暨南大學 JINAN UNIVERSITY

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JINAN UNIVERSITY
Fundamentals of Physics I (With Lab)

Lecturer: TBA
Time: Monday through Friday (June 17, 2019-July 19, 2019)
Office hours: 2 hours (according to the teaching schedule)
Contact Hours: 60 (50mins each)
Credits: 4
Location: MBA Center
Office: MBA Center 107
E-mail: TBA

Course Description

Fundamentals of Physics I is a general education course designed as an introduction to college physics for students majoring in the biological, environmental, earth, and social sciences, as well as disciplines such as architecture, business, and the humanities. The mathematical techniques used in this course include **algebra and trigonometry**, but not calculus. The main emphasis of the course is on the **fundamentals of Newtonian mechanics and the physics of fluids**. The goal of this course is to provide the student with a clear and logical presentation of the basic concepts and principles of physics, and to strengthen concept understanding through a range of interesting applications to the real world, including practical examples that demonstrate the role of physics in other disciplines. Because physics is a science based upon experimental observations, concept lectures will be supplemented by practical exercises and hands on experimentation. The course content is divided into 8 modules:

- Module I (***Introduction and Vectors***) discusses a few mathematical concepts and techniques that will be used throughout the course, such as dimensional analysis, significant figures, unit conversion, mathematical notation, and coordinate systems. This module will also define the basic quantities of measurement in mechanics (length, time, mass), and discuss the difference between scalar and vector quantities, as well as the properties and components of vectors.

- Module II (***Motion in One and Two Dimensions***) investigates kinematics, the part of mechanics that describe motion without regard to the causes of motion. We will start by describing motion along a straight line and define the concepts of velocity and acceleration. We will then investigate the motion of free-falling bodies influenced by gravity, and conclude this module by exploring projectile motion.

- Module III (***The Laws of Motion***) is an introduction to the classical (Newtonian) mechanics. Here we shall use the concepts of force and mass to describe the change in the motion of an object, relate mass and acceleration, and explore the laws of motion proposed by Newton. We will conclude this module by investigating some of the applications of Newton's laws and discuss the forces of friction.

- Module IV (***Circular Motion and the Law of Gravity***) deals with circular motion, a specific type of two-dimensional motion. We will explore the concepts of angular velocity, angular acceleration, and centripetal force, and introduce Newton's universal law of gravity, one of the fundamental laws in nature. We will discuss how this law of gravity, together with the laws of motion, enables us to understand a variety of familiar phenomena, including the motion of satellites. This module will conclude with an exploration of Kepler's laws of planetary motion.

- Module V (***Work and Energy***) will focus on the mechanical forms of energy. We will introduce the concepts of work, power, and kinetic and potential energy, and explore how the ideas of work and energy can be used in place of Newton's laws to solve certain problems. We will conclude this module by discussing the law of conservation of energy and applying it to various problems.

- Module VI (***Momentum and Collisions***) will introduce the concepts of momentum and impulse, and investigate how these concepts relate to the law of conservation of momentum. We will then apply this understanding to explain a number of elastic and inelastic collisions.

- Module VII (***Equilibrium and Rotational Motion***) will build on concepts from module IV by examining the relationship between angular velocity, angular acceleration, and the forces that produce rotational motion. We will also explore the conditions for equilibrium, and the relationship between torque, rotational inertia, and conservation of momentum.

- Module VIII (***Solids, Fluids, and Fluid Dynamics***) will explore the states of matter and some properties of solids and fluids (liquids and gases). We will investigate concepts of density and pressure, explore buoyant forces and the Archimedes' principle, then understand how these properties and concepts explain the behavior of fluids, both the fluids at rest and the fluids in motion.

Required Textbook

The Physics of Everyday Phenomena: A Conceptual Introduction to Physics, 8th edition (2015), by W. Thomas Griffith and Juliet Brosing. Publisher: McGraw-Hill, ISBN 978-0073513904.

Course Hours

The course has 20 lecture sessions and 5 lab sessions in total. Each session is 120 minutes in length. Lecture session meets from Monday to Thursday. Lab session meets on each Friday.

Assessment

Your final grade is based on the following components:

Quizzes/Homework	20%
Practical Exercises	25%
Midterm Exam	25%
Final Exam	30%
Total	100%

Grading Scale

The instructor will use the grading system as applied by JNU:

Definition	Letter Grade	Score
Excellent	A	90-100
Good	B	80-89
Satisfactory	C	70-79
Poor	D	60-69
Failed	E	Below 60

Quizzes/Homework

Multiple self-assessment quizzes and homework assignments will be offered for students to practice their concept understanding and to prepare for the lectures. These quizzes and homework assignments will be POSTED ON BLACKBOARD on a weekly basis. Many of these assignments will be discussed during class and/or recitation. Late homework will NOT be accepted, except in the case of a documented medical reason (documentation is required).

Lab Activities

At the end of each week (on Fridays) students will have the chance to practice their understanding of the concepts discussed in class. They will work in small groups on practical exercises using the interactive simulations developed by the PhET program (http://phet.colorado.edu).

Week 1:

a. *Moving Man Simulation* explores kinematics concepts such as velocity and acceleration graphs. Students will learn how to interpret, predict, and draw charts (position, velocity and acceleration) for common situations.

b. *Force and Motion Simulation* examines the forces at work when pulling against a cart, and pushing a refrigerator, crate, or person. Students will have the opportunity to:
   - Create an applied force and see how it makes objects move.
   - Change friction and see how it affects the motion of objects.
   - Identify when forces are balanced versus unbalanced.
   - Determine the sum of forces (net force) on an object with more than one force on it.
   - Predict the motion of an object with zero net force.
   - Predict the direction of motion given a combination of forces.

