Las Positas College
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Course Outline for PHYS 1A

GENERAL PHYSICS I

Effective: Fall 2017

I. CATALOG DESCRIPTION:
PHYS 1A — GENERAL PHYSICS I — 5.00 units

Introduction to the principles of Newtonian Mechanics and analytical methods of physics using calculus as needed. Topics covered include vectors, kinematics, forces, energy, momentum, rotation, and gravitation.

4.00 Units Lecture 1.00 Units Lab

Prerequisite
MATH 1 - Calculus I
with a minimum grade of C

Grading Methods:
Letter Grade

Discipline:
- Physics/Astronomy

	MIN
Lecture Hours:	72.00
Lab Hours:	54.00
Total Hours:	126.00

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: 1

III. PREREQUISITE AND/OR ADVISORY SKILLS:

Before entering the course a student should be able to:

A. MATH1

IV. MEASURABLE OBJECTIVES:

Upon completion of this course, the student should be able to:

A. Construct vectors in three dimensions to model physical phenomena, and perform algebraic calculations with these vectors.
B. Use algebra, trigonometry, geometry, and calculus to model physical phenomena and calculate relevant physical parameters.
C. Predict the future trajectory of an object moving in two dimensions with uniform acceleration.
D. Analyze a physical situation with multiple constant forces acting on a point mass using Newtonian mechanics.
E. Analyze a physical situation with multiple forces acting on a point mass or extended object using concepts of work and energy.
F. Analyze a physical situation with multiple forces acting on an extended object using the concept of torque.
G. Calculate the moment of inertia and angular momentum of an extended object or system of objects, using calculus if necessary.
H. Analyze collisions of point masses and extended objects using the concept of conservation of linear and angular momentum.
I. Analyze situations in which the gravitational acceleration changes as a function of distance using Newton's Law of Universal Gravitation.
J. Design, perform, analyze, and assess the effectiveness of simple experiments to demonstrate physical phenomena.
K. Operate standard laboratory equipment and analysis tools, including digital data acquisition systems, spreadsheet programs, and plotting programs.
L. Analyze real-world experimental data, including appropriate use of error propagation, units and significant figures.
M. Relate the results of experimental data to the physical concepts discussed in the lecture portion of the class.
N. Write comprehensive laboratory reports that describe the scientific basis of the experiment, clearly explain the experimental procedure, present a complete mathematical analysis of data and uncertainties, and evaluate the effectiveness of the experiment based on calculated uncertainties.

V. CONTENT:
A. Physics and Measurement
1. Standards of Length, Mass and Time
2. Matter and Model Building
3. Density and Atomic Mass
4. Dimensional Analysis
5. Conversion of Units
6. Estimates and Order-of-Magnitude Calculations
7. Significant Figures

