

## SCIENCE DEPARTMENT

## PHYSICS AE: COURSE #442

### **Contact Information**

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### **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.

## **PHYSICS AE: COURSE #442**

**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, 6<sup>th</sup> 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

<u>Learning objectives</u>	<u>Corresponding state standards, <i>where applicable</i></u>
<b><u>Kinematics</u></b>	
1] Distinguish between, and solve problems involving, position, velocity, and acceleration.	1.3
2] Create and interpret graphs of motion (position vs. time, velocity vs. time, and acceleration vs. time).	1.4
3] Convert vectors between unit-vector form, component form, graphical form and magnitude/direction.	1.1
4] Add and subtract vectors, both graphically and analytically.	1.2
5] Solve a variety of word problems concerning projectile motion, circular motion, and relative motion.	
<b><u>Newton's Laws</u></b>	
1] State, explain and give examples of Newton's 3 Laws of Motion.	1.6, 1.7, 1.10
2] Compare and contrast mass and weight.	1.5
3] Construct an appropriate free-body diagram for any given situation/word problem.	1.8
4] Distinguish between static and kinetic friction, what they depend on, and their effects on the motion of an object.	1.9
5] Solve a variety of word problems involving multiple applied forces, tensions, and frictional forces.	1.6, 1.7, 1.8, 1.10, 1.12
<b><u>Work and Energy</u></b>	
1] Explain and apply the Work-Kinetic Energy Theorem.	2.1, 2.3, 2.4, 2.6
2] Explain and apply the Law of Conservation of Energy.	2.1, 2.2, 2.3, 2.4, 2.6
3] Explain how simple machines work in terms of energy principles.	2.1, 2.3, 2.4
4] Distinguish between kinetic and potential energy and power.	2.4
<b><u>Momentum</u></b>	
1] Explain the concept of conservation of momentum. Use examples to support your explanation	2.5
2] Correctly use and apply the ideas of impulse, momentum, and collisions, in one and two dimensions.	2.5, 2.6
3] Compare and contrast elastic collisions with inelastic collisions.	2.1, 2.5

<b><u>Universal Gravitation</u></b>	
1] Explain and apply Newton’s Law of Universal Gravitation.	1.11
2] Explain and apply Kepler’s Laws of Planetary Motion.	
<b><u>Electrostatics</u></b>	
1] Explain and differentiate the three main ways of charging an object: by friction, induction, and conduction.	5.1
2] Construct and interpret sketches of electric field lines and equipotential lines.	5.3
3] Explain and apply Coulomb’s Law in a variety of situations.	5.2
4] Differentiate between an insulator and a conductor.	5.3
5] Differentiate between electric potential and electric potential energy and between electric force and electric field.	5.4
<b><u>Electric Circuits</u></b>	
1] Explain and apply the relationships between charge, current, resistance, voltage and power.	5.4, T/E 5.3
2] Explain what is meant by “Ohm’s Law” and describe why some things obey and others do not.	T/E 5.3
3] Apply the laws of conservation of charge and conservation of energy to a circuit.	T/E 5.4, T/E 5.5
4] Qualitatively and mathematically analyze a circuit of resistors.	T/E 5.1, T/E 5.4, T/E 5.5
<b><u>Magnetism</u></b>	
1] Explain and differentiate between magnetism and electric charge.	
2] Explain and apply Faraday’s Law of Induction.	
<b><u>Properties of Waves</u></b>	
1] Differentiate between wave motion and particle motion.	4.1
2] Compare and contrast the various types of waves and the media through which they travel.	4.3, 4.4
3] Measure, calculate and apply the various characteristics of waves (e.g., amplitude, frequency, wavelength, speed).	4.2, 4.8
4] Explain and apply the concept of wave superposition to a variety of situations.	4.6, 4.7, 4.9
5] Explain and apply the laws of reflection and refraction to a variety of situations.	4.5, 4.9

<p><b><u>Sound</u></b></p> <ol style="list-style-type: none"> <li>1] Measure the speed of sound in a variety of ways.</li> <li>2] Explain and apply how musical instruments work.</li> </ol> <p><b><u>Light</u></b></p> <ol style="list-style-type: none"> <li>1] Explain and apply the electromagnetic properties of light.</li> <li>2] Explain and apply Snell's Law.</li> <li>3] Differentiate between adding colors with light and with pigments; explain how we perceive colors.</li> <li>4] Construct and interpret ray diagrams for lenses and mirrors.</li> <li>5] Analytically solve for a variety of problems involving lenses and mirrors.</li> </ol>	<p>4.2, 4.5, 4.8, 4.9 4.7, 4.8, 4.9</p> <p>6.1, 6.2</p> <p>T/E 6.1</p> <p><i><b>Note:</b> T/E refers to the Technology/ Engineering Frameworks</i></p>
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**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.

**Technology and Health Learning Objectives Addressed in This Course**

**(This section is for faculty and administrative reference; students and parents may disregard.)**

<b><u>Course activity: skills &amp;/or topics taught</u></b>	<b><u>Standard(s) addressed through this activity</u></b>
<ol style="list-style-type: none"> <li>1] Extensive data acquisition and analysis using computers with a variety of attached probes and software.</li> </ol>	

**Materials and Resources**

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