Phys1112: General Physics I with Calculus (3 credits)

Description:
PHYS 1111 and PHYS 1112 target students who have learned the most basic knowledge in physics in high school. Students with more advanced physics background should consider taking PHYS 1312. PHYS 1112 employs a calculus-based approach. Students without knowledge of calculus should take PHYS 1111 instead. Key topics include motions and Newton's Laws, work and energy, conservation of energy and momentum, rotation, rigid body, simple harmonic and damped oscillations, forced oscillations, standing waves and sound waves, kinetic theory and the laws of thermodynamics. Students without the physics prerequisite but who have taken PHYS 1101 or equivalent, and/or without the mathematics prerequisite but who have taken MATH 1012/ MATH 1013/ MATH 1020/ MATH 1023 or equivalent may seek instructor's approval for enrolling in the course.

Pre-requisite:
Level 3 or above in HKDSE 1/2x or in HKDSE 1x Physics AND Level 3 in HKDSE Mathematics Extended Module M1/M2

Intended Learning Outcomes:
On successful completion of this course, students are expected to be able to:

1. Use Newton's laws of motion to solve simple dynamics problems.

2. Use the principles of conservation of energy and momentum to solve simple dynamics problems and problems with rotational motion, and explain common physical phenomena.

3. Explain physical phenomena unique to waves such as superposition, interference, formulation of standing waves, resonance, beats and Doppler effects.

4. Use kinetic theory to explain the properties of gases.

5. Use the first and second laws of thermodynamics to solve problems involving ideal gases.

6. Use scientific language to explain phenomena in the physical world.

7. Use calculus to analyze and solve physical problems

Teaching and learning activities:
<u>Lectures:</u>
Lecture notes are available in Files. You are strongly recommended to bring a copy to class. Class demonstration videos are available on Youtube and links are embedded in Syllabus. If you cannot play Youtube videos, you can download the video files in Files.

Self-Study Topics: Some topics in the lecture notes are labelled as self-study topics. You are assigned to learn these topics by yourself. The main points of these topics are included in the lecture notes and you are encouraged to read the corresponding chapters in the textbook. Self-Study Topics will appear in both homework assignments and exams.

Tutorials:
Tutorial is designed to strengthen your understanding of the concepts taught in lectures. Participation of tutorial session will be counted towards your course grade. Tutorial policy can be found in the Tutorial page.

Homework Assignments (Weekly):
There will be online homework assignments weekly. Grading policy can be found in the Homework page. Homework solutions are posted after the due date in the "File" page.

Grading Scheme:

Assignments	10%
Tutorials	5%
Midterm	35%
Final Exam	50%

All the tasks serve to assess all the ILOs.

Weekly course topics (2 lectures/week)

Lecture 1
Physical quantities, vectors & Motion in 2D
- projectile

Lecture 2
Newton's laws of motion I
- Relative Motion
- Reference Frame
- Newton's Three Laws

Lecture 3
Newton's laws of motion II
- Friction
- Circular motion

Lecture 4
Work and kinetic energy
- work-energy theorem
- work done by a varying force

Lecture 5

Potential energy and energy conservation
- gravitational (mgh) and elastic PE
- conservative and non-conservative forces

Lecture 6
Momentum, impulse and collision I
- impulse-momentum theorem
- conservation of momentum
- elastic, inelastic, and completely elastic collision

Lecture 7
Momentum, impulse, and collision II
- elastic collision
- center of mass

Lecture 8
Dynamics of rigid bodies I
- angular displacement, velocity and acceleration
- rotational kinetic energy and moment of inertia

Lecture 9
Dynamics of rigid bodies II
- calculation of moment of inertial
- torque

Lecture 10
Dynamics of rigid bodies III
- rigid body rotation about a moving axis
- work and power in rotation motion

Lecture 11
Angular momentum
- conservation of angular momentum
- gyroscope

Lecture 12
Gravitation I
- Newton's law of gravitation
- gravitational force and potential energy
- satellite motion

Lecture 13
Gravitation II
- Kepler's laws of planetary motion
- spherical mass distribution
- apparent weight due to earth's rotation
- black hole

Lecture 14
Periodic motion I - simple harmonic motion

Lecture 15
Periodic motion II
- various types of SHM, pendulum
- damped and forced oscillations
- resonance

Lecture 16
Wave motion and sound I
- mathematical description of wave
- power propagation
- reflection of traveling waves

Lecture 17
Wave motion and sound II
- standing wave
- beat
- Doppler effect

Lecture 18
Temperature and heat
- thermal expansion
- heat capacity and latent heat
- heat transfer

Lecture 19
Thermal properties of matter I
- equation of state
- kinetic theory of ideal gas

Lecture 20
Thermal properties of matter II
- heat capacity of gases
- molecular speed distribution

Lecture 21

First law of Thermodynamics I
- first law of thermodynamics
- heat and work in thermodynamic processes

Lecture 22
First law of Thermodynamics II
- typical thermodynamic processes
- heat capacities of ideal gas under different conditions
- adiabatic process of ideal gas

Lecture 23
Second law of Thermodynamics I

- heat engines and refrigerators
- different forms of the second law

<u>Lecture 24</u>
Second law of Thermodynamics II
- reversible processes
-Carnot cycle and engine

Text Book

University Physics Volume 1 Ch 1-20 W/MasteringPhysics, Edition 15
Author: Hugh D Young   Publisher: Pearson