a vector quantity and a scalar quantity and state which quantities used in kinematics are vector quantities and which are scalar quantities.
5. State the meaning of the symbols used in kinematics: x, x_o, v, v_o, a, y, y_o, v_y, v_{yo}, g, t.
6. Understand that freely falling objects accelerate downward at $9.8 m/s^2$.
7. Derive the equations used to describe uniformly accelerated motion.
8. Solve word problems related to kinematics.
9. Use the methods of graphical analysis to determine the instantaneous acceleration at a point in time and the distance traveled in an interval of time.

Lab Experiments:

Uniformly Accelerated Motion
Determining ***g*** on an Incline
Picket Fence Free-Fall

Additional Assignments:

Read Chapter 2 of textbook.

Unit 2: Kinematics in Two Dimensions; Vectors **Time = 3 weeks**

Objectives:

After studying the material of this chapter, students should be able to:

1. Draw the magnitude and direction of a vector using a protractor and ruler.
2. Multiply or divide a vector quantity by a scalar quantity.
3. Use the methods of graphical analysis to determine the magnitude and direction of the vector resultant in problems involving vector addition or subtraction of two or more vector quantities. The graphical methods to be used are the parallelogram method and the tip to tail method.
4. Use the trigonometric component method to resolve a vector components in the *x* and *y* directions.
5. Use the trigonometric component method to determine the vector resultant in problems involving vector addition or subtraction of two or more vector quantities.
6. Use the kinematics equations along with the vector components to solve problems involving the two-dimensional motion of projectiles.

Lab Experiments:

Ball Toss
Projectile Motion

Shoot for a Grade

Additional Assignments:

Read chapter 3 of the textbook

Unit 3: Newton's Laws of Motion **Time = 4 weeks**

Objectives:

After studying the material of this chapter, students should be able to:

1. State Newton's three laws of motion and give examples that illustrate each law.
2. Explain what is meant by the term net force.
3. Use the methods of vector algebra to determine the net force acting on an object.
4. Define each of the following terms: mass, inertia, weight and distinguish between mass and weight.
5. Identify the SI units for force, mass, and acceleration.
6. Draw an accurate free body diagram locating each of the forces acting on an object or a system of objects.
7. Use free body diagrams and Newton's laws of motion to solve word problems.

Lab Experiments:

Newton's 2nd Law
Friction
Atwood Machine
Incline Plane
Newton's 3rd Law

Additional Assignments:

Read chapter 4 of the textbook

Unit 4: Circular Motion; Gravitation **Time = 2 weeks**

Objectives:

After studying the material of this chapter, you should be able to:

1. Calculate the centripetal acceleration of a point mass in uniform circular motion given the radius of the circle and either the linear speed or the period of the motion.
2. Identify the force that is the cause of the centripetal acceleration and determine the direction of the acceleration vector.
3. Use Newton's laws of motion and the concept of centripetal acceleration to solve word problems.
4. Distinguish between centripetal acceleration and tangential acceleration.
5. State the relationship between the period of the motion and the frequency of rotation and express this relationship using a mathematical equation.
6. Write the equation for Newton's universal law of gravitation and explain the meaning of each symbol in the equation.
7. Determine the magnitude and direction of the gravitational field strength (g) at a distance r from a body of mass m.

8. Use Newton's second law of motion, the universal law of gravitation, and the concept of centripetal acceleration to solve problems involving the orbital motion of satellites.
9. Explain the "apparent" weightlessness of an astronaut in orbit.
10. Use Newton's second law of motion and the universal law of gravitation.

Lab Experiments:

Centripetal Force
Turntable Acceleration
Real World Acceleration

Additional Assignments:

Read chapter 5 of the textbook

Unit 5: Work and Energy **Time = 3 weeks**

Objectives:

After studying the material of this chapter, you should be able to:

1. Distinguish between work in the scientific sense as compared to the colloquial sense.
2. Write the definition of work in terms of force and displacement and calculate the work done by a constant force when the force and displacement vectors are at an angle.
3. Use graphical analysis to calculate the work done by a force that varies in magnitude.
4. Define each type of mechanical energy and give examples of types of energy that are not mechanical.
5. State the work energy theorem and apply the theorem to solve problems.
6. Distinguish between a conservative and a non-conservative force and give examples of each type of force.
7. State the law of conservation of energy and apply the law to problems involving mechanical energy.
8. Define power in the scientific sense and solve problems involving work and power.

