CT-03

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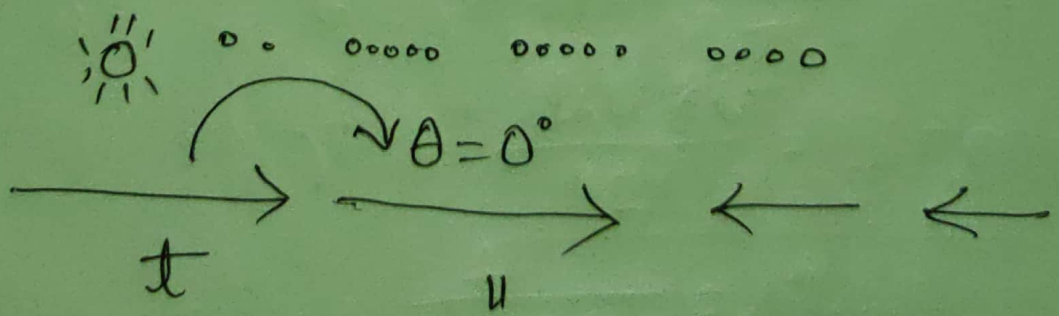
Section: A

01

longitudinal waves are waves in which the displacement of the medium is in the same direction. The disturbance occurs parallel to the line of travel of the wave is called longitudinal wave.

example
1. electric wave
2. magnatic wave
3. sound wave.



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03

$y = 10\sin(10t - \frac{\pi}{6}x)$

considering,

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

~~$\therefore y = 10\sin\frac{6}{\pi}(10t \times \frac{\pi}{6} - x)$~~

$\therefore y = 10\sin\frac{\pi}{6}(\frac{60}{\pi}t + x)$ - - (ii)

From (ii) and (iii)

(I) Amplitude $A = 10m$.

(II) $v = \frac{60}{\pi} = 19.0986\ ms^{-1}$.

(III) $\frac{2\pi}{\lambda} = \frac{\pi}{6} \Rightarrow \lambda = \frac{2\pi \times 6}{\pi} = 12m$.

(IV) $f = \frac{v}{\lambda} = \frac{19.0986}{12} = 1.59155\ Hz$.

(V) $T = \frac{1}{f} = \frac{1}{1.59155} = 0.63$ sec.

(Result)

02

Differential equation of DHM:-

$$\frac{d^2x}{dt^2} + \alpha\frac{dx}{dt} + \omega^2 x = 0$$

There are 3 types of damped harmonic motion.

① oscillatory behaviour.

② critically behaviour.

③ over damping.

for SHM, $\frac{d^2x}{dt^2} + \omega^2 x = 0 \;\cdots$ (i)

for DHM, $\frac{d^2x}{dt^2} + \alpha\frac{dx}{dt} + \omega^2 x = 0 \cdots$ (ii)

if $\alpha = 0$.

then (ii) $\frac{d^2x}{dt^2} + \omega^2 x = 0 \rightarrow$ SHM.

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$\therefore$ if $\alpha = 0$ Damping force is absent.

$$\omega' = \sqrt{\omega^2 - \alpha^2}$$

$$\Rightarrow \omega' = \sqrt{\omega^2}$$

$$\Rightarrow \omega' = \omega \text{ for SHM.}$$

For mechanical system, $\alpha = \frac{b}{2m}$.

For electrical system, $\alpha = \frac{R}{2L}$.

05

Here,

$C = 1\,\mu F = 10^{-6} F$

$L = 0.2\,H$

$R = 700\,\Omega$

$\therefore \omega^2 = \frac{1}{LC} = \frac{1}{0.2 \times 10^{-6}} = 50,00000$

$\therefore \left(\frac{r}{2}\right)^2 = \frac{R^2}{4L^2} = \frac{(700)^2}{4 \times (0.2)^2}$

$= 30,62500$

$\therefore \omega^2 > \left(\frac{r}{2}\right)^2$

$\therefore$ oscillatory.

$\therefore f_0 = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \left(\frac{R}{2L}\right)^2}$

$= \frac{1}{2\pi}\sqrt{5000000 - 3062500}$

$= 221.53\,Hz.$

$\therefore$ resonant frequency is $221.53\,Hz$.

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04

$$x = 10\cos\left(3\pi t + \frac{\pi}{3}\right)$$

Considering,

$$x = 10\cos(\omega t + \phi)$$

$\therefore \omega = 3\pi$ | $\omega = 3\pi$

$\Rightarrow 2\pi f = 3\pi$

$$\Rightarrow f = \frac{3\pi}{2\pi} = 1.5\ Hz.$$

$$\therefore T = \frac{1}{f} = \frac{1}{1.5} \cancel{= 0.67\ sec.}$$

$\cancel{\therefore \lambda = \frac{v}{f}}$

$\cancel{\Rightarrow \lambda = \frac{v}{f} = \frac{}{1.5}}$

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$\therefore V = -A\omega \sin(\omega t + \phi)$

$= -10 \times 3\pi \sin(3\pi \times 3 + \frac{\pi}{3})$

$= -81.62 \ ms^{-1}$

$\therefore$ velocity $81.62 \ ms^{-1}$

$\therefore$ wavelength $\lambda = \frac{f}{V}$

$= \frac{1.5}{81.62}$

$= 0.01225 \ m.$