Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-I Regular Examination January / February 2011

Subject code: 711502 N

Subject Name: Structural Dynamics and Earthquake Engineering

Date: 01 /02 /2011 **Time: 02.30 pm – 05.00 pm**

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of IS 1893 – 2002 and IS 13920 is permitted.**

Q.1 **(a)** For a three story building frame, lumped mass and story stiffness are shown in figure – 1, calculate natural frequency and corresponding mode shapes for the fundamental mode only. Also draw mode shapes. **14**

Q.2 **(a)** Describe seismic waves briefly. **07**

(b) Explain the following terms : **07**

1. Magnitude of Earthquake and Intensity of Earthquake
2. Ductility and Flexibility of building

OR

(b) Explain the structural irregularities in Reinforced Concrete buildings. **07**

Q.3 **(a)** Solve the following problems **07**

1. Find the natural frequency of the system as shown in figure – 2. Take $k = 2 \times 10^5$ N/mm^2 and m = 20 kg.
2. For the system shown in figure – 3, the characteristic of the dashpot is such that when the constant force of 49 N is applied to the piston its velocity is found to be constant 0.12 m/sec. Determine the value of C and justify that the system is periodic or aperiodic.

(b) Equation of motion of Single degree of freedom system is given by $5X^{\circ\circ}+3X^{\circ}+12X = 10 \sin \omega t$. Calculate the following 1.Damping factor 2. Damped Frequency 3.Critical damping 4.Amplitude at resonance 5. Magnification factor 6. Logarithmic decrement **07**

OR

Q.3 **(a)** Explain SDOF system and derive the response of undamped free vibration for SDOF system **07**

(b) A vertical cantilever of mild steel tube section is 2.5 m long and supports 5 kN weight. The tube has external diameter 250 mm and wall thickness 5 mm. The system is subjected to a harmonic force of 10 kN amplitude and 4 Hz frequency find the maximum steady state displacement in the tube. Take damping as 5% of critical damping. **07**

Q.4 **(a)** A typical floor as shown in figure – 4 is subjected to design lateral force of 150 kN in X - direction. Size of column is 400 mm X 600 mm and mass is uniformly distributed. Using appropriate clauses of code, carry out lateral forces on the column. **07**

(b) Explain the following **07**

1. Strong ground motion
2.Richter magnitude scale

OR

Q.4 **(a)** Calculate base shear for the 7 story R.C. frame building for hospital located in Bhuj, using seismic coefficient method for the following data **14**

1. No. of bays in X – direction - 6
2. No. of bays in Y – direction - 4
3. Bay width in both direction - 4 m
4. Story height - 3.5 m
5. Thickness of Slab - 150 mm
6. Size of Beam - 230 mm x 450 mm
7. Size of Column - 300 mm x 600 mm
8. Internal wall thickness - 115 mm
9. Internal wall thickness - 230 mm
10. Live Load - 4 kN/m^2

Assume suitable data if required. Give your calculation with appropriate clause number of code and draw shear distribution at each floor level.

Q.5 **(a)** Explain liquefaction in detail. **07**

(b) How the effects of earthquake can be reduced on the building? **07**

OR

Q.5 **(a)** Explain the important points to be kept in mind for the design of "Flexural members" as per IS 13920. **07**

(b) Describe the basic principles and guidelines for achieving efficient Earthquake resistant structural design. **07**

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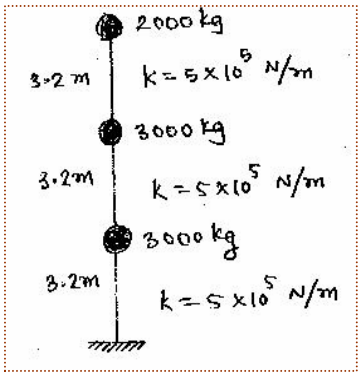

Figure – 1

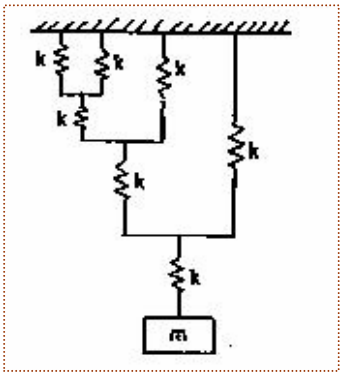

Figure – 2

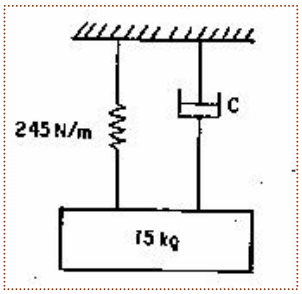

Figure – 3 Figure – 3

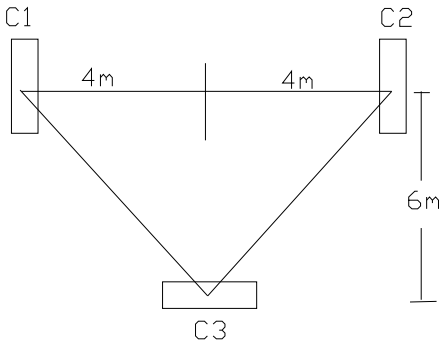

Figure – 4