Lab Experiments:

Energy of a Tossed Ball
Energy in Motion
Work Done by a Non-Conservative Force

Additional Assignments:

Read chapter 6 of the textbook

Unit 6: Linear Momentum **Time = 2 weeks**

Objectives:

After studying the material of this chapter, you should be able to:

1. Define linear momentum and write the mathematical formula for linear momentum from memory.
2. Distinguish between the unit of force and momentum.
3. Derive Newton's Second Law of Motion in terms of momentum.
4. Define impulse and write the equation that connects impulse and momentum.
5. State the Law of Conservation of Momentum and write, in vector form, the law for a system involving two or more point masses.
6. Distinguish between an elastic collision and an inelastic collision.
7. Apply the laws of conservation of momentum and energy to problems involving collisions between two point masses.

Lab Experiments:

Impulse and Momentum
Momentum and Energy

Additional Assignments:

Read chapter 7 of the textbook

<u>Part II: Waves and Optics</u>

Unit 7: Vibrations and Waves **Time = 3 weeks**

Objectives:

After studying the material of this chapter, you should be able to:

1. State the conditions required to produce SHM.
2. Determine the period of motion of an object of mass *m* attached to a spring of force constant *k*.
3. Calculate the velocity, acceleration, potential, and kinetic energy at any point in the motion of an object undergoing SHM.
4. Derive equations for displacement, velocity, and acceleration as sinusoidal functions of time for an object undergoing SHM if the amplitude and angular velocity of the motion are known. Use these equations to determine the displacement, velocity, and acceleration at a particular moment of time.
5. Determine the period of a simple pendulum of length *L*.
6. State the conditions necessary for resonance. Give examples of instances where resonance is a) beneficial and b) destructive. Explain how damped harmonic motion can be achieved to prevent destructive resonance.
7. Distinguish between a longitudinal wave and a transverse wave and give examples of each type of wave.
8. Describe wave reflection from a barrier, refraction as the wave travels from one medium into another, constructive and destructive interference as waves overlap, and diffraction of waves as they pass around an obstacle.

Lab Experiments:

Pendulum Periods
Simple Harmonic Motion

Additional Assignments:

Read chapter 11 of the textbook

Unit 8: Sound **Time = 2 week**

Objectives:

After studying the material of this chapter, you should be able to:

1. Determine the speed of sound in air at one atmosphere of pressure at different temperatures.
2. Distinguish between the following terms: pitch, frequency, wavelength, sound intensity, loudness.
3. Determine intensity level in decibels of a sound if the intensity of the sound is given in W/m^2.
4. Determine the beat frequency produced by two tuning forks of different frequencies.
5. Solve for the frequency of the sound heard by a listener and the wavelength of the sound between a source and the listener when the frequency of the sound produced by the source and the velocity of both the source and the listener are given.
6. Explain how a shock wave can be produced and what is meant by the term "sonic boom."

Lab Experiment

Speed of Sound
Sound Waves and Beats

Additional Assignments:

Read chapter 12 of the textbook

Unit 9: Geometric Optics **Time = 3 weeks**

Objectives:

After studying the material of this chapter, the student should be able to:

1. State the names given to the different segments of the electromagnetic spectrum.
2. State the approximate range of wavelengths associated with each segment of the electromagnetic spectrum.
3. State the equation which relates the speed of an electromagnetic wave to the frequency and wavelength and use this equation in problem solving.
4. Distinguish between mirror reflection and diffuse reflection.
5. Draw a ray diagram and locate the position of the image produced by an object placed a specified distance from a plane mirror. State the characteristics of the image.

6. Distinguish between a convex and a concave mirror. Draw rays parallel to the principal axis and locate the position of the principal focal point of each type of spherical mirror.
7. Draw ray diagrams and locate the position of the image produced by an object placed a specified distance from a concave or convex mirror. State the characteristics of the image.
8. Use the mirror equations and the sign conventions to determine the position, magnification and size of the image produced by an object placed a specified distance from a spherical mirror.
9. State Snell's law and use this law to predict the path of a light ray as it travels from one medium into another. Explain what is meant by the index of refraction of a medium.
10. Explain what is meant by total internal reflection. Use Snell's law to determine the critical angle as light travels from a medium of higher index of refraction into a medium of lower index of refraction.
11. Distinguish between a convex and a concave lens. Draw rays parallel to the principal axis and locate the position of the principal focal points for each type of thin lens.
12. Draw ray diagrams and locate the position of the image produced by an object placed a specified distance from either type of thin lens. State the characteristics of the image.
13. Use the thin lens equations and the sign conventions to determine the position, magnification, and size of the image produced by an object placed a specified distance from a concave or convex lens.

Lab Experiments:

Geometric Optics
Refraction
Lenses

Additional Assignments:

Read chapter 23 of the textbook

Part III: Electricity & Magnetism

Unit 10: Electric Charge and Electric Field Time = 3 weeks

Objectives:

After studying the material of this chapter, the student should be able to:

1. State from memory the magnitude and sign of the charge on an electron and proton and also state the mass of each particle.
2. Apply Coulomb's law to determine the magnitude of the electrical 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 charge.

