M.E. (Civil) 2nd Semester Final Examination, 2014

Subject: Dynamics of Structures
(CE: 1002)

Full Marks: 70 Time: 3 Hrs

*Answer any **four** questions.*
*The questions are of **equal** value.*
***Two marks** are reserved for neatness*

1. (i) Derive the MDOF equation of motion. Explain (a) stiffness matrix, (b) mass matrix and (c) damping matrix.
   (ii) Derive the stiffness matrix of four-storey shear building.

2. (a) Derive the orthogonal relationship of mode shape with respect to mass and stiffness of the structure
   (b) Derive the uncoupled equations of motion for a linear structure using the orthogonal relationship of mode shapes. Also write down the steps for dynamic analysis by mode superposition procedure.

3. Using Rayleigh-Ritz method, determine the natural frequencies and mode shapes of uniform three-storey shear building with storey stiffness at 1st, 2nd and 3rd storey 3k, 2k and k and lumped floor masses at 1st, 2nd and 3rd floor 1.0m, 1.5m and 3.0m. Assume 1st two modes are

$$\emptyset = \begin{bmatrix} 1 & 1 \\ 0.64 & -0.6 \\ 0.30 & -0.7 \end{bmatrix}$$

4. A three-storey building has lateral column stiffness at 1st, 2nd and 3rd storey 15×10^9 N/m, 10×10^9 N/m and 6×10^9 N/m respectively. The storey level masses are m_1 and m_2 = 400kN each and m_3 = 150kN. Compute the shear forces by code prescribed Response Spectra method from the following data: S_a/g = 2.5, Importance factor, I = 1.5, Zone factor = 0.24 and Response reduction factor = 5.0

5. (i) Derive the frequency of a shear building by Rayleigh method.
   (ii) A three storied building having floor stiffness 10 kN/cm, 9 kN/cm and 8 kN/cm of ground, 1st and 2nd floor respectively is loaded with equal masses of 15 kN-sec^2/cm at both the floors and roof. Determine natural frequencies.

6. Using direct stiffness method, determine the mass matrix and stiffness matrix of a cantilever prismatic beam. The beam is divided into three elements. Given, span = 1.5m, flexural stiffness EI = 18000 kgcm^2, mass = 500kg/m.

7. Write short notes on any ***two*** of the following:
   a. Elastic-rebound theory
   b. Plate Tectonics
   c. Response Spectra.