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MSC - Physics
Unit 1, Paper - 02
Sem II

Differential equation of S.H.M

Differential equation of Simple Harmonic motion—
→ Consider a particle of mass m executing Simple harmonic motion. If y be the displacement of the particle from equilibrium position at any instant t, the restoring force F acting on the particle is given by

$$F \propto y \quad \text{or,} \quad F = -Sy$$

Where S is the force constant of proportionality or, stiffness or, spring constant. The negative sign is used to indicate that the direction of the forced is opposite to the direction of increasing displacement.

Force constant s is defined as the restoring force per unit displacement or.

$$S = \frac{F}{y}$$ its unit is Newton permeter.

If $\frac{d^2y}{dt^2}$ is the acceleration of the particle at time t, then.

$$m\frac{d^2y}{dt^2} = -Sy \quad \text{or,} \quad \frac{d^2y}{dt^2} + \frac{S}{m}y = 0$$

Substituting $\frac{S}{m} = \omega^2$, we get $\boxed{\frac{d^2y}{dt^2} + \omega^2 y = 0}$ This is the general differential equation of a, Simple harmonic motion of a harmonic oscillator..