Registration No: | | | | | | | | | | |

Total Number of Pages: 2

M.TECH
CEPC102

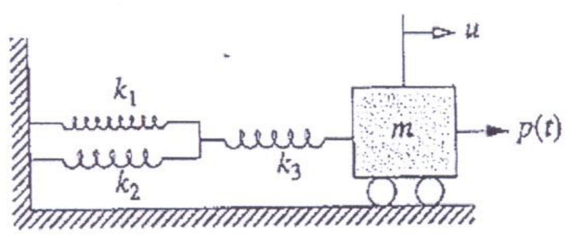
1st Semester Regular/Back Examination – 2014
STRUCTURAL DYNAMICS
BRANCH(S): STRUCTURAL ENGINEERING,STRUCTURAL & FOUNDATION ENGINEERING
Time: 3 Hours
Max Marks: 70

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

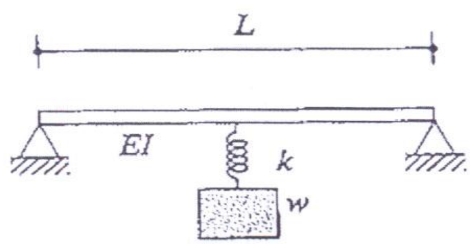
Q1 Answer the following questions: (2x10)

a) Define 'Loss coefficient'.
b) What does the 'transient response' of a system mean?
c) What is 'resonant frequency'?
d) What difference one can mark between the equations of motion of single and multi-degree of freedom damped systems?
e) State the physical meaning of Eigen solution of a vibration problem.
f) Define 'logarithmic decrement'.
g) Explain, with a neat sketch, the relation between external force and mass, stiffness, damping of a linearly elastic system.
h) Can the "Degree of freedom" of a structure be infinite? Briefly explain.
i) Define "Damping". Show the relation between circular and cyclic frequencies.
j) How do we determine the natural frequency of an undamped system?

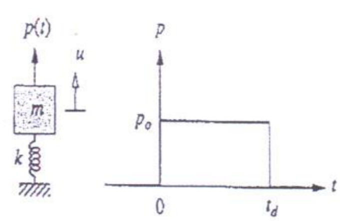
Q2 a) Determine the effective stiffness of the combined spring and write the equation of motion for the spring-mass system shown in figure below. (5)



b) Determine the natural frequency of a weight 'w' suspended from a spring at the mid point of a simply supported beam shown in figure below. Assume the beam to be massless. (5)

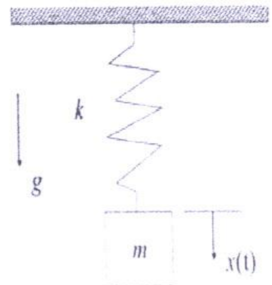


Q3 Determine the time response of the undamped spring mass system to the rectangular pulse force. (10)



(a) (b)

Q4 a) Find the equation of motion for the hanging spring mass system and compute the natural frequency using static equilibrium along with Newton's law. (5)

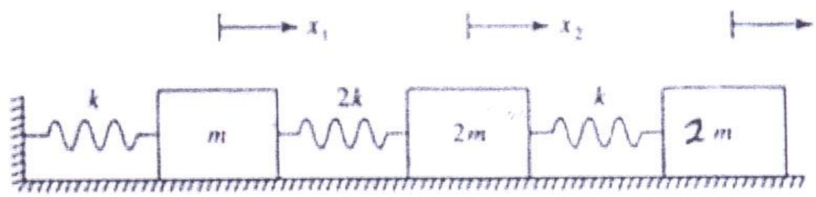


b) An undamped system vibrates with a frequency of 10 Hz and amplitude 1mm. Calculate the maximum amplitude of system's velocity and acceleration. (5)

Q5 a) For a damped system, m, c and k are known to be m = 1 kg, c = 2 kg/s and k = 10 N/m. Calculate the value of damping ratio and natural frequency. Is the system underdamped, overdamped or criticallydamped? (5)

b) The natural frequency of a 65 kg person illustrated in figure is measured along vertical or longitudinal direction to be 4.5 Hz. What is the effective stiffness of the person in the longitudinal direction? If the person, 1.8m in length and $0.58m^2$ in cross sectional area, is modeled as thin bar, what is the modulus of elasticity of the system? (5)

Q6 a) Use the stiffness influence coefficients to determine the stiffness matrix for the system shown in figure. (5)



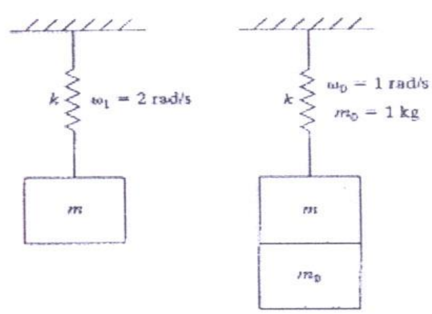
b) The differential equations governing the motion of a two degree of freedom system are (5)

$$\begin{bmatrix} m & 0 \\ 0 & m \end{bmatrix} \begin{Bmatrix} \ddot{x}_1 \\ \ddot{x}_2 \end{Bmatrix} + \begin{bmatrix} 2k & -k \\ -k & 3k \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \end{Bmatrix} = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$$

. Determine the system's natural frequencies.

Q7 a) Derive the equation for longitudinal vibration of bars. (5)

b) Frequency of the system in fig (a) is measured to be 2 rad/sec. and the frequency of fig (b) with an added mass of 1 kg is known to be 1 rad/sec. Calculate 'm' and 'k'. (5)



(a) (b)

Q8 Write Short Notes (Any Two) (5x2)

a) Modal matrix
b) Dynamic response factor
c) Duhamel's integral with its limitations
d) Response spectrum