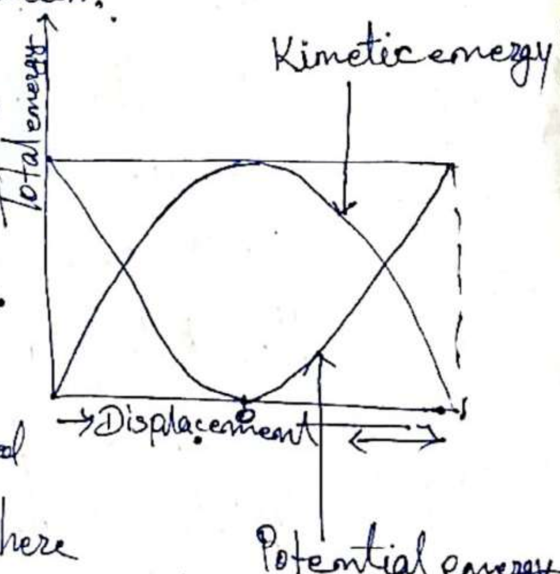
Date 7/02/2026
MSc-Physics, Sem II
Unit-1 | Paper 2

Energy of a simple harmonic motion

→ Energy in simple harmonic motion is a fundamental aspect of accillatory systems in physics. S.H.M discribe the periodic back-and-fourth motion of a particle, where energy continuously shifts between kinetic and potential forms. while the total mechanical energy remains constant throughout the motion.

- Kinetic energy in S.H.M:- →Due to the velocity of a particle as it moves through its path. The velocity at any displacement x is discrived by $v = \omega\sqrt{A^2 - x^2}$, where a is the amplitude. The kinetic energy is then given by $K = \frac{1}{2} m v^2 = \frac{1}{2} m\omega^2 (A^2 - x^2)$



at the mean position ($x=0$), the kinetic energy reaches its maximum value $K_{max} = \frac{1}{2} m\omega^2 A^2$. At the extreame position ($x = \pm A$), the kinetic energy becomes zero as the particle momentarily comes to rest.

Scanned with OKEN Scanner

Palential energy in S.H.M. $\rightarrow$ In SHM. palential energy arises due to the displacement of the particle from its equilibrium position. The restoring force can be represented as $F = -kx$, where k is the force constant and x is the displacement. The potential energy at displacement x is given by $U = \frac{1}{2}kx^2$

Science the relation $k = m\omega^2$ holds for SHM, the palential energy Can also be written as $U = \frac{1}{2}m\omega^2 x^2$, where m is the mass and ω is the angular frequency. The patential energy is maximum at the entreme position of the Oscillation, where displacement is equal to the amplitude. A. At $x = A$, $U_{max} = \frac{1}{2}m\omega^2 A^2$

Total mechanical energy in simple harmonic motion $\longrightarrow$: The total mechenical energy E of a particle in SHM. is the sum of its kinetic and patential energies at any instant.

$$E = K + U =$$
$$= \frac{1}{2}m\omega^2(A^2 - x^2) + \frac{1}{2}m\omega^2 x^2$$

Scanned with OKEN Scanner

$$\boxed{E = \frac{1}{2} m\omega^2 A^2}$$

The total energy in S.H.M. is independent of displacement x, and remains constant throughout the motion, provided no dissipative force are present.

In term of frequency (F), $\omega = 2\pi F$

$$\boxed{E = 2\pi^2 m F^2 A^2}$$

It is the mathematical formulation of oscillatio