CBCS SCHEME

USN | | | | | | | | | | 15CV744

Seventh Semester B.E. Degree Examination, Dec.2018/Jan.2019
Structural Dynamics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Differentiate between : i) Forced vibrations and free vibrations
ii) Random excitation and harmonic excitation
iii) Oscillation and vibration **(06 Marks)**

b. A body of 10kg is supported on spring of stiffness 300N/m and a dash-pot is connected to it, which produces a resistance of 0.04N at a velocity of 0.02m/s. In what ratio will be the amplitude of vibration reduces after 5 cycle? **(10 Marks)**

OR

2 a. Derive an expression for motion x(t) of an under damped Single Degree of Freedom system (SDOF) subjected to free vibration. **(10 Marks)**

b. A diver weighing 90kg stands at the end of a cantilever diving board of span 1m. The diver oscillates at a frequency of 2Hz. What is the flexural rigidity of the diving board? **(06 Marks)**

Module-2

3 a. What is magnification factor? Explain its dependence on frequency ratio and damping ratio with a qualitative graph relating to all the above three quantities. **(08 Marks)**

b. Source of vibration with frequency 300Hz is to be isolated from an equipment of mass 15kg. Determine the stiffness of spring if 50% of vibration is to be isolated, damping is negligible. **(08 Marks)**

OR

4 a. Derive an expression for the force transmitted to the foundation in a damped Single Degree of Freedom (SDOF) system due to harmonic force, F(t) = Fosincot. **(08 Marks)**

b. A machine weighing 600N is supported by springs of stiffness K = 20 N/mm and dampers of damping coefficient, C 0.01N-s/mm. A harmonic force of amplitude 20N is applied. Compute the resonant amplitude. **(08 Marks)**

Module-3

5 Determine the natural frequencies and mode shapes for structure as shown in Fig Q5. Draw the mode shapes. Given $I = 5 \times 10^5\ mm^4$, $E = 2.5 \times 10^4 N/mm^2$, $m_1 = 1360kg$, $m_2 = 660kg$.

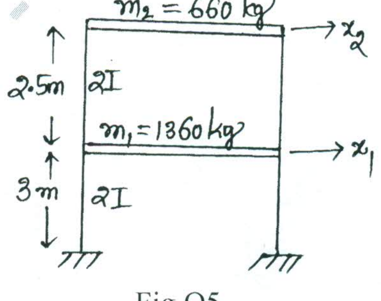

Fig Q5 **(16 Marks)**

OR

6 Compute the natural frequencies and mode shapes for the shear frame shown in the Fig Q6. Given EI = $23{\cdot}83 \times 10^6$ Nm^2 for all columns.

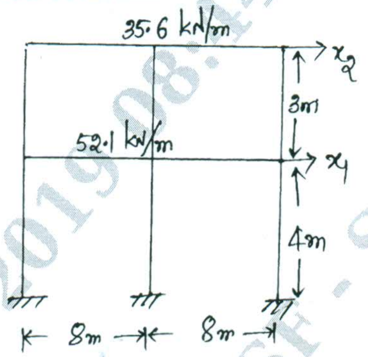

Fig Q6 **(16 Marks)**

Module-4

7 Determine natural frequencies and steady state response of the multi degree freedom system frame at t = 0.1sec for the Fig Q7.

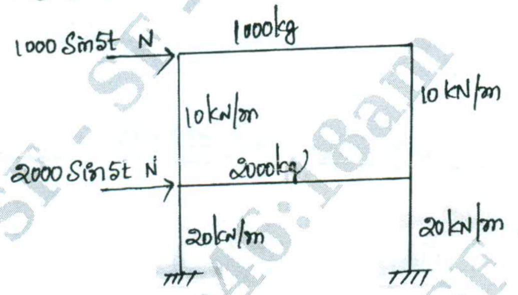

Fig Q7 **(16 Marks)**

OR

8 For a three storeyed shear building subjected to harmonic loading (Fig Q8), compute the response, given the results of the free vibration analysis. Neglect axial deformities in all structural elements. Given: Stiffness of floor : $K_1 = K_2 = 160 \times 10^6$ N/m ; $K_3 = 240 \times 10^6$ N/m. Mass of the floor : $M_1 = M_2 = M_3 = 20 \times 10^3$ kg (or Ns^2/m). The natural frequencies are $w_1 = 43.87$ rad/s, $w_2 = 120.15$ rad/s, $w_3 = 167$ rad/s.

The mode shapes are as follows: $\phi_1 = \begin{bmatrix} 1 \\ 0.76 \\ 0.34 \end{bmatrix}$ $\phi_2 = \begin{bmatrix} 1 \\ -0.8 \\ -1.16 \end{bmatrix}$ $\phi_3 = \begin{bmatrix} 1.0 \\ -2.43 \\ 2.51 \end{bmatrix}$.

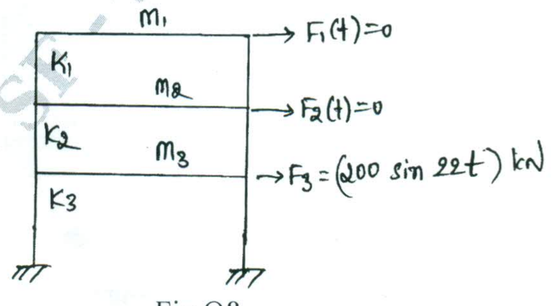

Fig Q8 **(16 Marks)**

Module-5

9 Develop stiffness matrix and mass matrix for a simply supported beam of length L, mass density ρ, cross section area A, flexural rigidity EI. **(16 Marks)**

OR

10 Compute the lowest natural frequency of simply supported beam of span 2m and mass per unit length 500N/m, EI = 833.33 × 10^9 Nmm^2. Consider the beam as a single element as indicated in Fig 10.

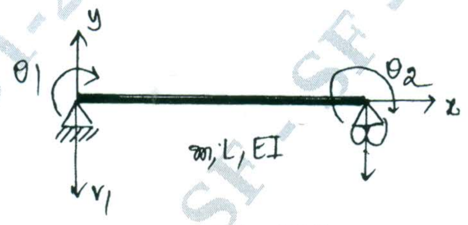

Fig Q10 **(16 Marks)**

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