Benha University
Shoubra Faculty of Engineering
Applied Mechanical Vibration

4th year Mechanical Power
Mid-Term Exam 1st semester 2016/ 2017
Time Allowed 1.0 Hr.

Name: model answer Sec.

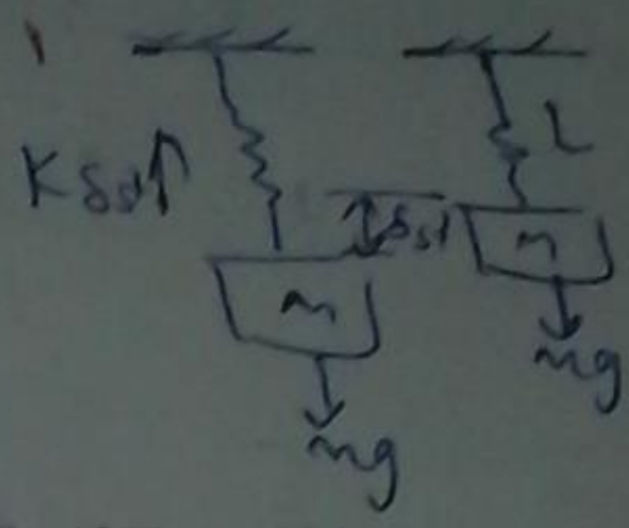
Answer the following Questions :

1] a) How can you find the natural frequency of a system by measuring its static deflection? [3 Marks]

Solution

δst = stat. deflection $\delta st \Rightarrow K\delta st = mg$ 1

$\frac{K}{m} = \frac{g}{\delta st} = \omega n^2 \Rightarrow \omega n = \sqrt{\frac{g}{\delta st}}$ 1



b) For a vibrating single degree of freedom system m=10kg, K=250N/m, and C= 45 N.s/m. If the initial displacement and velocity of the mass are 15 mm and 5 mm/s, Find the solution representing the motion of the mass. (7 marks)

Solution

$m\ddot{x} + c\dot{x} + kx = 0$

$\omega n = \sqrt{\frac{K}{m}} = \sqrt{\frac{250}{10}} = 5$ rad/sec

$\zeta = \frac{c}{c_c} = \frac{45}{2 \times 10 \times 25} = 0.45 < 1 \Rightarrow$ underdamped

$\omega d = \sqrt{1-\zeta^2}\,\omega n = \sqrt{1-(0.45)^2} \times 5 = 4.47$ rad/sec

$x(t) = e^{-\zeta \omega n t}\left[x_0 \cos \omega d t + \frac{\dot{x_0} + \zeta \omega n x_0}{\omega d} \sin \omega d t\right]$

$x(t) = e^{-2.25t}\left[0.015 \cos 4.47t + 0.009 \sin 4.47t\right]$