Las Positas College
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Course Outline for PHYS 2A

INTRODUCTION TO PHYSICS I

Effective: Fall 2018

I. CATALOG DESCRIPTION:
PHYS 2A — INTRODUCTION TO PHYSICS I — 4.00 units

Introduction to the major principles of classical mechanics using pre-calculus mathematics. Includes Newtonian mechanics, energy, gravitation, fluids, thermodynamics, oscillations, and waves.

3.00 Units Lecture 1.00 Units Lab

Prerequisite
MATH 39 - Trigonometry
with a minimum grade of C

Grading Methods:
Letter Grade

Discipline:
- Physics/Astronomy

	MIN
Lecture Hours:	54.00
Expected Outside of Class Hours:	108.00
Lab Hours:	54.00
Total Hours:	216.00

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. MATH39
1. Define trigonometric functions in terms of the right triangle, using coordinates of a point and distance from the origin, and using the unit circle;
2. State from memory the values for sine, cosine and tangent functions of common angles given in either degrees or radians;
3. Identify special triangles and their related angle and side measures;
4. State from memory the Pythagorean identities, reciprocal identities, quotient identities, double angle identities, and sum and difference identities for sine and cosine ;
5. Evaluate the trigonometric function of an angle in degree and radian measure;
6. Manipulate and simplify a trigonometric expression;
7. Solve trigonometric equations, including equations with multiple angles over different intervals, and solve triangles and applied problems;
8. Graph the basic trigonometric functions and apply changes in period, phase and amplitude to generate new graphs;
9. Develop and use trigonometric ratios or other trigonometric formulas to solve problems;
10. Convert between polar and rectangular coordinates and equations;
11. Graph polar coordinate equations.
12. Represent a vector (a quantity with magnitude and direction) in the form <a,b> and ai+bj.

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, and geometry to model physical phenomena and calculate relevant physical parameters.
C. Predict the future trajectory of an object 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 using concepts of work and energy.
F. Analyze static and dynamic extended systems using the concepts of torque and angular acceleration.
G. Analyze collisions of point masses and extended objects using the concept of conservation of linear and angular momentum.
H. Analyze situations in which the gravitational acceleration changes as a function of distance using Newton’s Law of Universal Gravitation.

I. Analyze hydrodynamic situations using the definition of pressure and/or Bernoulli's Principle.
J. Analyze the temperature, pressure, and volume of a system using the laws of thermodynamics.
K. Analyze interacting physical systems, including heat engines, using the laws of thermodynamics and the concept of entropy.
L. Analyze physical situations involving simple and/or damped harmonic motion using concepts of force and energy.
M. Analyze the properties of traveling and standing waves using trigonometric functions and the concept of wave superposition.
N. Analyze real-world experimental data, including appropriate use of units and significant figures.
O. Relate the results of experimental data to the physical concepts discussed in the lecture portion of the class.
P. Design, perform, analyze, and assess the effectiveness of simple experiments to demonstrate physical phenomena.
Q. Operate standard laboratory equipment and analysis tools, including digital data acquisition systems, spreadsheet programs, and plotting programs.
R. 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. The Building Blocks of Matter
    3. Dimensional Analysis
    4. Uncertainty in Measurements and Significant Figures
    5. Conversion of Units
    6. Order-of-Magnitude Calculations
    7. Coordinate Systems
    8. Trigonometry
B. Motion in One Dimension
    1. Displacement
    2. Average Velocity
    3. Instantaneous Velocity
    4. Acceleration
    5. Motion Diagrams
    6. One-Dimensional Motion with Constant Acceleration
    7. Freely Falling Objects
C. Vectors and Two Dimensional Motion
    1. Vectors and Scalars Revisited
    2. Some Properties of Vectors
    3. Components of a Vector
    4. Displacement, Velocity and Acceleration in Two Dimensions
    5. Projectile Motion
    6. Relative Velocity
D. The Laws of Motion
    1. The Concept of Force
    2. Newton's First Law
    3. Newton's Second Law
    4. Newton's Third Law
    5. Some Applications of Newton's Laws
    6. Force of Friction
E. Work and Energy
    1. Work
    2. Kinetic Energy and the Work-Kinetic Energy Theorem
    3. Potential Energy
    4. Conservative and Non-Conservative Forces
    5. Conservation of Mechanical Energy
    6. Non-Conservative Forces, Nonisolated Systems and Conservation of Energy
    7. Power
    8. Work Done by A Varying Force
F. Momentum and Collisions
    1. Impulse and Momentum
    2. Conservation of Momentum
    3. Collisions
    4. Glancing Collisions
    5. Rocket Propulsion
G. Rotational Motion and the Law of Gravity
    1. Angular Speed and Angular Acceleration
    2. Rotational Motion with Constant Angular Acceleration
    3. Relationships between Angular and Linear Quantities
    4. Centripetal Acceleration
    5. The Vector Nature of Angular Quantities
    6. Forces Causing Centripetal Acceleration
    7. Newton's Universal Law of Gravity
    8. Gravitational Potential Energy Revisted
    9. Kepler's Laws
H. Rotational Equilibrium and Rotational Dynamics
    1. Torque
    2. Torque and the Two Conditions for Equilibrium
    3. The Center of Gravity
    4. Examples of Objects in Equilibrium
    5. Relationships Between Torque and Angular Acceleration
    6. Rotational Kinetic Energy
    7. Angular Momentum
I. Solids and Fluids
    1. States of Matter
    2. The Deformations of Solids
    3. Density and Pressure
    4. Variation of Pressure with Depth
    5. Pressure Measurements
    6. Bouyant Forces and Archimedes' Principle
    7. Fluids in Motion
    8. Other Applications of Fluid Dynamics
    9. Surface Tension, Capillary Action, and Viscous Fluid Flow

