EASTERN UNIVERSITY, SRI LANKA

SECOND EXAMINATION IN SCIENCES - 2003/2004

SECOND SEMESTER

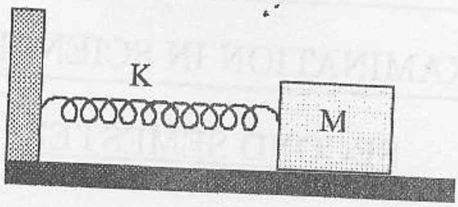
(JUNE/JULY 2005)

PH 206 WAVES AND VIBRATIONS

Time: 01 hour.

Answer ALL Questions

1. Consider a horizontal coiled spring carring a mass M in one end and the other end to a wall as shown in the figure. Assume that the system is placed in a frictionless and the spring is stretched at a distance x from its equilibrium position. Deri equation of motion for the system and show that it is a simple harmonic motion.



A horizontal coiled spring is found to be stretched 0.10 m from its equlibrium po when a force of 4 N acts on it. Then a body of mass 1.6 Kg is attached to one end o spring and is pulled 0.12 m along a horizontal frictionless table from the equlib position. The body is then released and executes S.H.M. Find

(i) the force constant of the spring
(ii) the force exerted by the spring on 1.6 Kg body just before it is released
(iii) period of oscillation after release
(iv) amplitude of motion
(v) the velocity, acceleration, kinetic energy and potential energy of the b when it is moved half-way from its initial position towards the cent the motion.
(vi) the total energy of the oscillating system
(vii) the equation of motion of the body.

2. The equation of motion of a driven harmonic oscillator is

$$m\ddot{x} + b\dot{x} + kx = F_0 \, Cos\, \omega t$$

where b is the resistance factor and k is the spring factor.

(a). Show that it possesses a steady state solution of the form

$$x = A\,Cos(\omega t - \delta),$$

where
$$A = \frac{\frac{F_0}{m}}{\sqrt{(\omega_0^2 - \omega^2)^2 + \left(\frac{\omega}{\tau}\right)^2}}$$

and
$$\delta = \tan^{-1}\left(\frac{\frac{\omega}{\tau}}{(\omega_0^2 - \omega^2)}\right)$$

Here $\frac{b}{m} = \frac{1}{\tau}$ and $\frac{b}{m} = \omega_0^{\ 2}$.

Hence deduce an expression for the velocity amplitude x_0.

(b). Show that for a particular frequency and for given driving force the velocity amplitude depends on mass, resistance factor and spring factor for the cases $\omega >> \omega_0$, $\omega = \omega_0$ and $\omega << \omega_0$ respectively.