United International University

School of Science and Engineering

Mid Term Examination; Year 2024; Trimester: Spring
Course: PHY 2105; Title: Physics; Sec: A-M
Full Marks: 30, Time: 1 Hour 30 Minutes

Any examinee found adopting unfair means will be expelled as per UIU disciplinary rules.
Questions no 1, 2, 3 are mandatory to answer. Answer anyone from question no 4 and 5.

1.	(a) Why we observe damped harmonic motion in RLC circuit?	2	CO1
	(b) The equation of displacement of a simple harmonic oscillator is $x = Acos(\omega t + \pi)$. Plot displacement vs. time and acceleration vs. time graphically. What is the phase difference between displacement and acceleration?	2	CO1
	(c) Draw a transverse wave and show the wavelength on the wave.	2	CO1
2.	(a) Consider a mass-spring system oscillating in SHM and where the equation of displacement is $y = 7\,sin(8t - \frac{\pi}{4})$. If the block has mass m = 2 kg, calculate: (i) time period of the oscillation (ii) the velocity at t = 0.3 sec Consider all the units in S.I. unit system.	4	CO3
	(b) A block attached to a spring is suspended vertically. If the block is pushed 7 cm upward from the equilibrium position and released at t = 0. The mass of the block is 5 kg and the spring constant is k = 22 N/m. (i) Calculate the potential energy at x = 3 cm. (ii) Calculate the kinetic energy at the same position.	4	CO3
3.	(a) John constructed an RLC circuit with the value, C = 0.009 μF, L = 0.5 mH, and R= 200Ω respectively. (i) Whether the circuit is oscillatory, calculate the frequency of oscillation of the RLC circuit. (ii) What will be the value of resistance R if he wants to produce critical damping?	4	CO3
	(b) For a damped oscillator, m = 0.30 kg, k = 19.6 N/m, and b = 0.00086 kg/s. The oscillator is released at t = 0 and the amplitude is 10 cm. (i) Calculate the frequency of oscillations of the oscillator. (ii) How long does it take for the amplitude of the damped oscillator to drop to one half of its initial value?	4	CO3
4.	(a) Show that, for a simple pendulum in SHM, $\frac{d^2\theta}{dt^2} + g\frac{\theta}{L} = 0$.	4	CO2
	(b) For a mass-spring system oscillating in SHM, the equation of displacement is, $x = Asin\omega t$ Show that the total energy of the oscillator is, $E = \frac{1}{2}KA^2$. Plot energy vs. displacement graph.	4	CO2
5.	(a) Show that, the equation of displacement of the particles of a medium for a progressive wave is $y = A\,sin\frac{2\pi}{\lambda}(vt-x)$. Calculate the value of $\frac{d^2y}{dt^2}$. Here the symbols have their usual meanings.	4	CO2
	(b) Derive the differential equation of a mass-spring system oscillating in DHM. Write the conditions of three types of damped harmonic motion and graphically represent them by plotting displacement vs. time graphs.	4	CO2

CO1: Define different physical quantities with examples **CO2:** Derive/Show the various equations of SHM, DHM, wave motion etc.
CO3: Evaluate different numerical problems based on the basic characteristics of SHM, DHM.