

Salem Community College Course Syllabus

Course Title: Calculus-Based Physics I

Course Code: PHY221

Lecture Hours: 2

Laboratory Hours: 4

Credits: 4

Course Description:

This course involves using calculus to solve problems in mechanics. Topics include those studied in PHY 101 but extended into problems that require calculus and/or additional physics understanding. Material will be presented in an integrated laboratory-lecture format. This is a state approved General Education Science elective course.

Prerequisite:

High School Physics or the written permission of the instructor.

Corequisite:

MAT231 Calculus I

Place in College Curriculum:

PHY221 is a science or open elective for any program. This course is a requirement for science majors with a concentration in physics, pre-engineering, or mathematics.

Date of last revisions: May / 2012

Section II

Course Outline:

I. Physics and Measurement, Concepts of Motion

- A. Standards of Length, Mass, and Time
- B. Dimensional Analysis
- C. Significant Figures
- D. Velocity
- E. Linear Acceleration

II. Kinematics in One Dimension

- A. Motion with Constant Acceleration
- B. Free Fall
- C. Motion on an Inclined Plane
- D. Instantaneous Acceleration

III. Vectors and Coordinate systems

- A. Vectors
- B. Properties of Vectors
- C. Coordinate systems and Vector Components

IV. Kinematics in Two Dimensions

- A. Acceleration
- B. Kinematics in Two-Dimensions
- C. Projectile Motion
- D. Uniform Circular Motion

V. Force and Motion

- A. The Concept of Force
- B. Newton's Second Law
- C. Newton's First Law
- D. Free-Body Diagrams

VI. Dynamics I: Motion Along a Line.

- A. Equilibrium
- B. Using Newton's Second Law
- C. Mass, Weight, and Gravity
- D. Friction

VII. Newton's Third Law

- A. Interacting Objects
- B. Newton's Third Law
- C. Ropes and Pulleys

VIII. Dynamics II: Motion in a Plane

- A. Dynamics in Two Dimensions
- B. Velocity and Acceleration in Uniform Circular Motion
- C. Dynamics of Uniform Circular Motion

IX. Impulse and Momentum

- A. Momentum and Impulse
- B. Conservation of Momentum
- C. Inelastic Collisions

X. Energy

- A. Kinetic Energy and Gravitational Potential Energy
- B. Restoring Forces and Hooke's Law
- C. Elastic Collisions
- D. Energy Diagram

XI. Work

- A. Work and Kinetic Energy
- B. Work Done by a Variable Force
- C. Force, Work and Potential Energy
- D. Conservative and Non-conservative Forces
- E. Power

XII. Rotation of a Rigid Body

- A. Rotational Motion
- B. Rotation About the Center of Mass
- C. Calculating Moment of Inertia
- D. Torque and the Vector Product
- E. Rotation About a Fixed Axis
- F. Angular Momentum of a Rigid Body

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Section III

Course Performance Objective 1: The students will convert units and perform graphical and component operations with vectors.

Learning Outcomes:

1. Students will determine whether or not an equation is dimensionally consistent.
2. Students will apply the rules when multiplying (or dividing) several quantities, and the rules for adding (or subtracting) quantities.
3. Students will apply the concept of a unit, and convert quantities from one set of units to another.

4. Students will show the kinds of errors that may arise in measurements.
5. Students will apply the rules of significant figures.
6. Students will define velocity and linear acceleration.

Course Performance Objective 2: The students will state the relationships (including the calculus forms) of the kinematic equations.

Learning Outcomes:

1. Students will distinguish between average and instantaneous values of velocity and acceleration, and distinguish between position, displacement.
2. Students will solve problems on the motion of a body with constant acceleration.
3. Students will determine the displacement, velocity, and/or acceleration of a body in free fall.
4. Students will solve problems involving motion on an inclined plane.
5. Students will write about linear acceleration

Course Performance Objective 3 : The students will manipulate vector quantities and scalar quantities.

Learning Outcomes:

1. Students will distinguish between a vector and a scalar.
2. Students will summarize the properties of vectors.
3. Students will graph, add and subtract vectors.

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Course Performance Objective 4 : The students will solve kinematic problems in two dimensions.

Learning Outcomes:

1. Students will solve problems on acceleration in two dimensions.
2. Students will explain projectile motion.
3. Students will solve problems involving position, velocity, acceleration, and time for Uniform Circular Motion.
4. Students will write the equations of motion using angular quantities.

Course Performance Objective 5 : The students will solve dynamics problems in two dimensions.

