(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2857 Roll No. | | | | | | | | | | |

B. Tech.

(SEM. VIII) THEORY EXAMINATION 2011-12

EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

Time : 3 Hours *Total Marks : 100*

Note : (1) Attempt ***all*** questions.

(2) Each question carries equal marks.

(3) Assume any missing data suitably.

(4) Use of IS : 1893 is allowed.

1. Attempt any ***four*** parts of the following : **(5×4=20)**

(a) Define the following terms :

(i) Epicentre

(ii) Hypocentre

(iii) Iso-seismal

(iv) Seismogenic.

(b) How earthquakes are caused ? Can they be predicted ? If not, why ? How are they measured ?

(c) State some assumptions made in earthquake resistant design of structures.

(d) State some structural considerations for safe building design in active seismic zone.

(e) The standard torsion seismograph records a trace amplitude 8.5 mm long in N-S direction and 6.1 mm long

in E-W direction. The distance to the epicentre is estimated as 112 Km. The station correction is +0.2. Determine the magnitude of the earthquake.

(f) Write a short note on seismic zoning.

2. Attempt any ***four*** parts of the following : **(5×4=20)**

(a) What do you understand by degree of freedom ? Derive the expressions for free vibrations of undamped systems having single degree of freedom; with suitable diagram.

(b) Deriving the suitable expressions explain overdamped and underdamped systems having single degree of freedom. What is critical damping ?

(c) In an experiment of free-vibration, it is found that the maximum amplitude has reduced to 0.4 times its value in three complete cycles. Determine the percentage damping in the system.

(d) For a forced vibrating system with damping devices the exciting force has a form given below :

$$f(t) = f_0 \sin wt.$$

Where f_0 is the maximum amplitude of the force and w its angular frequency. Deduce the expression for dynamic magnification of the displacement.

(e) What is equivalent viscous damping ? Describe with suitable expressions and interpret the result.

(f) For a single degree of freedom system having damping devices, subjected to ground motion excitation; derive the expressions for spectral values for displacement, velocity and acceleration.

3. Attempt any ***two*** parts of the following : **(10×2=20)**

(a) For a 2-degree of freedom system having two single storeyed structures linked together by a spring element as shown in fig. 1. Find the expression for displacement when :

(i) equal initial amplitude of 10 cm in phase is given for both masses.

(ii) equal initial amplitude of 10 cm out of phase (180°) is given for both masses.

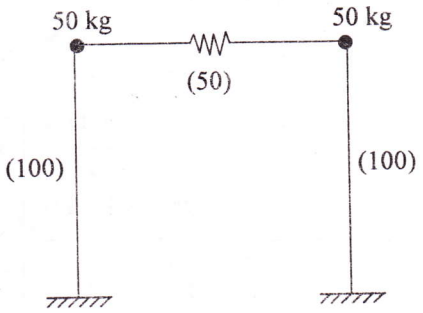

Fig. 1

Where the values in parenthesis are stiffness of the members.

(b) Consider the three-degree of freedom system shown in the following fig. 2. Obtain the solution for equation of motion and mode shapes. Use stiffness method.

(c) Consider an undamped n degree of freedom system subjected to forced vibration, find the complete solution for displacement.

4. Attempt any ***two*** parts of the following : **(10×2=20)**

(a) A four-storeyed reinforced concrete frame building as shown is situated at NCR. The height between the floors is 3 m and total height of building is 12 m. The dead load and normal live load is lumped at respective floor. The soil below the foundation is assumed to be hard rock. Assume building to be used as a hospital. Determine the total base shear as per I.S. 1893 (Part 1) : 2002 and

distribute the base shear along the height of the building.

See fig. 2. Use equivalent lateral load method.

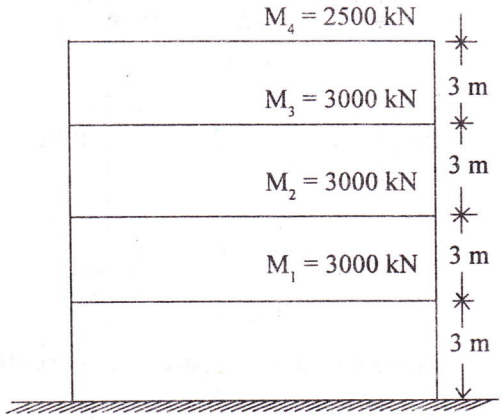

Fig. 2 (Hospital Building)

(b) List the step by step method for seismic analysis of R.C. building as per IS code 1893 (Part 1) : 2002 by :

(i) Response spectrum method

(ii) Time History method.

(c) Enumerate the basic seismic design philosophy in brief.

5. Attempt any ***one*** part of the following : **(20×1=20)**

(a) Design the foundation for a gas engine with a vertical cylinder and vertically oscillating parts, for the following data :

(i) Total weight of engine = 4500 kN

(ii) Speed or rotation = 260 rpm

(iii) Unbalanced vertical load = 10 kN

(iv) Base dimension of the engine = 1 m × 2.5 m

(v) Elevation of the machine base above ground = 1 m

weak silty sand exist to a depth of 0.5 m followed by a dense sand to a depth of 6 m. The unit weight of moist sand 17 kN/m^2.

Assume $\beta = 4.6 \times 10^4$ kN/m^2/m and $\lambda = 3.5$.

(b) Enumerate the step-by-step method for design of foundation for impact type machine as per Indian standard code of practice IS : 2974 (Part II) : 1966.