SCIENCE DEPARTMENT **PHYSICS AE: COURSE #442**

The Department's Educational Philosophy

We believe that students should be exposed to the process of scientific inquiry so they can acquire and interpret scientific knowledge, and begin to realize the wider applicability of scientific problem-solving methods. By making the laboratory the focal point of learning, we seek to foster students' appreciation for the experience of doing science.

Guiding Principles

- Students must be able to collect and analyze data and formulate hypotheses.
- Inductive and deductive problem-solving skills are central to science education.
- An effective program in science addresses the limitations of data and conclusions.
- Students should be able to use or design a strategy for testing scientific concepts.
- A comprehensive science program will emphasize the delicate checks and balances in man's abiotic and biotic environments and the stresses upon these ecosystems, which could affect the destiny of the world.
- Science is integrally related to mathematics.
- An effective science program builds students' ability to communicate accurately and precisely.
- An effective science program stresses both cooperative and independent learning.

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Course Frequency: Full year course, eight times per six-day cycle
Credits Offered: Six
Prerequisites: Trigonometry (taken concurrently)

Background to the Curriculum

This is a trigonometry-based physics course that is very lab-oriented. The main text is Physics, 6th Edition by Wilson, Buffa, and Lou. The text is supplemented with a variety of teacher-developed handouts and other materials. Labs are used extensively to both introduce and reinforce the key concepts being studied. Mathematically, algebra and trigonometry are used throughout the course.

Core Topics/Questions/Concepts/Skills

Kinematics
Newton's Laws
Momentum
Work and Energy
Universal Gravitation
Electrostatics
Electric Circuits
Magnetism
Properties of Waves
Sound
Light

Course-End Learning Objectives

Students will:

Kinematics

1] Distinguish between, and solve problems involving, position, velocity, and acceleration.
2] Create and interpret graphs of motion (position vs. time, velocity vs. time, and acceleration vs. time).
3] Convert vectors between unit-vector form, component form, graphical form and magnitude/direction.
4] Add and subtract vectors, both graphically and analytically.
5] Solve a variety of word problems concerning projectile motion, circular motion, and relative motion.

Newton's Laws

1] State, explain and give examples of Newton's 3 Laws of Motion.
2] Compare and contrast mass and weight.
3] Construct an appropriate free-body diagram for any given situation/word problem.
4] Distinguish between static and kinetic friction, what they depend on, and their effects on the motion of an object.
5] Solve a variety of word problems involving multiple applied forces, tensions, and frictional forces.

Work and Energy

1] Explain and apply the Work-Kinetic Energy Theorem.
2] Explain and apply the Law of Conservation of Energy.
3] Explain how simple machines work in terms of energy principles.
4] Distinguish between kinetic and potential energy and power.

Momentum

1] Explain the concept of conservation of momentum. Use examples to support your explanation
2] Correctly use and apply the ideas of impulse, momentum, and collisions, in one and two dimensions.
3] Compare and contrast elastic collisions with inelastic collisions.

Universal Gravitation

1] Explain and apply Newton's Law of Universal Gravitation.
2] Explain and apply Kepler's Laws of Planetary Motion.

Electrostatics

1] Explain and differentiate the three main ways of charging an object: by friction, induction, and conduction.
2] Construct and interpret sketches of electric field lines and equipotential lines.
3] Explain and apply Coulomb's Law in a variety of situations.

4] Differentiate between an insulator and a conductor.
5] Differentiate between electric potential and electric potential energy and between electric force and electric field.

Electric Circuits

1] Explain and apply the relationships between charge, current, resistance, voltage and power.
2] Explain what is meant by "Ohm's Law" and describe why some things obey and others do not.
3] Apply the laws of conservation of charge and conservation of energy to a circuit.
4] Qualitatively and mathematically analyze a circuit of resistors.

Magnetism

1] Explain and differentiate between magnetism and electric charge.
2] Explain and apply Faraday's Law of Induction.

Properties of Waves

1] Differentiate between wave motion and particle motion.
2] Compare and contrast the various types of waves and the media through which they travel.
3] Measure, calculate and apply the various characteristics of waves (e.g., amplitude, frequency, wavelength, speed).
4] Explain and apply the concept of wave superposition to a variety of situations.
5] Explain and apply the laws of reflection and refraction to a variety of situations.

Sound

1] Measure the speed of sound in a variety of ways.
2] Explain and apply how musical instruments work.

Light

1] Explain and apply the electromagnetic properties of light.
2] Explain and apply Snell's Law.
3] Differentiate between adding colors with light and with pigments; explain how we perceive colors.
4] Construct and interpret ray diagrams for lenses and mirrors.
5] Analytically solve for a variety of problems involving lenses and mirrors.

Assessment

- Tests: 3-4 per term using multiple choice, problem solving and short answer
- Quizzes: 1-5 per term using multiple choice, problem solving and short answer
- Labs: several per term
- Lab Practicum: about once per term
- Engineering Projects: Once per term students will have to build and test an object applying the concepts studied.

Materials and Resources

Wilson, Buffa and Lou, Physics, 6th Edition (2007), Pearson Prentice Hall.