PHYS 140 - Physics for Scientists & Engineers 1 Course Outline

Approval Date: 05/12/2022
Effective Date: 08/26/2024

SECTION A

Unique ID Number	CCC000243442
Discipline(s)	
Division	Science and Engineering
Subject Area	Physics
Subject Code	PHYS
Course Number	140
Course Title	Physics for Scientists & Engineers 1
TOP Code/SAM Code	1902.00 - Physics, General / E - Non-Occupational
Rationale for adding this course to the curriculum	Change math co-req to: co-req or pre-req
Units	4
Cross List	*N/A*
Typical Course Weeks	18

Total Instructional Hours

	Contact Hours
Lecture	54.00
Lab	72.00
Activity	0.00
Work Experience	0.00
Outside of Class Hours	108.00

Total Contact Hours	126
Total Student Hours	234
Open Entry/Open Exit	No
Maximum Enrollment	
Grading Option	Letter Grade or P/NP
Distance Education Mode of Instruction	

SECTION B

General Education Information:

SECTION C

Course Description

Repeatability May be repeated 0 times

Catalog Description This is a calculus-based introduction to the principles of mechanics and wave motion. Topics include measurements, vectors, kinematics and dynamics,

linear and circular motion, gravitation, work and mechanical energy, conservation of energy, linear and angular momentum, rotational motion, static equilibrium, oscillations, and fluid mechanics.

Schedule Description

SECTION D

Condition on Enrollment

1a. Prerequisite(s)

- MATH 120 and
- MATH 121 with a minimum grade of C or better

1b. Corequisite(s)

- MATH 121 or

1c. Recommended: *None*

1d. Limitation on Enrollment: *None*

SECTION E

Course Outline Information

1. Student Learning Outcomes:

A. Communicate the principles of kinematics and dynamics processes within the realm of Newtonian mechanics and solve problems with qualitative reasoning.
B. Solve quantitative calculus level mechanics problems while demonstrating a thorough understanding of the application of Newton?s Laws of mechanics and conservation principles.
C. Implement laboratory experiment techniques correctly during the investigation of mechanics and express the results clearly in written laboratory reports.

2. Course Objectives: Upon completion of this course, the student will be able to:

A. Use the units of metric measurement and be able to convert from one unit to another.
B. Solve calculus problems in kinematics using the concepts of velocity and acceleration. For example: Predict the future trajectory of an object moving in two dimensions with uniform acceleration
C. Use the trigonometric functions to solve vector problems.
D. Analyze force and motion using Newton?s Laws of Motion.
E. Draw free body diagrams to find unknown forces.
F. Use the concepts of centripetal force and Kepler?s Laws of satellite motion to solve problems.
G. Use the conservation of energy and momentum in solving motion and collision problems.
H. Analyze torque, angular motion, and gyroscopic motion problems.
I. Solve complex statics problems involving multiple forces. Exmaples: 1. Analyze a physical situation with multiple constant forces acting on a point mass using Newtonian mechanics. 2. Analyze a physical situation with multiple forces acting on a point mass or extended object using concepts of work and energy
J. Use the concepts of pressure, Archimedes principle and fluid flow in solving problems.
K. Analyze and solve problems in simple harmonic motion.
L.

3. Course Content

A. Mechanics
    a. Standards of length, mass, and time
    b. Density and atomic mass

    c. Dimensional analysis
    d. Conversion of units
    e. Order-of-Magnitude calculations

B. Vectors:
    a. Vectors and scalars
    b. Some properties of vectors
    c. Components of a vector and unit vectors

C. Motion in One Dimension
    a. Average velocity
    b. Instantaneous velocity
    c. Acceleration
    d. Freely falling bodies

D. Motion in Two Dimensions: translational kinematics
    a. The displacement, velocity, and acceleration vectors
    b. Motion in two dimensions with constant acceleration
    c. Projectile motion
    d. Uniform circular motion

