Name: **Enrolment No:**	

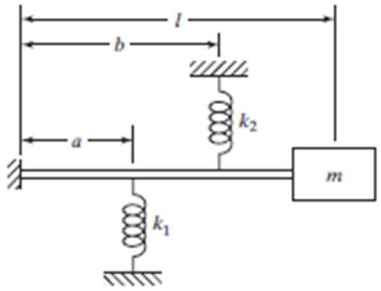
UPES

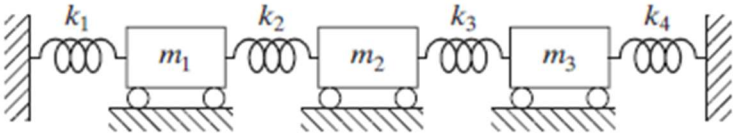
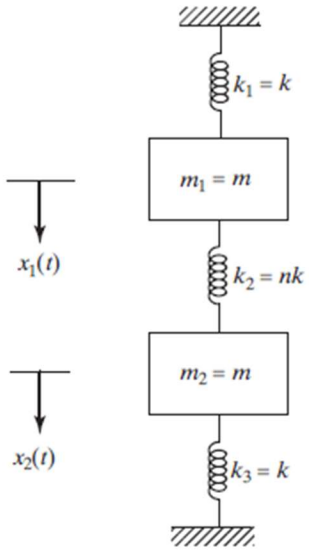
End Semester Examination, May 2024

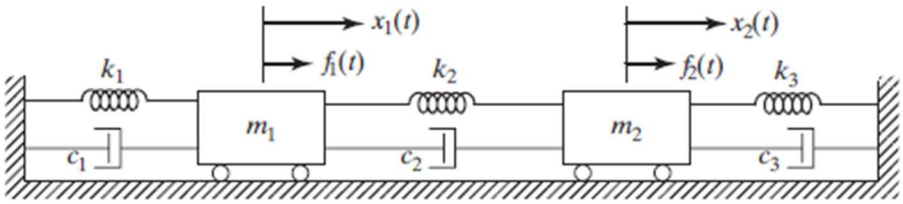
Course: Structure Dynamics **Semester: VI**
Program: B. Tech. AM&NT **Time : 03 hrs.**
Course Code: MECH 3053 **Max. Marks: 100**

Instructions: Assume suitable right-handed coordinate system if it is not mentioned in problem.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Define the term *magnification factor*. How is the magnification factor related to the frequency ratio?	**4**	**CO1**
Q 2	What is a normal mode shape? How is it computed?	**4**	**CO1**
Q 3	What is the difference between the peak amplitude and the resonant amplitude?	**4**	**CO1**
Q 4	Will the force transmitted to the base of a spring-mounted machine decrease with the addition of damping? Explain it.	**4**	**CO1**
Q 5	Define the flexibility and stiffness influence coefficients. What is the relation between them?	**4**	**CO1**
	SECTION B **(4Qx10M= 40 Marks)**		
Q 6	A spring-mass-damper system is subjected to a harmonic force. The amplitude is found to be 20 mm at resonance and 10 mm at a frequency 0.75 times the resonant frequency. Determine the damping ratio of the system.	**10**	**CO2**
Q 7	Drive the equation of motion of the system as shown in figure. Also, determine the natural frequency of the system. 	**10**	**CO2**
Q 8	A vibrating system consists of mass of 50 kg, a spring with a stiffness of 30 kN/m and a damper. The damping factor is 0.2 i.e. damping provided 20% of the critical damping. Derermine, the a) critical damping	**10**	**CO2**

	coefficient b) lograthim decrement c) natural frequency of damped vibration d) ratio of two consecutive amplitudes.		
Q 9	Determine the eigenvalues and eigenvectors of a vibrating system for which, $[m] = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ and $[k] = \begin{bmatrix} 1 & -2 & 1 \\ -2 & 4 & -2 \\ 1 & -2 & 1 \end{bmatrix}$ **Or** Determine the natural frequencies of the system shown below where $k_1 = k_2 = k_3 = k_3 = k$, $m_1 = 2m$, $m_2 = 3m$, and $m_3 = 2m$. 	**10**	**CO4**
	SECTION-C **(2Qx20M=40 Marks)**		
Q 10	Determine the natural frequencies and mode shapes of a spring-mass system, as shown in figure, which is constrained to move in the vertical direction only. Take n=1. Also determine the initial conditions that need to be applied to the system shown as to make it vibrate in (a) the first mode, and (b) the second mode. 	**20**	**CO3**
Q 11	Determine the free-vibration response of the system shown in figure below with $k_1 = 30$, $k_2 = 5$, $k_3 = 0$, and $c_1 = c_2 = c_3 = 0$ for the initial conditions $x_1(0) = 1, x_2(0) = \dot{x}_1(0) = \dot{x}_2(0) = 0$	**20**	**CO4**



Or,

Determine the pitch (angular motion) and bounce (up-and-down linear motion) frequencies and the ratio of amplitudes (bounce/pitch ratio) of an automobile with the following data.

Mass (m) = 1000 kg

Radius of gyration (r) = 0.9 m

Distance between front axle and C.G. (l_1) = 1.0 m

Distance between rear axle and C.G. (l_2) = 1.5 m

Front spring stiffness (k_f) = 18 kN/m

Rear spring stiffness (k_r) = 22 kN/m