United International University

School of Science and Engineering

Mid-Term Examination; Year 2022; Trimester: Spring

Course: PHY 2105; Title: Physics

Full Marks: 30; Section: A/D/E; Time: 1 hour and 45 mins.

There are Five question. Answer to the questions 1, 2 and 3 are mandatory. Answer any one from the questions 4 and 5.

1.	a)	Give some examples of Simple Harmonic Motion.	[1]	CO1
	b)	A simple pendulum is oscillating on a horizontal plane. The maximum displacement of the bob from its equilibrium is A. At what positions the maximum velocity and acceleration occur?	[1]	CO1
	c)	What are damping factors that slow down the motion of a swing pendulum and an oscillating of a spring mass system?	[2]	CO1
	d)	Are the wave velocity and particle velocity same in a medium? If no justify your answer.	[2]	
2.	a)	A body of mass 500gm is suspended from a spring of negligible mass and it stretches the spring by 7 cm. For a displacement of 3 cm it is given a downward velocity 40 cm/s. Calculate (i) the spring constant, (ii) the angular frequency, (iii) the time period (iv) the initial potential energy, and (v) the initial kinetic energy.	[3]	CO3
	b)	An oscillator consists of a block attached to a spring (k =400 N/m). At some time t, the position (measured from the system's equilibrium location), velocity, and acceleration of the block are x =0.100 m, v=-13.6 m/s, and a=-123 m/s^2. Calculate (a) the frequency of oscillation, (b) the mass of the block, and (c) the amplitude of the motion.	[3]	CO3
	c)	A block has a kinetic energy of 3 J and potential energy of 3 J when the block is at x =+2.0 cm. (a) What is the potential energy when the block is at x = 0? What is the kinetic energy when the block is at (b) x= -2.0 cm and (c) x =A?	[3]	CO3
3.	a)	For the damped oscillator system the block has a mass of 1.50 kg and the spring constant is 8.00 N/m. The damping force is given by F'= -b(dx/dt), where b =230gm/s. The block is pulled down 12.0 cm and released. (a) Calculate the time required for the amplitude of the resulting oscillations to fall to one-third of its initial value. (b) How many oscillations are made by the block in this time?	[3]	CO3
	b)	A simple harmonic wave of amplitude 8cm travels a line of particles in the direction of positive X axis. At any instant for a particle at a distance of 10cm from the origin, the displacement is +6cm and at a distance a particle from the origin is 25cm, the displacement is +4cm. Calculate the wavelength of the wave.	[3]	CO3
	c)	In oscillatory circuit L= 40mH, C = 0.020μF. How you should set the resistance (R) for the circuit to be oscillatory? Calculate the frequency of Oscillation.	[3]	CO3
4.	a)	Derive differential equation for simple pendulum and find the expression of frequency of the pendulum. Draw necessary figure for the derivation.	[3]	CO2
	b)	Displacement of a particle with time is given by the equation $x = B\sin(\omega t + \varphi)$. Find out relation between instantenious acceleration and displacement of the particle. Show that the displacement and velocity has a phase difference of right angle between them.	[3]	CO2

5. a) Derive the differential equation for LRC circuit and explain the necessary condition for the circuit to be over damped. [3] CO2

   b) Derive the differential equation for travelling wave. [3] CO2

CO1: Definition with example and diagram of basic concepts of optics and mechanics; CO2: Apply the engineering knowledge using calculation of different mathematical or engineering/numerical problems related to physics; CO3: Derive different equations and explanation of the laws of physics with their significance.