E. The Laws of Motion: Dynamics
    a. The concept of force
    b. Newton's first law and inertial frames
    c. Newton's second law
    d. Weight
    e. Newton's third law
    f. Forces of friction

F. Circular Motion and Other Applications of Newton's Laws
    a. Newton's second law applied to uniform circular motion.
    b. Nonuniform circular motion
    c. Motion in accelerated frames
    d. Motion in the presence of resistive forces

G. Work and Energy
    a. Work done by a constant force
    b. The scalar product of two vectors
    c. Work done by a varying force
    d. Work and kinetic energy
    e. Power

H. Potential Energy and Conservation of Energy
    a. Conservative and nonconservative forces
    b. Potential energy
    c. Conservation of mechanical energy
    d. Gravitational potential energy near the earth's surface
    e. Nonconservative forces and the work-energy theorem
    f. Potential energy stored in a spring

I. Linear Momentum and Collisions
    a. Linear momentum and impulse
    b. Conservation of linear momentum for a two-particle system
    c. Collisions
    d. Collisions in one dimension
    e. Two-dimensional collisions
    f. The center of mass

J. Rotation of a Rigid Body About a Fixed Axis
    a. Angular velocity and angular acceleration

b. Rotational kinematics
c. Rotational kinetic energy
d. Calculations of moments of inertia
e. Torque
f. Work and energy in rotational motion

K. Rolling Motion (rotational dynamics), Angular Momentum, and Torque
a. Rolling motion of a rigid body
b. The vector product and torque
c. Angular momentum of a particle
d. Conservation of angular momentum

L. Statics: Static Equilibrium and Elasticity
a. The conditions of equilibrium of a rigid object
b. The center of gravity
c. Elastic properties of solids

M. Oscillatory Motion
a. Simple harmonic motion
b. Energy of the simple harmonic oscillator
c. The pendulum
d. Damped oscillations
e. Forced oscillations

N. The Law of Universal Gravitation
a. Newton's Universal Law of Gravitation
b. Measurement of the gravitational constant
c. Weight and gravitational force
d. Kepler's laws
e. The law of universal gravitation and the motion of planets
f. The gravitational field
g. Gravitational potential energy

O. Fluid Mechanics
a. States of Matter
b. Density and pressure
c. Variation of pressure with depth
d. Pressure measurements
e. Fluid dynamics
f. Streamlines and the equation of continuity
g. Bernoulli's Equation.
h.

4. Methods of Instruction:

Discussion: Classroom discussion of example problems
Experiments: Laboratory Experiments
Lab: Problem Solving Lab in Computer Room
Lecture: Presentation of course material
Observation and Demonstration: In class demonstrations of physical principles

5. Methods of Evaluation: Describe the general types of evaluations for this course and provide at least two, specific examples.

Typical classroom assessment techniques

Exams/Tests -- Multiple Choice Questions, Conceptual Questions, and Symbolic and Numerical Problems
Projects -- Lab Experiment
Home Work -- Textbook problems

Lab Activities -- Complete Lab Experiments in groups
Final Exam -- Multiple Choice Questions, Conceptual Questions, and Symbolic and Numerical Problems
Mid Term -- Multiple Choice Questions, Conceptual Questions, and Symbolic and Numerical Problems

Letter Grade or P/NP

6. Assignments: State the general types of assignments for this course under the following categories and provide at least two specific examples for each section.

A. Reading Assignments
Textbook chapters
Laboratory Manual experiments

Sample Reading Assignment 1:
Read Chapter 9 - Linear Momentum

Sample Reading Assignment 2:
Read Experiment 3 - Uniformly Accelerated Motion

B. Writing Assignments
Complete Laboratory Reports

Lab Report Requirements:

1) Cover Page (Typed): Include Your Name, Lab Exp. #, Lab Title, Date, and list of Lab Partners.

2) Procedure (Typed): In your own words describe the general procedure(s) for this experiment. The procedure can be in an outline format, paragraphs, or any other way that can best convey the procedure used to carry out the experiment, make measurements, and obtain the required results. Please: Do Not Just Copy the Procedure from the Lab Manual.

