SEM - VI

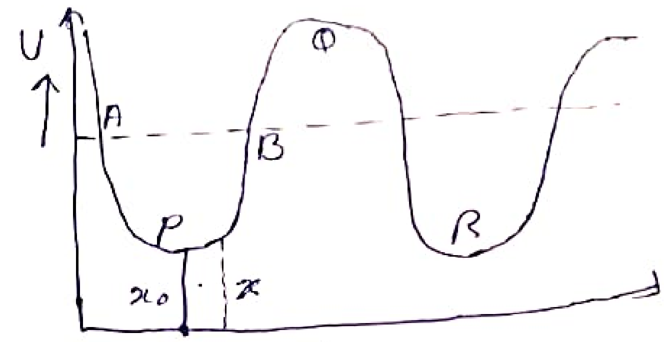
POTENTIAL WELL → A particle or system is move back and forth to mean or equilibrium position that region is called potential well. Potential energy is continuous function i.e $U = U(x, y, z)$

Relation in force & potential energy is

$$\vec{F} = -\nabla U = -\left(\hat{i}\frac{\partial U}{\partial x} + \hat{j}\frac{\partial U}{\partial y} + \hat{k}\frac{\partial U}{\partial z}\right)$$

If particle move only in x-direction

$$F_x = -\frac{\partial U}{\partial x}$$



Stable equilibrium → A point where P.E of particle is minimum that called S.E.

Tayler series expansion of $U(x)$

$$U(x) = U(x_0) + \left(\frac{\partial U}{\partial x}\right)_{x_0}(x - x_0) + \left(\frac{\partial^2 U}{\partial x^2}\right)_{x_0}(x - x_0)^2 + \left(\frac{\partial^3 U}{\partial x^3}\right)_{x_0}(x - x_0)^3$$

$U(x_0)$ = minimum, $\left(\frac{\partial U}{\partial x}\right)_{x_0} = 0$

$$\frac{\partial^2 U}{\partial x^2} = +ve = K, \quad \frac{\partial^3 U}{\partial x^3} = K_1$$

$$U(x) = U(x_0) + \frac{K}{2}(x - x_0)^2 + \frac{K_1}{6}(x - x_0)^3 + \cdots$$

x_0 = origion $\quad U(x_0) = 0$

$$U(x) = \frac{K}{2}x^2 + \frac{K_1}{6}x^3 + \cdots$$

$$F(x) = -\frac{\partial U}{\partial x} = -Kx - \frac{K_1}{2}x^2 + \cdots$$

x point take very small value so that higher terms are zero (neglected)

$$\boxed{F = -Kx}$$

$$\boxed{U = \frac{K}{2}x^2}$$

That motion of Partical is called S.H.M.

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