Learning Outcomes:

1. Students will draw a diagram of a particle and show the forces acting on it.

2. Students will write Newton's first and second laws in mathematical form;
3. Students will solve problems on the motion of a body and the external forces acting on the body.
4. Students will draw free-body diagrams (using a particle representation) for each body.

Course Performance Objective 6: The students will calculate the forces acting during motion along a line.

Learning Outcomes:

1. Students will show objects in equilibrium.
2. Students will draw the normal force and the other forces acting on an object.
3. Students will apply Newton's second law.
4. Students will distinguish between weight and mass.
5. Students will see the role of frictional forces.

Course Performance Objective 7: The students will apply Newton's third law.

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Learning Outcomes:

1. Students will apply Newton's third law in interacting objects.
2. Students will state Newton's third law.
3. Students will determine the forces acting in ropes and pulleys.

Course Performance Objective 8: The students will solve dynamics problems in motion in a plane.

Learning Outcomes:

1. Students draw free-body diagrams and show the centripetal forces.
2. Students will find the relationships between the radius, speed, and velocities for objects undergoing circular motion.
3. Students will solve problems relating the motion and forces acting on a body in circular motion.

Course Performance Objective 9: The students will solve problems involving momentum.

Learning Outcomes:

1. Students will distinguish between momentum and impulse.
2. Students will explain and apply the conservation of linear momentum.
3. Students will recognize inelastic collisions.

Course Performance Objective 10: The students will state the relationships between energy variables.

Learning Outcomes:

1. Students will define and calculate the kinetic energy of a particle.
2. Students will state Hooke's Law.
3. Students will recognize elastic collisions.
4. Students will draw and interpret energy diagrams.

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Course Performance Objective 11: The students will define work, a link between force and energy.

Learning Outcomes:

1. Students will define the work done by a force.
2. Students will calculate the work done by a variable force.
3. Students will state the work-energy theorem.
4. Students will solve problems involving conservative or non-conservative forces.
5. Students will define power and apply the relationships of power to work, force.

Course Performance Objective 12: The students will solve rotational motion problems.

Learning Outcomes:

1. Students will define angular displacement, velocity, and acceleration in rotational motion.
2. Students will write the formulas for the center of mass (c.m.) of a system.
3. Students will apply the definition of moment of inertia.
4. Students will define torque and angular momentum.
5. Students will solve problems in rotation of an object about a fixed axis.
6. Students will utilize the Law of Conservation of Angular Momentum.

General Education Requirements:

The general education goals covered in Calculus Based Physics I are quantitative, critical thinking and problem solving skills. See the Student Handbook for additional details.

Outcomes Assessment:

A college-wide outcomes assessment program has been put into place to enhance the quality and effectiveness of the curriculum and programs at Salem Community College. As part of this assessment program, the learning outcomes for this course will be assessed. Assessment methods may include tests, quizzes, papers, reports, projects and other instruments. Copies of all outcomes assessments are available in an electronic assessment bank maintained by the Institutional Research and Planning Office.

Course Activities:

The students will learn from lectures, small group discussions, individual explorations, and practice work. They will also be assigned homework problems, laboratory activities, and class work problems.

Writing assignments: students will analyze current issues in the field using current articles, library research and electronic resources databases.

Speaking assignments: students will present research individually or in groups using the available technology to support their presentation (e.g., PowerPoint presentation).

Course Requirements and Means of Evaluation:

Please refer to the instructor's syllabus addendum (to be distributed in class) for specific information regarding the course requirements and means of evaluation.

Attendance Policy:

Regular and prompt attendance in all classes is expected of students. Students absent from class for any reason are responsible for making up any missed work. Faculty members establish an attendance policy for each course and it is the student's responsibility to honor and comply with that policy.

Academic Honesty Policy:

Students found to have committed an act of academic dishonesty may be subject to failure of this course, academic probation, and / or suspension from the college. See the Student Handbook for additional details.

ADA Statement:

If you have a 504 Accommodation Plan, please discuss it with your instructor. If you have any disability but have not documented it with the Disability Support coordinator at Salem Community college, you must do so to be eligible for accommodations. To contact the Disability Support Coordinator, call 856-351-2773, or email disabilitysupport@salemcc.edu to set up an appointment. To find out more information about disability support services at Salem Community College, visit www.salemcc.edu/students/student-success-programs/disability-support.

Section VII

Required Text(s): For textbook information, please see the Salem Community College Bookstore website.

Materials and Supplies: Graphing Calculator (TI-83 or better)

Additional Costs: None unless equipment is abused.