Week 2:

a. *Ladybug Revolution Simulation* invites students to join the ladybug in an exploration of rotational motion. In this simulation, students will:

- Rotate the merry-go-round to change its angle, or choose a constant angular velocity or angular acceleration.
- Explore how circular motion relates to the bug's x, y position, velocity, and acceleration using vectors or graphs.
- Explain some of the variables for rotational motion by describing the motion of a bug on a turning platform
- Describe how the bug's position on the turning platform affects these variables.

b. *Pendulum Simulation* includes topics such as periodic motion, simple harmonic motion, and conservation of energy. Students will have the opportunity to:

- Discover how the period of a simple pendulum depends on the length of the string, the mass of the pendulum bob, the strength of gravity, and the amplitude of the swing.
- Observe the energy in the system in real-time, and vary the amount of friction.
- Use the pendulum to find the value of g on Planet X.

Week 3: *Masses and Spring Simulation* displays the kinetic, potential, and thermal energy for each spring. In this simulation, students will:

- Hang masses from springs and adjust the spring stiffness and damping.
- Explain the Conservation of Mechanical Energy concept using kinetic, elastic potential, and gravitational potential energy.
- Use their understanding of how a spring scale works to determine the mass of an unknown object.
- Find the value of g on Planet X.

Week 4:

a. *Torque Simulation* includes concepts such as rotation, torque, moment of inertia, and angular momentum. In this simulation, students will:

- Investigate how torque causes an object to rotate.
- Discover the relationships between angular acceleration, moment of inertia, angular momentum, and torque.
- Determine the relationship between the applied force, frictional force (of the brake) and the torque.
- Write an equation that relates the torque required to the radius at which the force is applied.

- Write an equation that relates the moment of inertia to the angular velocity.

b. *Collision Simulation* displays an air hockey table to investigate simple collisions in 1D and more complex collisions in 2D by the use of a variations in the number of discs, masses, and initial conditions. The simulation varies the elasticity in order to explore how the total momentum and kinetic energy changes during collisions. In this simulation, students will:

- Construct momentum vector representations of "before-and-after" collisions.
- Apply law of conservation of momentum to solve problems of collisions.
- Explain why energy is not conserved and varies in some collisions.
- Determine the change in mechanical energy in collisions of varying "elasticity".

Week 5: *Buoyancy Simulation* explores the how buoyancy works with blocks. In this simulation, students will:

- Predict whether an object will sink or float when placed in a liquid, given densities of the object and liquid.
- Apply the definition of density to both liquids and solids.
- Relate the buoyant force on an object to the weight of liquid it displaces.
- Describe how the buoyant force is related to an object's relative density to the fluid.
- Predict the weight of a completely or partially submerged object of known mass and volume.
- Describe the forces that act on a completely or partially submerged object.

Class Schedule

Week 1

Lecture 1: Introduction to Mechanics – Measurements and Vectors (Chapter 1)
Lecture 2: Describing Motion in One and Two Dimensions (Chapter 2)
Lecture 3: Falling Objects and Projectile Motion (Chapter 3)
Lecture 4: Introduction to Classical Mechanics (Chapter 4)
Lab 1: Moving Man Simulation and Force/Motion Simulation

Week 2

Lecture 5: Applications of Newton's Laws (Chapter 4)
Lecture 6: Circular Motion, Angular Velocity and Acceleration (Chapter 5)
Lecture 7: Planetary Motion and Newton's Law of Universal Gravitation (Chapter 5)
Lecture 8: Work and Energy – Kinetic and Potential Energy (Chapter 6)
Lab 2: Ladybug Revolution Simulation and Pendulum Simulation

Week 3

Lecture 9: Conservative and Non-conservative Forces (Chapter 6)
Lecture 10: Review session for the Mid-Term Exam (Chapters 1-6)
Mid-Term Exam (Chapters 1 to 6)
Lecture 11: Momentum and Impulse (Chapter 7)
Lab 3: Masses and Spring Simulation

Week 4

Lecture 12: Elastic and Inelastic Collisions (Chapter 7)
Lecture 13: Rotational Motion (Chapter 8)
Lecture 14: Objects in Equilibrium – Torque, Balance, and Center of Gravity (Chapter 8)
Lecture 15: Rotational Inertia and Conservation of Momentum (Chapter 8)
Lab 4: Torque Simulation and Collision Simulation

Week 5

Lecture 16: Solids and Fluids – States of Matter, Density, and Pressure (Chapter 9)
Lecture 17: Fluids Dynamics and the Bernoulli's Equation (Chapter 9)
Lab 5: Buoyancy Simulation
Final Exam Review Session
Final Exam (Chapters 1 to 9)

Academic Honesty

Jinan University defines academic misconduct as any act by a student that misrepresents the students' own academic work or that compromises the academic work of another. Academic misconduct includes (but is not limited to) cheating on assignments or examinations; plagiarizing, i.e. misrepresenting as one´s own work any work done by another; submitting the same paper, or substantially similar papers, to meet the requirements of more than one course without the approval and consent of the instructors; sabotaging another´s work. Instructors will ultimately determine what constitutes academic misconduct in the courses they teach. Students found guilty of academic misconduct in any portion of the academic work face penalties ranging from a lower grade in the assignment to a final grade of E for the entire course.