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[BCT A7 019]

First unit test

Q.2)

=> soln.

given,

$M = 3\ kg$

$R = 70\ cm = 0.7 m$

$T = 0.6\ N.m$

(i) The rotational inertia of a disc about the wire,

$$I = \frac{1}{2} MR^2$$

$$= \frac{1}{2} \times 3 \times (0.7)^2$$

$$\boxed{I = 0.735\ kg \cdot m^2}$$

(ii) The torsional constant

$T = k\theta$

where k is torsion constant.

$$k = \frac{T}{\theta} = \frac{0.6\ Nm}{2.5}$$

$$= 0.24\ Nm/rad.$$

Date
Page

(iii) The angular frequency of the torsion pendulum where it is oscillating is,

$$T = 2\pi\sqrt{\frac{I}{K}}$$

angular frequency is,

$$\omega = \frac{2\pi}{T} = \sqrt{\frac{K}{I}} = \sqrt{\frac{0.24}{0.735}}$$

$$= 0.571 \text{ rad/s.}$$

Q 6

⇒ Sol^n

we have total absorption in hall based on the given date

The absorption by plastered wall $= 98 \cdot 0.03 = 2.94 \ m^2$

Plastered ceiling $= 144 \times 0.04 = 5.76 \ m^2$

Wooden floor $= 15 \times 0.06 = 0.90 \ m^2$

Cushioned Chairs $= 80 \times 1.0 = 88.0 \ m^2$

Total Audience $= 97.6 \ m^2$

∴ The total absorption in a hall when hall is empty is $97.6 \ m^2$

When the hall is full capacity 110 persons, then absorpption due to them,

$= 110 \times 4.7 = 517 \ m^2$

Now total absorption

$= (97.6 + 517) \ m^2$

$= 614.6 \ m^2$ #

$$t = \frac{0.158}{(\alpha s)^2}$$

$$= \frac{0.158 \times 1400}{614.6}$$

$$= \frac{221.2}{614.6}$$

$= 0.35$ sec #

Q (4) Sol^n,

linear mass density (μ) $= 0.5$ kg/m

$T = 10N$

$A = 0.12$ mm $= 0.00012$ m

$f = 100$ Hz

let the eq^n be

$y = A\sin(\omega t + kx)$ { since it is in -ve x dir^n

$\left[k = \frac{2\pi}{\lambda}\right]$

now,

$v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{10}{0.5}}$

$= 4.47$ m/s

now

$v = f \times \lambda$

$\lambda = \frac{4.47}{100}$

$= 0.0447$ m

now

$k = \frac{2\pi}{\lambda}$

$= 140.563$

$\omega = 2\pi f$

$= 628.31$

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Q3) Progressive wave — Stationary wave

Progressive wave	Stationary wave
1) It is travelling wave	1) It is standing wave
2) The transfer of energy take place from one location to another within a medium	2) Energy is confined with a medium.
3) All the particles have similar maximum velocity	3) All the particle have their own maximum velocity.
4) Amplitude is same	4) Amplitude is different.
5) Crests & trough of wave from move in the forward direction	5) Crests & trough of the wavefrom apper & disapper at inital position.

⇒ Total energy is the sum of kinetic & potential energy.

There fore, potential energy in the progressive wave is.

$$U = \frac{1}{2} k y^2 \quad ; \quad y = \text{diplacement of particle}$$

if $y = a \sin \frac{2\pi}{\lambda}(vt - x)$

$$U = \frac{1}{2} k\, a^2 \sin^2 \frac{2\pi}{\lambda}(vt - x)$$

$$= \frac{1}{2} m a \omega^2 a^2 \sin^2 \frac{2\pi}{\lambda}(vt - x)$$

Now,

potential energy per unit volume is

$$U = \frac{1}{2}\rho\omega^2 a^2 \cdot \sin^2\frac{2\pi}{\lambda}(vt - x).$$

& K.E per unit volume is

$$KE = \frac{1}{2}\rho v^2$$

$$= \frac{1}{2}\rho\left(\frac{dy}{dt}\right)^2$$

$$= \frac{1}{2}\rho\left(\frac{2\pi}{\lambda}va\cos\frac{2\pi}{\lambda}(vt - x)\right)^2$$

$$= \frac{1}{2}\rho\frac{4\pi^2v^2a^2}{\lambda^2}\cos^2\frac{2\pi}{\lambda}(vt - x)$$

$$= \frac{1}{2}\rho\omega^2a^2\cos^2\frac{2\pi}{\lambda}(vt - x)$$

So,

$$E = KE + U$$

$$E = \frac{1}{2}\rho\omega^2a^2 \Rightarrow E = \frac{2\pi^2\rho v^2 a^2}{\lambda^2}$$

since $v = f\lambda$

$$E = \frac{2\pi^2\rho f^2 \cancel{\lambda^2} a^2}{\cancel{\lambda^2}}$$

$$E = 2\pi^2\rho f^2 a^2$$

Total energy for volume is

$$E = 2\pi^2\rho f^2 a^2 v$$

since

$$v = A \times l, \quad \text{But } l = vt$$

$$\therefore V = Avt$$

$$E = 2\pi^2\rho f^2 a^2 Avt.$$

Now, power $(P) = \frac{E}{t}$

$$P = 2\pi^2 \rho f^2 a^2 A v$$

Q(5)

=> Reverberation time is the time for which sound is heard even when the source has stopped to produce it. In cinema hall there is much crowd & there are large speaker used so if reverberation time is not studied before making it then there occurs the reverberation & people are not able to heard the sound of the movie due to the intermixing of sound. So the wall of cinema hall are made of good sound absorbing matrial.

Sabine Relation

Change in intensity (ΔI) is directly propⁿ to the small time (Δt). no. of reflection per second of sound (n) average intensity (I) & absorption coeff (α)

ie $\Delta I = -n \alpha I \Delta t$ —— (i) here

$$n = \frac{SV}{4V} \quad \text{--(ii)}$$

where v is velocity of sound & V is volume of hall & S is total surface area

from (i) & (ii)

$$\Delta I = \frac{-Sv \alpha I \Delta t}{4V}$$

$$\frac{\Delta I}{I} = -\frac{Sv\alpha}{4V} \Delta t$$

$$\frac{dI}{I} = -\frac{Sv\alpha}{4V} dt$$

Integrating both side

$$\int_{I_0}^{I_t} \frac{dI}{I} = \int_0^t -\frac{Sv}{4V} \alpha \, dt$$

$$\log(I_t/I_0) = -\alpha \frac{Sv}{4V} t$$

we have $I_t = \frac{I_0}{10^6}$.

$$\log\left(\frac{I_0}{10^6 \times I_0}\right) = -\alpha \frac{Sv}{4V} t$$

$$\log(10^{-6}) = -\alpha \frac{Sv}{4V} t$$

$$+13.815 = +\alpha \frac{Sv}{4V} t$$

put value of $(v) = 350$ m/sec

$$13.815 = \frac{\alpha S \times 350 t}{4V}$$

$$t = \frac{0.158V}{\alpha S}$$

where 't' is time

α is absorption coeff.

V is volume.

S is total surface area