4. Distinguish between an insulator, a conductor, and a semi conductor and give examples of each.
5. Explain the concept of 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 pattern in the region between charged objects.

Lab Experiments:

Electroscopes
Balloons

Additional Assignments:

Read chapter 16 of the textbook

Unit 11: Electric Potential **Time = 3 weeks**

Objectives:

After studying the material of this chapter, the student should be able to:

1. Write from memory the definitions of electric potential, and electric potential difference.
2. Distinguish between electric potential, electric potential energy, and electric potential difference.
3. Draw the electric field pattern and equipotential line pattern which exist between charged objects.
4. Determine the magnitude of the potential at a point a known distance from a point charge or an arrangement of point charges.
5. 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.
6. Determine the kinetic energy in both joules and electron volts of a charged particle which is accelerated through a given potential difference.
7. Explain what is meant by an electric dipole and determine the magnitude of the electric dipole moment between two point charges.
8. Given the dimensions, distance between the plates, and the dielectric constant of the material between the plates, determine the magnitude of the capacitance of a parallel plate capacitor.
9. 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 stored in the capacitor.

Lab Experiments:

Electric Energy

Additional Assignments:

Read chapter 17 of the textbook

Unit 12: Electric Currents **Time = 2 weeks**

Objectives:

After studying the material of this chapter, the student should be able to:

1. Explain how a simple battery can produce an electrical current.
2. Define current, ampere, emf, voltage, resistance, resistivity, and temperature coefficient of resistance.
3. Write the symbols used for electromotive force, electric current, resistance, resistivity, temperature coefficient of resistance and power and state the unit associated with each quantity.
4. Distinguish between a) conventional current and electron current and b) direct current and alternating current.
5. Know the symbols used to represent a source of emf, resistor, voltmeter, and ammeter and how to interpret a simple circuit diagram.
6. Given the length, cross sectional area, resistivity, temperature coefficient of resistance, determine a wire's resistance at room temperature and some higher or lower temperature.
7. Solve simple dc circuit problems using Ohm's law.
8. Use the equations for electric power to determine the power and energy dissipated in a resistor and calculate the cost of this energy to the consumer.

Lab Experiments:

Ohm’s Law

Additional Assignments:

Read chapter 18 of the textbook

Unit 13: DC Circuits **Time = 3 weeks**

Objectives:

After studying the material of this chapter, the student should be able to:

1. Determine the equivalent resistance of resistors arranged in series or in parallel or the equivalent resistance of a series parallel combination.
2. Use Kirchhoff's rules to determine the current through each resistor and the voltage drop across each resistor in a single loop or multiloop circuit.
3. 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.
4. Determine the equivalent capacitance of capacitors arranged in series or in parallel or the equivalent capacitance of a series parallel combination.
5. Determine the charge on each capacitor and the voltage drop across each capacitor in a circuit where capacitors are arranged in series, parallel, or a series parallel combination.

Lab Experiments:

Series Circuits
Parallel Circuits

Additional Assignments:

Read chapter 19 of the textbook

Unit 14: Magnetism **Time = 3 weeks**

Objectives:

After studying the material of this chapter, the student should be able to:

1. Draw the magnetic field pattern produced by iron filings sprinkled on paper placed over different arrangements of bar magnets.
2. 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 produced by the current.
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. Explain how a mass spectrograph can be used to determine the mass of an ion and how it can be used to separate isotopes of the same element.

Lab Experiments:

Magnetic Field Surrounding a Magnet

Additional Assignments:

Read chapter 20 of the textbook

COURSE EVALUATION CRITERIA

1. Tests & Quizzes	50-60%
2. Homework	25-30%
3. Lab Reports	25-30%

TEXTBOOKS & RESOURCES

1. Text – PHYSICS: Principles with Applications, 5th ed. - Giancoli
2. Homework – Web Assign online
3. Lab Manual – Physics with Calculators – Vernier
4. Lab Manual - Practical Physics Labs – Peter Goodwin
5. Lab Manual – Physics: A Laboratory Manual – Puri, Zober & Zober

MATERIALS

1. Classroom Equipment
2. Smartboard
3. Vernier LabPro with Probes
4. Graphing Calculator (TI-84+ recommended)

COURSE REVISIONS

1. June 2014

MID-TERM & FINAL EXAM REVISIONS

1. Mid-Term: January 2011
2. Final: June 2011

High Point Regional High School's curriculum and instruction are aligned to the State's Core Curriculum Content Standards and address the elimination of discrimination by narrowing the achievement gap, by providing equity in educational programs and by providing opportunities for students to interact positively with others regardless of race, creed, color, national origin, ancestry, age, marital status, affectionate or sexual orientation, gender, religion, disability or socioeconomic status.