Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER–V • EXAMINATION – WINTER • 2014

Subject Code: X50602 **Date: 02-12-2014**

Subject Name: Earthquake Engineering

Time: 10:30 am - 01:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **IS 1893 Part I (2002) & IS 13920 (1993) are allowed in the Examination.**

Q.1 **(a)** Derive the equation of motion for the free damped single degree of freedom system. **07**

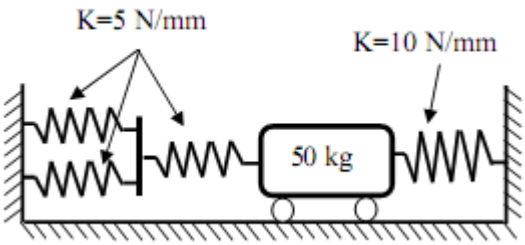
(b) Define (i) Iso-seismal (ii) soft storey (iii) epicenter (iv) magnitude (v) resonance (vi) seismogram (vii) Intensity **07**

Q.2 **(a)** Explain concept of ductile detailing & explain factor affecting the ductility of structures in detail. Explain ductile detailing of beam as per IS 13920 – 1993. **07**

(b) An empty elevated water tank is pulled by a steel cable by applying a 30 kN force. The tank is pulled horizontally by 5 cm. The cable is suddenly cut and the resulting free vibration is recorded. At the end of five complete cycles, the time is 2 seconds and the amplitude is 2 cm. Determine the damping ratio, natural period of undamped vibration, effective stiffness, effective weight and damping coefficient for the given data. **07**

OR

(b) Find the natural frequency of the system shown in the fig. below **07**



Q.3 **(a)** Calculate the base shear for a five storey hospital building having special moment resisting frame (SMRF) located in Ahmedabad on medium soil with following data using seismic coefficient method. **07**

(i) No. of bay in x and y-direction = 4
(ii) Width of each bay = 5m
(iii) Thickness of slab =150 mm
(iv) Storey height = 3 m
(v) Size of beam and column = 300 mm x 450 mm
(vi) Amount of damping = 10 % of critical damping
(vii) Live load = 4 kN/m2

Assume any additional data if required and neglect the weight of the infill wall panels.

(b) Calculate the lateral forces at each floor level of hospital building of Q.3.a using seismic coefficient method. **07**

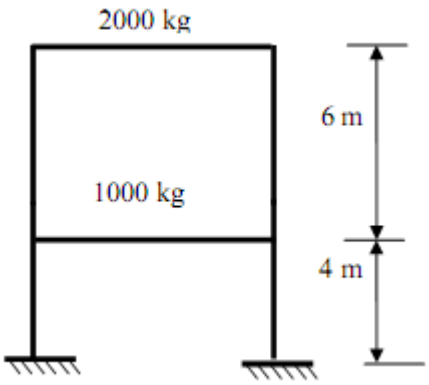
OR

Q.3 **(a)** What is the natural period of vibration of the second system with respect to first if both systems are identical except support condition? First system has hinge support & second system has fixed support **04**

(b) Explain four virtue of good earthquake resistant design. **05**

(c) Explain Base Isolation technique. **05**

Q.4 **(a)** What is mode shape? Plot the mode shapes for the frame shown in the fig. and indicate the fundamental mode. Take $EI_{column} = 1.5 \times 10^{12}$ N-mm, $EI_{beam} = \infty$. **14**

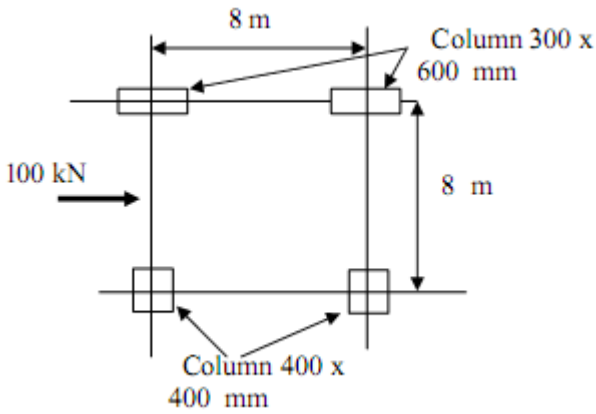


OR

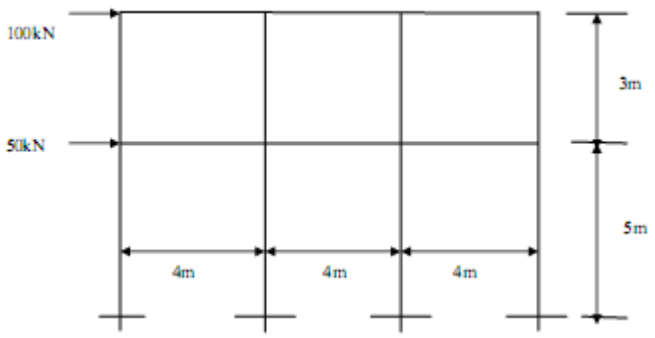
Q.4 **(a)** State whether following statements are true or false. Give logical reason for your answer : **07**

1. Masonry structures offers less damping as compared to steel structures.
2. Code specifies lower value of R for building having better performance.
3. Dahod is having maximum earthquake risk.
4. Peak ground acceleration (PGA) & Zero period acceleration (ZPA) are same.
5. Two identical building to be constructed in zone IV & V. Building in zone IV should be designed for higher lateral load than building in zone V.
6. Any structure is designed as earthquake proof structure.
7. Liquefaction is only possible in clayey soil.

Q.4 **(b)** Find the lateral loads in the columns of a rigid floor shown in the fig. All columns are of same height and mass is uniformly distributed. **07**



Q.5 **(a)** **07**



Analyze the structure as shown in the figure. by portal method .

(b) Draw axial force, shear force & bending moment diagram for the RC frame given in Q 5 (a) **07**

OR

Q.5 **(a)** Explain failures of masonry structures observed in past earthquakes & how will you improve performance of masonry building. **07**

(b) Define & explain liquefaction. Also give remedial measures for the liquefaction. **07**

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