10. Transportation Phenomena

J. Thermal Physics
   1. Temperature and the Zeroth Law of Thermodynamics
   2. Thermometers andTemperature Scale
   3. Thermal Expansion of Solids and Liquids
   4. Macroscopic Description of and Ideal Gas
   5. Avagadro's Number and the Ideal Gas Law
   6. The Kinetic Theory of Gases
K. Energy in Thermal Processes
   1. Heat and Internal Energy
   2. Specific Heat
   3. Calorimetry
   4. Latent Heat and Phase Changes
   5. Energy Transfer by Thermal Conduction
   6. Energy Transfer by Convection
   7. Energy Transfer by Radiation
   8. Resisting Energy Transfer
   9. Global Warming and Greenhouse Gases
L. The Laws of Thermodynamics
   1. Work in Thermodynamic Processes
   2. The First Law of Thermodynamics
   3. The First Law and Human Metabolism
   4. Heat Engines and the Second Law of Thermodynamics
   5. Reversible and Irreversible Processes
   6. The Carnot Engine
   7. Entropy
   8. Entropy and Disorder
M. Vibrations and Waves
   1. Hooke's Law
   2. Elastic Potential Energy
   3. Velocity as a Function of Time
   4. Comparing Simple Harmonic Motion with Uniform Circular Motion
   5. Position, Velocity and Acceleration as a Function of Time
   6. Motions of a Pendulum
   7. Damped Oscillations
   8. Wave Motion
   9. Types of Waves
   10. Frequency, Amplitude and Wavelength
   11. The Speed of Waves on Strings
   12. Interference of Waves
   13. Reflection of Waves
N. Sound
   1. Producing a Sound Wave
   2. Characteristics of Sound Waves
   3. Speed of Sound Waves
   4. Energy and Intensity of Sound Waves
   5. Spherical and Plane Waves
   6. The Doppler Effect
   7. Interference of Sound Waves
   8. Standing Waves
   9. Forced Vibrations and Resonance
   10. Standing Waves in Air Columns
   11. Beats
   12. Quality of Sound
   13. The Ear

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:

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

VIII. EVALUATION:

A. **Methods**
   1. Exams/Tests
   2. Quizzes
   3. Papers
   4. Oral Presentation
   5. Class Participation
   6. Class Work
   7. Home Work
   8. Lab Activities
B. **Frequency**
   1. 3-5 exams per semester
   2. quizzes weekly or bi-weekly. between exams, if desired
   3. special topic research paper, once per semester, if desired
   4. oral presentations on lab work a few times per semester, if desired
   5. daily class participation and classwork, if desired
   6. weekly or bi-weekly homework assignments

7. weekly lab activities, with lab report papers assigned every few weeks

IX. TYPICAL TEXTS:

1. Giancoli, Douglas. *Physics: Principles with Applications.* 7th ed., Pearson, 2014.
2. Cutnell, John, Kenneth Johnson, David Young, and Shane Stadler. *Physics.* 11th ed., Wiley, 2018.
3. Knight, Randall, Brian Jones, and Stuart Field. *College Physics: A Strategic Approach.* 3rd ed., Pearson, 2015.
4. Las Positas College Physics 2A Laboratory Manual, available online in PDF format.

X. OTHER MATERIALS REQUIRED OF STUDENTS:

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