CBCS SCHEME

USN

15CV744

Seventh Semester B.E. Degree Examination, July/August 2021
Structural Dynamics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions.

1 a. Define logarithmic decrement and derive the expression for the same. **(07 Marks)**

b. Differentiate
   i) Forced vibration and Free vibration
   ii) Oscillation and vibration
   iii) Random excitation and harmonic excitation. **(09 Marks)**

2 a. Define resonance and explain the factors affecting resonance condition. **(06 Marks)**

b. The vibration of an electric system consisting of a weight W = 200N and a spring with viscous damping, so that the ratio of two successive amplitudes is 1 to 0.75. Determine:
   i) Natural frequency
   ii) Damping ratio and damping coefficient
   iii) Amplitude of the 10^{th} oscillation if the amplitude of first oscillation is 5mm **(10 Marks)**

3 a. Derive an expression for Duhamel Integral as an expression for response due to general dynamic loading. **(07 Marks)**

b. The machine weighing 600N is supported by springs of stiffness K = 20N/mm and dampers of damping coefficient C = 0.01N-s/mm. A harmonic force of amplitude 20N is applied. Compute resonant amplitude. **(09 Marks)**

4 a. What is a magnification factor? Explain its dependency on frequency ratio and damping ratio with a qualitative graph relating to all the above quantities. **(07 Marks)**

b. A source of vibration with a frequency of 300Hz is to be isolated from an equipment of mass 15kg. Determine the stiffness of the spring if 50% isolation is to be attained and damping is to be neglected. **(09 Marks)**

5 A two degree freedom system is shown in Fig.Q.5. If m_1 = 2kg, m_2 = 2kg, k_1 = 40N/m, k_2 = 20N/m, determine natural frequencies of vibration and mode shapes. **(16 Marks)**

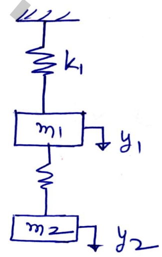

Fig.Q.5

Determine natural frequencies and mode shapes for a structure shown in Fig.Q.6. Draw the mode shapes.

Given, $I = 5 \times 10^5 mm^4$ $m_1 = 1360kg$

$E = 2.5 \times 10^4 N/mm^2$ $m_2 = 660kg$ **(16 Marks)**

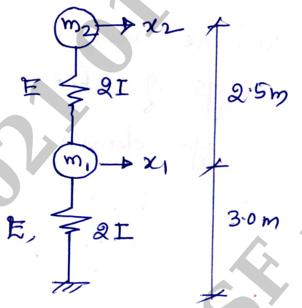

Fig.Q.6

7 A three storeyed shear building is subjected to harmonic loading. Compute the response. Neglect the axial deformation in the structural elements. Refer Fig.Q.7.

Given,

$m_1 = m_2 = m_3 = 20 \times 10^3$ kg

$k_1 = k_2 = 160 \times 10^6$ N/m

$k_3 = 240 \times 10^6$ N/m

$w_1 = 43.87$ rad/s

$w_2 = 120.15$ rad/s

$w_3 = 167$ rad/s

The mode shapes are as follows:

$$\phi_1 = \begin{bmatrix} 1 \\ 0.76 \\ 0.34 \end{bmatrix}; \quad \phi_2 = \begin{bmatrix} 1 \\ -0.8 \\ -1.16 \end{bmatrix}; \quad \phi_3 = \begin{bmatrix} 1.0 \\ -2.43 \\ 2.51 \end{bmatrix}$$ **(16 Marks)**

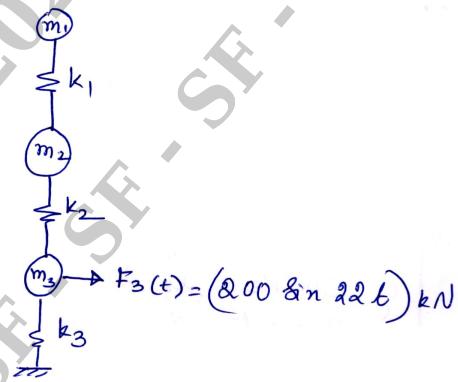

Fig.Q.7

8 Compute the response due to a harmonic loading for the shear frame shown in Fig.Q.8. Given $EI = 24 \times 10^6$ N-m^2, $m = 500 \times 10^3$ kg, $P_1(t) = 0$, $P_2(t) = (10{,}000 \sin 30t)$ kN, storey height = 3m. **(16 Marks)**

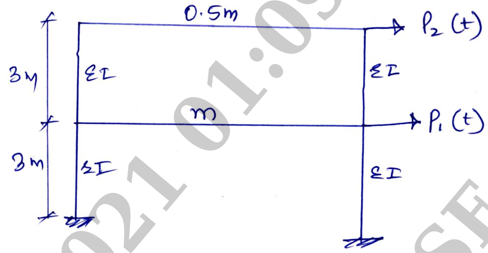

Fig.Q.8

9 a. Explain lumped mass and consistent mass formulation for vibration of beams. **(07 Marks)**

b. Compute the lowest natural frequency of a simply supported beam of span 2m and mass per unit length, 500N/m, $EI = 833.33 \times 10^{\circ}$ Nmm^2. Consider the beam as a single element. Refer Fig.Q.9(b). **(09 Marks)**

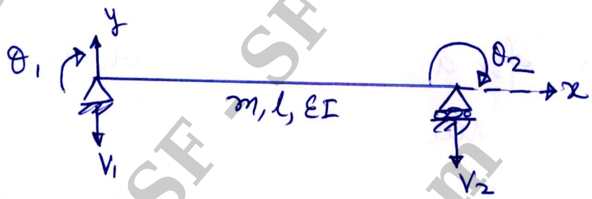

Fig.Q.9(b)

10 a. Derive the governing differential equation of motion for a free flexural vibration of a beam. **(08 Marks)**

b. Develop mass matrix for a simply supported beam of length L, mass density *l*, cross-sectional area A, flexural rigidity EI. **(08 Marks)**

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