BACHELOR OF SCIENCE (CBCS-2018 COURSE)
S. Y. B. Sc. Sem-IV :SUMMER- 2022
SUBJECT : PHYSICS : WAVES & OSCILLATIONS

Day : Friday
Date : 1/7/2022

S-18377-2022

Time : 03:00 PM-06:00 PM
Max. Marks : 60

N. B.:

1) All questions are **COMPULSORY**.
2) Figures to the **RIGHT** indicate full marks.
3) Use of scientific **CALCULATOR** is allowed.

Q.1 Attempt **ANY TWO** of the following: **[12]**

a) Drive the condition for velocity resonance and obtain amplitude of velocity at resonance.

b) In the experiment for measuring the intensity of just audible sound from the source of sound having frequency 2730Hz at the distance 820 m, the calculated intensity was 4.26×10^{-6} watt/m^2 in still air. Determine the amplitude of vibration of air particles assuming all the energy from the source is radiated as sound. (Given: density of air is 0.001293 gm/cm^3 and velocity sound is 3.44×10^4 cm/s)

c) Give the analytical composition of two S.H.M's mutually perpendicular to each other and having frequency ratio 1:1. Explain when the phase difference is $\frac{\pi}{2}$.

Q.2 Attempt **ANY TWO** of the following: **[12]**

a) Show that the rate of absorption of energy is equal to the rate of dissipation of energy in case of forced oscillator

b) Obtain an expression for energy of simple harmonic progressive wave. Hence show that energy density is directly proportional to the square of the amplitude of the wave.

c) A body oscillates with simple harmonic motion according to the equation

$$x = 5.0 \sin\left(3\pi\, t + \frac{\pi}{6}\right) \text{meters}$$

What is i) displacement ii) the velocity iii) acceleration at t = 2 sec?

Q.3 Attempt **ANY TWO** of the following: **[12]**

a) In alternating e.m.f. of peak value 200V is applied across the series combination of an inductor of inductance 20mH, a capacitor of capacitance 2 μF and resistance of 50 Ω. Determine resonant frequency, quality factor and band width.

b) Obtain expression for velocity of transverse wave over a stretched string.

c) Explain the asymmetric nature of Doppler effect in sound.

Q.4 Attempt **ANY THREE** of the following: **[12]**

a) Derive an expression for quality factor Q of damped oscillator

b) The displacement equation of an oscillator executing damped oscillatory motion is $x = ae^{-4t} \sin(6t + \theta)$

where a and θ are constants. If the initial displacement and velocities are 5 cm and -50 cm/ sec respectively, determine the values of constants.

c) Electrons in an oscilloscope are deflected by two mutually perpendicular fields in such a manner that the displacement at any instant is given by $x = 4\sin(wt + 30^\circ)$ and $y = 4\sin \omega t$. Find the nature and equation of the path.

d) State the factors on which loudness depends.

P.T.O.

Q.5 Attempt **ANY FOUR** of the following: **[12]**

a) State and explain any three applications of Doppler effect.

b) Explain the equation of forced oscillations of an oscillator is given as

$$4\left(\frac{d^2x}{dt^2}\right)+3\left(\frac{dx}{dt}\right)+36x=2.7\sin 3t$$

Determine the average power absorbed by the oscillator.

c) A spectral line of wavelength 6564 Å in the spectrum of a star is observed to be shifted from its normal position towards the red end by 0.2188 Å. Determine the velocity of star. ($c = 3x10^8$ m/s)

d) Define intensity of wave and show that intensity of wave is proportional to square of the amplitude.

e) What is Lissajous figures? State any one method by which it can be obtained.

f) The amplitude of an oscillating system reduces from 3.981 cm to 1 cm. If the logarithmic decrement is 0.02303. Find the number of oscillations during that time interval.

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