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

Day : Tuesday

Date : 6/12/2022

W-18377-2022

Time : 02:00 PM-05:00 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) The phase difference between two S.H.M's perpendicular to each other and having in the ratio 1:2 is $\dfrac{\pi}{2}$. Explain the nature of the resultant motion.

b) Obtain the expression for the velocity of longitudinal waves propagating through a fluid of density ρ and bulk modulus of elasticity K.

c) Show that average energy of damped harmonic oscillator is $\overline{E} = \dfrac{1}{2} m a^2 \omega^2 e^{-\frac{Rt}{m}}$

Where symbols have their usual meanings.

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

a) Explain Doppler effect in sound is asymmetric while in light it is symmetric in nature.

b) A body of mass 2 kg executes damped S.H.M. under a restoring force 10 N/m and a damping force 4 N/msec^{-1}. Find the displacement time equation if the initial displacement is 4m and initial velocity is -4 m/sec.

c) What are the Lissajous figures? Explain any one method for obtaining Lissajous figures.

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

a) The amplitude of a pendulum of period 0.5 sec falls to half of its initial value in 230.3 sec. Determine the quality factor.

b) Derive the condition for velocity resonance and obtain amplitude of velocity at resonance.

c) Plane harmonic waves of frequency 500Hz are produced in air with displacement amplitude of 2×10^{-3} cm. Find
   i) Pressure amplitude
   ii) Energy density
   iii) Energy flux in the wave
   (Given: Density of air 1.29×10^{-3} gm/cm^3, velocity of sound in air = 340 m/s)

P.T.O.

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

a) Show that total energy of undamped simple harmonic oscillator is constant and proportional to the square of amplitude.

b) Determine the reverberation time of a hall having volume 25,000 cubic feet, if it contains sound absorbing material of area 15000 square feet having absorption coefficient 0.25.

c) A car travelling with a speed of 30 m/s on the highway, sound its horn for overtaking another car travelling with speed 20 m/s in the same direction. If the frequency of horn sound is 550 Hz, determine the frequency heard by the driver in the slower car (a) before passing and (b) after passing. (Assume the speed of sound to be 340 m/s).

d) The equations of forced oscillations is given by

$$2\left(\frac{d^2x}{dt^2}\right)+3\left(\frac{dx}{dt}\right)+16x=30\sin 2t$$

where all the quantities are expressed in CGS units. Find velocity amplitude and maximum kinetic energy.

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

a) Explain the quality factor of an oscillating system.

b) What is red shift? Explain how it supports the theory of the expanding universe?

c) A longitudinal disturbance generated by an earthquake travels 1000 km in 2 minutes. If the average density of rock is assumed to be 2500 kg/m^3, calculate the bulk modulus for the rock.

d) The equation of damped motion is given as $2\left(\frac{d^2x}{dt^2}\right)+10\left(\frac{dx}{dt}\right)+50x=0$

Find the frequency of damped oscillations.

e) State any three applications of resonance.

f) State and explain the factors on which loudness depends.

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