B. Motion in One Dimension
    1. Position, Velocity, and Speed
    2. Instantaneous Velocity and Speed
    3. Acceleration
    4. Motion Diagrams
    5. One-Dimensional Motion with Constant Acceleration
    6. Freely Falling Objects
    7. Kinematic Equations Derived from Calculus
    8. General Problem-Solving Strategy
C. Vectors
    1. Coordinate Systems
    2. Vector and Scalar Quantities
    3. Some Properties of Vectors
    4. Components of a Vector and Unit Vectors
D. Motion in Two Dimensions
    1. The Position, Velocity and Acceleration Vectors
    2. Two-Dimensional Motion with Constant Acceleration
    3. Projectile Motion
    4. Uniform Circular Motion
    5. Tangential and Radial Acceleration
    6. Relative Velocity and Relative Acceleration
E. The Laws of Motion
    1. The Concept of Force
    2. Newton's First Law and Inertial Frames
    3. Mass
    4. Newton's Second Law
    5. The Gravitational Force and Weight
    6. Newton's Third Law
    7. Some Applications of Newton's Laws
    8. Forces of Friction
F. Circular Motion and Other Applications of Newton's Laws
    1. Newton's Second Law Applied to Uniform Circular Motion
    2. Non-uniform Circular Motion
    3. Motion in the Presence of Resistive Forces
G. Energy and Energy Transfer
    1. Systems and Environments
    2. Work Done by a Constant Force
    3. The Scalar Product of Two Vectors
    4. Work Done by a Varying Force
    5. Kinetic Energy and the Work-Kinetic Energy Theorem
    6. The Nonisolated System – Conservation of Energy
    7. Situations Involving Kinetic Friction
    8. Power
H. Potential Energy
    1. Potential Energy of a System
    2. The Isolated System – Conservation of Mechanical Energy
    3. Conservative and Non-conservative Forces
    4. Changes in Mechanical Energy for Non-conservative Forces
    5. Relationship Between Conservative Forces and Potential Energy
    6. Energy Diagrams and Equilibrium of a System
I. Linear Momentum and Collisions
    1. Linear Momentum and Its Conservation
    2. Impulse and Momentum
    3. Collisions in One Dimension
    4. Two-Dimensional Collisions
    5. The Center of Mass
    6. Motion of a System of Particles
    7. Rocket Propulsion
J. Rotation of a Rigid Object around a Fixed Axis
    1. Angular Position, Velocity and Acceleration
    2. Rotational Kinematics: Rotational Motion with Constant Angular Acceleration
    3. Angular and Linear Quantities
    4. Rotational Kinetic Energy
    5. Calculation of Moments of Inertia
    6. Torque
    7. Relationship Between Torque and Angular Acceleration
    8. Work, Power and Energy in Rotational Motion
    9. Rolling Motion of a Rigid Object
K. Angular Momentum
    1. The Vector Product and Torque
    2. Angular Momentum
    3. Angular Momentum of a Rotating Rigid Object
    4. Conservation of Angular Momentum
    5. The Motion of Gyroscopes and Tops
L. Static Equilibrium and Elasticity
    1. The Conditions of Equilibrium
    2. More on the Center of Gravity
    3. Examples of Rigid Objects in Static Equilibrium
    4. Elastic Properties of Solids
M. Universal Gravitation
    1. Newton's Law of Universal Gravitation
    2. Measuring the Gravitational Constant
    3. Free-Fall Acceleration and the Gravitational Force
    4. Kepler's Laws and the Motion of Planets
    5. The Gravitational Field
    6. Gravitational Potential Energy
    7. Energy Considerations in Planetary and Satellite Motion

VI. METHODS OF INSTRUCTION:

A. **Lecture** -
B. **Discussion** -
C. **Lab** -
D. Problem solving
E. Internet and other computer-based simulations and instructional multi-media
F. **Demonstration** -

VII. TYPICAL ASSIGNMENTS:

Assignments include weekly or bi-weekly homework assignments with an average of 10-15 word problems per assignment. Weekly or bi-weekly practice problems may be worked on collaboratively during class, for practice only. Weekly laboratory activities take place which may involve direct experimentation, computer analysis, theoretical calculations, and written lab reports.

VIII. EVALUATION:
Methods/Frequency

A. Exams/Tests
B. Quizzes
C. Papers
D. Oral Presentation
E. Class Participation
F. Class Work
G. Home Work
H. Lab Activities

IX. TYPICAL TEXTS:

1. Young, Hugh, and Roger Freedman. *University Physics.* 14th ed., Pearson Education, 2016.
2. Halliday, David, Robert Resnick, and Jearl Walker. *Fundamentals of Physics (Extended).* 10th ed., Wiley, 2013.
3. Knight, Randall. *Physics for Scientists and Engineers: A Strategic Approach with Modern Physics.* 4th ed., Pearson Education, 2017.
4. Las Positas College Physics 1A Laboratory Manual available online in PDF format.

X. OTHER MATERIALS REQUIRED OF STUDENTS:

A. Programmable scientific calculator capable of graphing
B. Campus print card