PHYSICS 362 SYLLABUS

This syllabus is intended to provide the student with a rough layout of course scope and sequence. Topics and activities may be modified to meet the needs of the class.

Unit 1: Physics Skills

Big Questions:

- How are mathematical skills necessary for Physics?
- How is graphical analysis used to enhance knowledge of the physical world?
- How can we use mathematics to quantify the concepts observed in the physical world?

Learning Objectives:

SI System

- Understand the base units of the SI system
- Convert units using the factor label method
- Apply significant figures to mathematical calculations

Graphical Analysis

- Represent numerical relationships graphically
- Draw conclusions and analyze graphical relationships

Precision and Accuracy

- Compare and contrast numerical data in terms of precision and accuracy

Unit 2: Kinematics and Vectors

Big Questions:

- How are vector and scalar quantities related?
- How are displacement and distance differentiated?
- How can vector quantities be manipulated?
- Why is a coordinate system important in physics?
- How do simple motion graphs help us visualize motion?
- How can equations be derived by analyzing simple motion graphs?
- What are the problem-solving steps associated with the use of Kinematic Equations?
- What constitutes an object in free-fall?

Learning Objectives:

Motion-

- Draw and use motion diagrams to describe motion
- Use a particle model to represent moving objects
- Choose coordinate systems for motion problems
- Differentiate between scalar and vector quantities
- Define a displace vector and determine a time interval
- Recognize how the chosen coordinate system affects the signs of vectors quantities
- Define velocity and acceleration operationally
- Relate the direction and magnitude of velocity and acceleration vectors to the motion of objects

Vector Addition

- Determine graphically the sum of two or more vectors
- Solve problems of relative velocity
- Establish a coordinate system in problems involving vector quantities
- Use the process of resolution of vectors to find the components of vectors
- Determine algebraically the sum of two or more vectors by adding the components of the vectors

Graphing Motion in One Dimension

- Interpret graphs of position versus time for a moving object to determine the velocity of the object
- Describe the information presented in graphs and draw graphs from descriptions of motion
- Write equations that describe the position of an object moving at constant velocity
- Determine, from a graph of velocity versus time, the velocity of an object at a specified time
- Interpret a v-t graph to find the time at which an object has a specific velocity
- Calculate the displacement of an object from the area under a v-t curve
- Determine from curves on a velocity time graph both the constant and instantaneous acceleration
- Determine the sign of acceleration using a v-t graph and a motion diagram
- Calculate the velocity and the displacement of an object undergoing constant acceleration
- Recognize the meaning of acceleration due to gravity
- Define the magnitude of the acceleration due to gravity as a positive quantity and determine the sign of the acceleration relative to the chosen coordinate system.
- Use the motion equations to solve problems involving freely falling objects

Unit 3: Newtonian Mechanics

Big Questions:

- How are Newton's Laws visible in the environment around us?
- How do you differentiate between weight and mass?
- How do you compare and contrast contact and non-contact forces?
- How are free body diagrams representative of forces acting on a body?
- How are multi-dimensional forces analyzed?
- How do forces act on an object moving in circular motion?

Learning Objectives:

Newtons Laws:

- Draw free body diagrams for objects
- Find the net force acting on an object
- Relate net force acting on an object to its acceleration

Friction:

- Compare and contrast static and kinetic friction forces
- Find the acceleration of an object when friction is involved
- Calculate the coefficient of static and kinetic friction

Forces acting in two dimensions:

- Analyze the trajectory of an object in projectile motion
- Analyze the forces acting on an object on an inclined plane (with and without friction)

Circular Motion:

- Analyze forces acting on an object moving in circular motion at constant velocity
- Find the net force (centripetal) acting on a roller coaster rider in circular motion

Unit 4: Work and Energy

Big Questions:

- What is energy and why is important to our surroundings?
- What forms can energy take?
- What is power?
- Can energy be spontaneously created or destroyed?
- What is the relationship between the change in energy of an object and work done to/by it?
- How is energy conserved throughout different processes?

