EASTERN ARIZONA COLLEGE
Physics with Calculus I
Course Design
2018-2019

Course Information

Division	Science
Course Number	PHY 211 (SUN# PHY 1121)
Title	Physics with Calculus I
Credits	5
Developed by	Madhuri Bapat/Revised by Pedro Dabalsa
Lecture/Lab Ratio	4 Lecture/3 Lab

Transfer Status

ASU	NAU	UA
PHY 121 (3) & PHY 122 (1) & Elective Credit (1), Natural Science - Quantitative (SQ), Natural Science - Quantitative (SQ)	PHY 161; Lab Science [LAB] –and-- PHY Departmental Elective	PHYS 141--and-- PHYS Departmental Elective

Activity Course	No
CIP Code	40.0801
Assessment Mode	Pre/Post Test (5 Questions/50 Points)
Semester Taught	Fall
GE Category	Lab Sciences
Separate Lab	Yes
Awareness Course	No
Intensive Writing Course	No
Diversity and Inclusion Course	No

Prerequisites

MAT 220 or concurrent enrollment in MAT 220 required

Educational Value

Students majoring in physics, chemistry, math and engineering

Description

Covers fundamental principles of mechanics, fluids, thermodynamics, and wave motion using calculus.

Supplies

Scientific, preferably graphing calculator

Competencies and Performance Standards

1. Use modeling (conceptual, mathematical, and visual) approach in analyzing physical situations.

Learning objectives

What you will learn as you master the competency:

a. Use computer software such as data studio, excel, graphical analysis, explorer, Mepi for simulations, and modeling.

b. Use equipment such as motion sensors, photo gates, and force sensors to collect data.

c. Model situation conceptually, by finding analogies in other situations.

d. Model situation mathematically using equations, formulas, laws, principles.

e. Model situations visually by drawing motion, vector, force diagrams, schematic diagrams, graphs, building prototype models, computer simulations.

f. Learn the correlation in all three types of modeling aids.

Performance Standards

You will demonstrate your competence:

- during labs
- on homework
- in group discussions
- on tests
- on white board presentations

Your performance will be successful when:

- learner imagines self as an object undergoing the phenomena
- learner draws motion diagrams, force diagrams, graphs manually, and using computer software. Recreates the situation by building simple prototype models
- learner writes and solves equations of graphs (motion)

2. Analyze one and two-dimensional motion in the absence and in the presence of non-conserving forces like air resistance and friction.

Learning objectives

What you will learn as you master the competency:

a. Quantify linear motion using velocity acceleration, force, momentum, and energy models.

b. Quantify projectile motion of an object by writing expressions for position, velocity, and acceleration in absence and presence of air resistance and friction.

c. Predict position, velocity and acceleration of an object in projectile and circular motion in absence and presence of air resistance and friction.

d. Quantify motion of an object on incline.

Performance Standards

You will demonstrate your competence:

- during labs
- on homework
- on tests
- in group discussions

- o on white board presentations

Your performance will be successful when:

- o learner draws motion and force diagrams for linear motion, projectile motion, and circular motion in absence and in presence of air resistance and friction
- o learner draws force/free body diagrams for object/s on incline in absence and in presence of friction
- o learner writes expressions for position, velocity, and acceleration of objects in projectile and circular motion
- o learner writes expressions for position, velocity, and acceleration of object/s on incline
- o learner solves for position, velocity, acceleration for objects in circular motion, projectile motion, and on incline

3. Quantify gravitational and other interactions between two or more objects by modeling it by using force, momentum, and energy concepts.

Learning objectives

What you will learn as you master the competency:

- a. Use Newton's law of gravitation.
- b. Use force, momentum, and energy to analyze interactions between two bodies.
- c. Draw force and free body diagrams.
- d. Write expressions for net force using Newton's second law.
- e. Apply the law of conservation of momentum to elastic and inelastic collisions.
- f. Apply the law of conservation of energy to elastic and inelastic collisions.

