United International University

School of Science and Engineering

Mid Term Examination; Year 2023; Trimester: Summer

Course: PHY 2105; Title: Physics; Sec: A-H

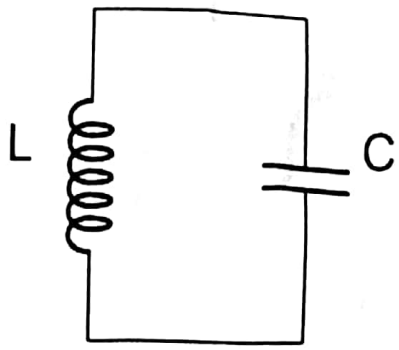
Full Marks: 30, Time: 1 Hour 45 Minutes

Any examinee found adopting unfair means will be expelled from the trimester/program 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 does the amplitude of a oscillatory body decrease in Damped Harmonic Motion (DHM)?	2	CO1
	(b) Does the total energy of an oscillatory body with SHM vary with time? Explain briefly.	2	CO1
	(c) The equation of displacement of a simple harmonic oscillator is $x = Asin\left(\omega t + \frac{\pi}{6}\right)$. Graphically represent the displacement and acceleration with respect to time.	2	CO1
2.	(a) A 5 kg block is attached to a spring and the spring constant is k = 1400 N/m. The block is held a distance of 6 cm from equilibrium and released at t = 0. (i) Find the angular frequency w, the frequency f, and the period T. (ii) Write an equation for x vs. time.	3	CO3
	(b) Suppose a spring block-system moves between top and bottom point of a tall building as a moving mass. The block has mass m = 5.7×10^3 kg and is designed to oscillate at a frequency f = 50 Hz with amplitude x_m= 15 cm. Calculate: (i) the potential energy at the equilibrium point, (ii) the block speed as it passes through the equilibrium point, (iii) the maximum acceleration of the spring block-system.		
	(c) A particle executes simple harmonic motion given by the equation $x = 3\,sin(25t - \frac{3\pi}{4})$ .Calculate the (i) displacement at t = 5 s (ii) velocity and acceleration at t = 2.5 s.	3	CO3
3.	(a) For a damped oscillator m = 580 gm, k = 240 N/m and b = 72 gm/s. The oscillator is stretched up to 8 cm from the equilibrium and released at t = 0. (i) What is the period of the motion? (ii) How long does it take for the amplitude of the damped oscillations to drop to one third of its initial value?.	3	CO3
	(b) Karim want to construct a RLC circuit that produces critical damping. He have a capacitor and inductor with value, C = 0.003 mF, L = 0.0001 H respectively. (i) What is the value of resistance he must connect to make his desired circuit? (ii) If R = 800 Ω, is the circuit oscillatory? If oscillatory, find the frequency of oscillation.	2	CO3
	(c) When a simple harmonic motion is propagated through a medium, the displacement of the particle at any instant of time is given by $y = 2sin\,(t - 0.0035x)$. Calculate the (i) wave velocity, (ii) wavelength, (iii) amplitude and (iv) frequency.	3	CO3
4.	(a) For a mass spring system oscillating in simple harmonic motion, the equation of displacement is, $x = Asin(\omega t + \phi)$. Calculate the potential and kinetic energy from the equation of displacement and graphically represent the potential and kinetic energy vs displacement.	4	CO2

(b) An inductor and a charged capacitor are connected to a circuit given below. Derive differential equation for the circuits and write down the solution of the equation. 4 CO2



5. (a) Derive the differential equation of damped harmonic motion for an RLC circuit. With proper conditions, graphically represent the types of damping that may be observed in the circuit. 4 CO2

(b) For a body oscillating in simple harmonic motion, the equation of displacement is, $y = Acos\left(\omega t + \frac{\pi}{4}\right)$. Calculate the equations of velocity and acceleration. Graphically plot velocity vs. time and acceleration vs. time graph. Determine the phase difference between velocity and acceleration. 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.