

**School of Basic Sciences**  
**Bachelor of Science Honours in Physics**  
**Mid Term Examination - Nov 2023**

**Duration : 90 Minutes**  
**Max Marks : 50**

**Sem III - C1UD301B - Waves and Optics**

General Instructions

*Answer to the specific question asked*

*Draw neat, labelled diagrams wherever necessary*

*Approved data hand books are allowed subject to verification by the Invigilator*

- 1) A tuning fork A produces 4 beats with tuning fork B of frequency 256 Hz. When A is waxed, the beats are found to occur at shorter intervals. Explain its original frequency. K2 (2)
- 2) A mass on a string oscillates along horizontal line, taking 15 seconds to complete 8 oscillations. Obtain (i) Time period, and (ii) angular frequency of oscillations. K1 (3)
- 3) Two particles are oscillating along the same line with the same frequency and the same amplitude. They meet each other at a point midway between the mean position and the extreme position while going in opposite direction. Find out the phase difference between their motions. K2 (4)
- 4) Two simple harmonic motions are represented by the equations:  $y_1 = 10 \sin (3t + \pi/4)$ ,  $y_2 = 5(\sin 3t + \cos 3t)$ . Show that the ratio of their amplitudes  $\sqrt{2}$  K2 (6)
- 5) A particle is oscillating in simple harmonic with its displacement  $x = 10 \sin 3\pi t$  at time  $t$ . Construct its graph showing variation of position and acceleration with time for two complete periods K3 (6)
- 6) A tuning fork vibrating at 300 Hz is placed in a tank of water. Solve to (a) find the frequency and wavelength of the sound waves in the water (b) find the frequency and wavelength of the sound waves produced in the air above the tank by the vibrations of the water surface. The velocity of the sound is 4913 ft/s in water and 1125 ft/s in air. K3 (9)
- 7) A particle is subjected to two simple harmonic motions in the same direction having equal amplitudes and equal frequency. If the resultant amplitude is equal to the amplitude of the individual motions, evaluate the phase difference between the individual motions. K4 (8)
- 8) Two simple harmonics  $x(t) = a_1 \sin(\omega_0 t)$  and  $y(t) = a_2 \sin(\omega_0 t + \beta)$  are superposing to each other in mutually perpendicular direction. Analyze the path of motions of resultant for (i)  $\beta = 0$ , (ii)  $\beta = \pi/2$ , and (iii)  $\beta = \pi$ . K4 (12)

**OR**

What are beats? Analyse graphically and mathematically their production and derive expression for the frequency of beats. K4 (12)