3) Data Sheet(s) Section: Include your Lab data sheets here that came out of your Wilson Lab Manual or were provided on handouts. This sheet MUST have my initials from the lab. Do Not Forget to include units, correct number of significant figures, and make sure your entries are legible.

4) Graph Section: Any graphs assigned are to be done on the computer with software that includes Regression Analysis by the method of least squares. The regression equation must be printed on the top of the graph. Each graph must be labeled with a Title and Axes description with units. In Lab Graphs MUST have my initials from the lab.

5) Calculations Section: Hand calculations, which includes providing units for each factor, term and results. Any conversions or geometric calculations are to be included. Intermediate calculations are to be provided. Your goal should be to write up your calculations so someone else can understand them. Always start by stating the equation being used and then restate it with all variables replaced with their values and dimensions filled in. Leave pie as a symbol. If the same identical calculations are repeated, you only need to show each result once. Calculation details of average values can be omitted. You will lose points if data and results do not include units. Use a separate piece of paper when needed and label the calculations. Do not try to cram the

calculations into the margins or put them in the wrong order.

6) Question Answer Section (Typed): Answers to assigned lab questions must be typed and spell checked. Be sure to include the question number and any reference page number. The question must be restated (typed) followed by your answer.

7) Analysis and Conclusion (Typed): In this section, you must critically analyze your results, experiment procedure, measurement techniques, and include a conclusion that explains if the experiment objectives were met or not. Explain why or why not. You are expected to show clear logic and understanding of the final results and their physical meaning.

The laboratory is a large portion of your PHYS 240 grade. In fact, the lab accounts for 30% of the total grade. Hence, it is important to make sure that you meet the entire requirement on every lab. Please ask for assistance and/or any clarification.

The lab work is done by teams and it is acceptable for students to do analysis together but the laboratory report is to be your own work. Laboratory reports from group members that are identical or essentially identical will be treated as a single report and the points awarded to each member will be graded as one report and the points will be split among the students violating this rule. The very best grade you can get if you do not do your own work is 50%.

You are expected to obtain a copy of the laboratory instructions for each week and study them before coming to the laboratory class. This preparation will enhance your learning experience. In order to encourage you to do your preparation, there will be occasional quizzes covering the procedure for the current lab experiment. It is your responsibility to obtain a copy of the laboratory instructions before you come to the lab. Copies will not be available at the laboratory during the lab session.

C. Other Assignments
Homework Problems

Sample Problem 1:
A person jumps from the roof of a house 4.0 m high. When he strikes the ground below, he bends his knees so that his torso decelerates over an approximate distance of 0.71 m. If the mass of his torso (excluding legs) is 43 kg , find: (a) his velocity just before his feet strike the ground, and (b) the magnitude of the average force exerted on his torso by his legs during deceleration.

Sample Problem 2:
Water at a gauge pressure of 3.8 atm at street level flows into an office building at a speed of 0.70 m/s through a pipe 5.4 cm in diameter. The pipe tapers down to 2.8 cm in diameter by the top floor, 18 m above, where the faucet has been left open. (a) Calculate the flow velocity in the pipe on the top floor. (b) Calculate the gauge pressure in the pipe on the top floor. Assume no branch pipes and ignore viscosity.

7. Required Materials

A. EXAMPLES of typical college-level textbooks (for degree-applicable courses) or other print materials.

Book #1:
Author: Giancoli, D.C.

Title:	Physics for Scientists and Engineers with Modern Physics
Publisher:	Pearson Education
Date of Publication:	2008
Edition:	4th

Book #2:

Author:	Knight, Randall
Title:	Physics for Scientists and Engineers: A Strategic Approach
Publisher:	Addison-Wesley
Date of Publication:	2012
Edition:	3nd

Book #3:

Author:	Moebs, W., et. al.
Title:	University Physics Volume 1
Publisher:	OpenStax
Date of Publication:	2021
Edition:	

B. Other required materials/supplies.