Learning Objectives:

Work:

- Develop the relationship between force and displacement
- Calculate total work when force is not co-linear to displacement
- Compare and contrast conservative and non-conservative work
- Develop a graphical representation of work

Power:
- Determine the rate at which energy is used
- Compare and contrast power outputs of various objects

Energy:
- Define potential and kinetic energy
- Identify changes from one form of energy to another
- Determine energy conservation in changing objects
- Compare the change in an object's kinetic energy to the work done by the object

Unit 5: Electricity

Big Questions:
- How do objects obtain an electrical charge?
- How do objects transfer electrical charge?
- How do charged objects exert forces?
- How do charged particles do work on objects?
- How are Ohm's Law and Joule's Law used to analyze electrical circuits?
- How can complex electrical circuits be simplified?

Learning Objectives:
Static Electricity
- Describe how objects become charged
- Explain the attractive and repulsive nature of charges
- Demonstrate that charging is the separation, not the creation, of electrical charges
- Compare and contrast conductors and insulators
- Summarize the relationship between forces and charges
- Describe how an electroscope detects electric charge
- Explain how to charge by conduction and induction
- Use Coulomb's law to solve problems relating to electrical force
- Develop a model of how charged objects can attract a neutral object

Current Electricity-
- Define an electric current and ampere
- Describe conditions that create current in an electric circuit
- Draw circuits and recognize they are closed loops
- Define power in electric circuits
- Define resistance and describe Ohm's law.
- Explain how electric energy is converted into thermal energy
- Determine why high voltage transmission lines are used to carry electric energy over long distances
- Define and calculate the kilowatt hour.

Series and Parallel Circuits
- Compare and Contrast series and parallel connections
- Calculate current, voltage drops, and equivalent resistance for devices connected in series and in parallel
- Explain how fuses, circuit breakers, and ground fault interrupters protect household wiring
- Analyze combined series- parallel circuits and calculate the equivalent resistance of such circuits
- State the important characteristics of voltmeters and ammeters, and explain how each is used in circuits.

Unit 6: Waves

Big Questions:
- How waves transfer energy?
- How do transverse and longitudinal waves differ?
- How does the medium affect the properties of the wave?
- How are wave velocity, frequency, and wavelength related?
- How can the physical properties of sound waves be mathematically measured?
- How can light be described in the ray model?
- How can refraction and reflection be differentiated?
- How can the image of an object be graphically and mathematically represented?

Learning Objectives:

Waves and Energy Transfer

- Identify how waves transfer energy with out transferring matter
- Contrast transverse and longitudinal waves
- Relate wave speed, wavelength, and frequency
- Relate a wave's speed to the medium in which the wave travels
- Describe how waves are reflected and refracted at boundaries between media, and explain how waves diffract
- Apply the principle of superposition to the phenomenon of interference

Sound

- Compare and contrast the properties of sound waves with other waves
- Solve problems relating to the frequency, wavelength, and velocity of sound
- Define the Doppler shift and identify some of its applications
- Determine the speed of objects using Doppler Shift
- Describe the origin of sound
- Demonstrate an understanding of resonance as applied to air columns
- Explain why there is a variation among instruments and among voices using the terms timbre, resonance, fundamental, and harmonic
- Determine why beats occur

Light

- Recognize that light is the visible portion of an entire range of electromagnetic frequencies
- Describe the ray model of light
- Solve problems involving the speed of light
- Define luminous intensity, luminous flux, and illumiance
- Solve illumination problems

Reflection and Refraction

- Explain the law of reflection
- Distinguish between diffuse and regular reflection and provide examples
- Calculate the index of refraction in a medium
- Explain total internal reflection
- Define critical angle
- Explain effects caused by the refraction of light in a medium with varying refractive indices
- Explain dispersion of light in terms of the index of refraction

Mirrors and Lenses

- Explain how concave, convex, and plane mirrors form images
- Locate images using ray diagrams, and calculate image location and size using equations
- Explain the cause of spherical aberration and how the effect may be overcome
- Describe uses of parabolic mirrors
- Describe how real and virtual images are formed by convex and concave lenses
- Locate the image with a ray diagram and find the image location and size using a mathematical model