Performance Standards

You will demonstrate your competence:

- o during labs
- o on homework
- o on tests
- o in group discussions
- o on white board presentations

Your performance will be successful when:

- o learner is able to analyze law of gravitation conceptually
- o learner solves for unknown acceleration, velocity, and position of object/s by applying Newton's law and kinematics equations
- o learner solves for unknown velocity, position of an object/s by applying laws of conservation of momentum and energy

4. Quantify complex motions like circular, projectile, rotational, and simple harmonic.

Learning objectives

What you will learn as you master the competency:

- a. Understand simple harmonic, rotational, circular motions are universal from inside of an atom to planetary systems.
- b. Analyze each motion independently.
- c. Analyze two motions combined at a time, e.g. linear/SHM, linear/circular, linear/rotational, and projectile/rotational.

d. Explain the conservation of energy, and damping in SHM.

e. Identify the dependence of period of motion of spring and pendulum on various factors such as material, amplitude, geometry, gravity, etc.

Performance Standards

You will demonstrate your competence:

- o during labs
- o on tests
- o on homework
- o in group discussions
- o on white board presentations

Your performance will be successful when:

- o learner draws force and motion diagrams for objects in SHM
- o learner writes trigonometric expressions for the position, velocity, acceleration of an object/s in SHM
- o learner finds derivatives/integrals to determine velocity/ acceleration
- o learner writes expressions for kinetic energy of object and elastic potential energy of spring

5. Use concepts of static, translational, and rotational equilibrium in problem solving in statics and dynamics.

Learning objectives

What you will learn as you master the competency:

a. Explain the difference between different types of equilibrium.

b. Identify the conditions of equilibrium.

c. Solve statics and dynamics problems.

Performance Standards

You will demonstrate your competence:

- o during labs
- o on test
- o on homework
- o in group discussions
- o on white board presentations

Your performance will be successful when:

- o learner solves for unknown force, torque, distances
- o learner writes expressions for the net force, net torque acting on the object
- o learner draws force and free body diagrams for the objects in the system in equilibrium

6. Apply principles in fluid mechanics while problem solving.

Learning objectives

What you will learn as you master the competency:

a. Use Archimedes' principle and Pascal’s law.

b. Use the equation of continuity and Bernoulli's equation.

Performance Standards

You will demonstrate your competence:

- o on homework
- o on tests
- o group discussions

Your performance will be successful when:

- o learner solves hydrostatic and hydrodynamic problems

7. Apply kinetic theory of gases while problem solving.

Learning objectives

What you will learn as you master the competency:

a. Explain the degrees of freedom, different types of motion (translational, vibrational, and rotational) of molecules and atoms, and how they play role in behavior of gas.

b. Use gas laws (inter dependence of pressure, volume, and temperature of gas).

c. Explain the behaviors of isobaric, isochoric, adiabatic and isothermal gasses.

d. Explain the first and second law of thermodynamics.

Performance Standards

You will demonstrate your competence:

- o on homework
- o on tests
- o in group discussions

Your performance will be successful when:

- o learner solves problems about behavior of gas
- o learner draws isothermal, isobaric, isochoric, and adiabatic curves to show behavior of gas

8. Synthesize knowledge in mechanics and use it in complex problem solving.

Learning objectives

What you will learn as you master the competency:

a. Categorize problems according to the method of solving them e.g. conservation of energy/momentum, and kinematics.

b. Assemble several ways of modeling same situation. Compare and contrast the methods as well as the answers for accuracy, sophistication, and time consumption.

Performance Standards

You will demonstrate your competence:

- o on tests
- o on homework
- o during group discussions

Your performance will be successful when:

- o learner chooses and performs the most efficient method of modeling situation

Types of Instruction

Classroom presentation, demonstrations, and discussions

Laboratories

Grading Information

Grading Rationale

Physics labs	20%
Homework	20%
Unit or Chapter Exams	40%
Final Exam	20%

Important Notice: To pass this class you must have a grade of 70% (a C) or better.

Grading Scale

A	100 – 90 %
B	80 – 89%
C	70 – 79%
D	60 – 69 %
F	Below 59 %