Roll No. | | | | | | | | | | | | | **Total No. of Pages : 02**

Total No. of Questions : 08

M.Tech.(CE) (Sem.–1)

DYNAMICS OF STRUCTURES

Subject Code : CE-501

M.Code : 35202

Date of Examination : 14-01-23

Time : 3 Hrs. **Max. Marks : 100**

INSTRUCTIONS TO CANDIDATES :

1. **Attempt any FIVE questions out of EIGHT questions.**
2. **Each question carries TWENTY marks.**

1. Compute the response due to harmonic loading for the shear frame shown in Fig.l. Give| $K_l = 2.5 \times l0^6$N/m, $K_2 = 5.0 \times l0^6$N/m, $M_l = 25 \times 10^3$ kg and $M_2 = 15 \times 10^3$ kg, $P_l(t) = 50000 \sin (20t)$N, $P_2(t)$ = storey height = 3m

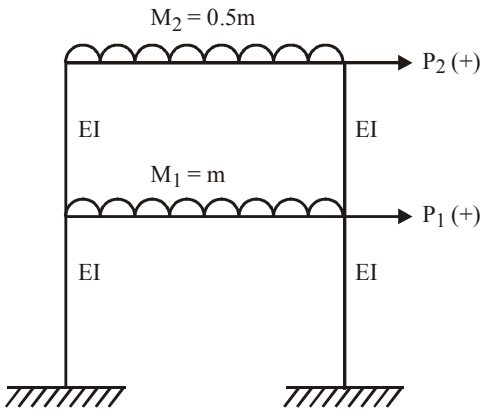

Fig. 1

2. State and explain D'Alemberts principle? Derive the equation of motion and expression for $x(t)$ for the free undamped vibration of SDOF system.

3. a) Explain the lumped mass and consistent mass formulation for vibration of beam.

   b) Derive the governing differential equation for a free flexural vibration of beam

4. For a three storeyed shear building as shown in Fig.2, compute the natural frequencies, natural periods, and mode shapes. Plot the mode shapes. Neglect axial deformations in all structural elements. Given:

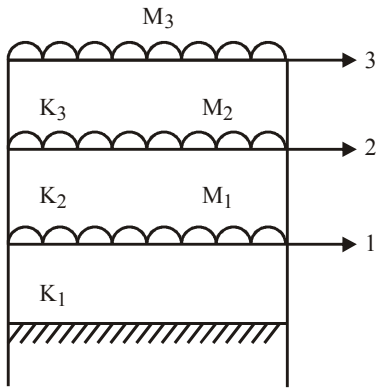

Fig. 2

Stiffness of floor : $K_1 = 3 \times 10^6$N/m, $K_2 = K_3 = 4 \times 10^6$N/m Mass of floor: $M_1 = 2 \times 10^3$ kg, $M_2 = 1.5 \times 10^3$ kg, $M_3 = 1.0 \times 10^3$ kg

5. Compute the magnification factor of forced vibration produced by a machine operating at a speed of 600 rpm, installed at the middle of the beam. The static deflection at the middle of the beam due to weight of the machine W= 5000N is δst = 0.25mm. Neglect the weight of the beam and consider the viscous damping force of 500N at a velocity of 25mm/sec.

6. a) A spring mass system has maximum velocity 40 cm/s and time period 2 s. If the initial displacement is 2 cm, determine (i) the amplitude, (ii) the initial velocity, (iii) the maximum acceleration and (iv) the phase angle.

   b) Define critical damping.

7. Derive the differential equation of motion for free flexural vibration of the simply supported beam. Sketch the first three mode shapes.

8. a) The stiffness matrix and mass matrix of a two degree freedom system are given by :

$$K = \begin{bmatrix} 4 & 2 \\ 2 & 4 \end{bmatrix} \qquad m = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

   Determine the natural frequencies and corresponding modes of vibration, normalized with respect to the matrix such that x^T mx = 1.

   b) Reduce the above system to a system of two independent differential equations by decoupling the variables by the normal mode method.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.