M.E.(CIVIL) 2nd Semester Examination. 2013

DYNAMICS OF STRUCTURES (CE - 1002)

Full Marks : 100 Time : 3 hours

*Answer Question No.1 and any **FOUR** from the rest.*
The questions are of equal value.

1. (i)Formulate the MDOF equation of motion. Explain (a) stiffness matrix, (b) Mass matrix and (c) damping matrix.

(ii) Derive the orthogonal relationship of mode shapes with respect to mass and stiffness of the structure.

2. Obtain the equilibrium equation for MDOF shear building for free vibration.

(b) A three storied building having floor stiffnesses at ground floor, first floor and second floor as 600Kn/cm, 1200Kn/cm and 2400Kn/cm respectively is loaded with equal masses of 2Kn-sec^2/cm at both the floors and also at roof. Hence obtain the other natural frequencies and corresponding mode shapes using relations of orthogonality.

3. A two storied frame behaving like a shear building has three bays in the bottom storey of height 4.5m and only the central bay in the top storey of height 3m. Each of the four columns in the bottom storey has fixed bases and relevant moment of inertia 22000 cm^4 and the moment of inertia of the two columns in the upper storey is 12000 cm^4 each. Lumped masses at the top storey and bottom storey beam levels are 120 and 280 kg-sec^2/cm respectively. Considering E = 2.0x106 kg/cm^2 compute the frequencies and associated mode shapes.

4. A three-storey building has lateral column stiffness at 1st, 2nd and 3rd storey 18x 109 N/m, 12x109 N/m and 8x 109 N/m respectively. The storey level masses are m1and m2=500kN each and m3=200kN. Compute the shear forces by code prescribed Response Spectra method from the following data: Sa/g =2.5 Importance factor, I=1.5, Zone factor = 0.24 and response reduction factor = 3

5. Using Stodola method, determine the natural frequencies for the shear building having the mass and Stiffness matrix as follows:

$$[M] = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1.5 & 0 \\ 0 & 2 & 0 \end{bmatrix} \text{kips-sec}^2/\text{in} \qquad [K]^{-1} = \frac{1}{3600}\begin{bmatrix} 11 & 5 & 2 \\ 5 & 5 & 2 \\ 2 & 2 & 2 \end{bmatrix} \text{in/kip}$$

6. Usng Rayleigh-Ritz method, determine the natural frequencies and modal amplitude of a uniform three-storey shear building with storey stiffness at 1st , 2nd and 3rd storey k, 2k and 3k and lumped floor masses at 1st , 2nd and 3rd floor m, 1.5m and 2m. where k=600kN/mm and m=1.0 kNs^2/mm.Assume 1st two modes are

$$\phi = \begin{Bmatrix} 1 & 1.0 \\ 0.65 & -0.61 \\ 0.31 & -0.685 \end{Bmatrix}$$

7. Write short notes on any Two of the following:
   i. Elastic-rebound theory
   ii. Plate Tectonics
   iii. Measurements of earthquake
   iv. Response Spectra