DI Physics Hons.

Paper-I

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the Lecture Contents

Torsional Pendulum:

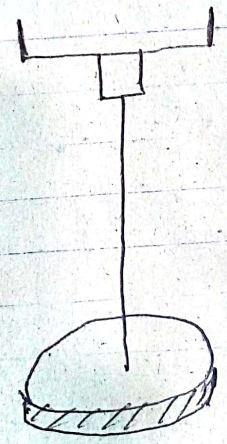

Fig. (1)

If one end of a fairly thin and long wire is clamped to a rigid support and the other end is attached to the centre of a heavy body (e.g., disc or sphere), then this arrangement is called the torsional pendulum.

If the disc or sphere be turned in the horizontal plane to twist the wire and then released, it executes torsional vibrations of a definite period about the wire as axis. Let θ be the angle at any instant, through which the body is twisted. Then the restoring couple set up in the wire, is given by

$$\frac{n\pi r^4}{2l} \cdot \theta = C\theta,$$

where $C \left(= \frac{n\pi r^4}{2l}\right)$ is the couple per unit twist of the wire.

This couple produced an angular acceleration $d^2\theta/dt^2$ in the disc or sphere. If I be the moment of inertia of the disc or sphere about the wire as axis, the equation of motion is

$$I\frac{d^2\theta}{dt^2} + C\theta = 0 \quad \text{or,} \quad \frac{d^2\theta}{dt^2} + \frac{C}{I}\theta = 0$$

or, $\frac{d^2\theta}{dt^2} + \omega^2\theta = 0$; where $\omega^2 = \frac{C}{I}$.

This equation represents a simple harmonic motion of period

$$T = \frac{2\pi}{\omega} \quad \text{or,} \quad T = 2\pi\sqrt{\frac{I}{C}}.$$

This is the expression for the time period of a torsional pendulum.

$\sqrt{\quad}$ of modulus of