EASTERN UNIVERSITY, SRI LANKA

SECOND EXAMINATION IN SCIENCE - 2005/2006

SECOND SEMESTER

(MARCH/APRIL 2008)

PH 206 WAVES AND VIBRATIONS

Time: 01 hour.

Answer ALL Questions

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1. A damped oscillating system has an effective mass m, a natural un-damped frequency ω_0 and has a damping co-efficient proportional to the velocity of magnitude $\frac{m\omega_0}{\sqrt{2}}$. If there exists a driving force $F\cos\left(\frac{\omega_o t}{\sqrt{2}}\right)$ Show that:

   i. The displacement of the system is

   $$\frac{F}{m\omega_0^2}Cos\left(\omega_0 t-\frac{\pi}{2\sqrt{2}}\right).$$

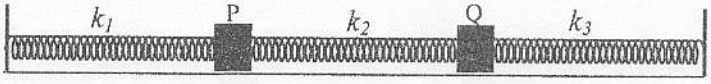
   ii. The velocity of the system is

   $$\frac{F}{m\omega_0}Sin\left(\omega_0 t-\frac{\pi}{2\sqrt{2}}\right).$$

   iii. The work done in the first quarter is

   $$\frac{F^2}{m\omega_0^2}\left(\frac{\pi}{4}-\frac{1}{2}\right).$$

2. Two objects P and Q each of mass m are connected by three springs of spring constants k_1, k_2 and k_3 as shown in the figure.



If the objects undergoes longitudinal vibration with x_1 and x_2 as the horizontal displacement,

   i. Show that the equation of motion of P and Q are given by

   $$m\ddot{x}_1+(k_1+k_2)x_1-k_2x_2=0$$

   $$m\ddot{x}_2+(k_2+k_3)x_2-k_2x_1=0$$

   ii. Show that, if $k_1 = k_3$ the angular frequencies ω_1 and ω_2 of the normal modes are given by

   $$\omega_1=\sqrt{\frac{k_1}{m}} \quad \text{and} \quad \omega_2=\sqrt{\frac{k_1+2k_2}{m}}.$$

   iii. When normal mode frequencies are equal to ω_1 and ω_2 discuss the vibrations of the system.