

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. - SEMESTER – I • EXAMINATION – WINTER • 2013

Subject code: 711502N**Date: 26-12-2013****Subject Name: Structural Dynamics & 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. Use of IS 1893-2002, IS 13920 – 1993, IS 4326, SP 16 is allowed

- Q.1 (a) Attempt following** **07**
1. Enlist required condition for liquefaction.
 2. Give four virtue of good earthquake resistant design.
 3. Differentiate - Iso-seismal & Meizo-seismal
 4. Differentiate - Ductility Vs Flexibility
 5. Differentiate - Gravity load distribution Vs lateral load distribution
 6. Differentiate - Magnitude & Intensity
 7. Differentiate - Seismograph Vs Seismogram
- (b) State whether following statements are true or false & also justify your answer. (Any seven)** **07**
1. Soft storey & weak storey are same.
 2. Liquefaction is only possible in cohesive soil.
 3. Resonance is possible during earthquake event.
 4. Design philosophy for gravity loads & design philosophy for lateral loads due to earthquake are same.
 5. Inter storey drift is maximum in Zero Period Structure.
 6. A building is located on the boundary of zone III & IV. It will be designed as if it is in zone IV.
 7. Mizoram is having least seismic risk.
 8. Non structural wall will not contribute any thing to structure during earthquake event.
 9. P & S waves are responsible for maximum damage to structures.
 10. Base isolation is preferred in high rise building.
- Q.2 (a) Explain concept of ductile detailing & explain factor affecting the ductility of structures in detail. Also explain ductile detailing of column as per IS 13920 – 1993** **07**
- (b) Derive expression for the response of free damped SDOF structural system.** **07**
- OR**
- (b) Derive expression for the response of SDOF structural system to earthquake ground motion.** **07**
- Q.3 (a)** **07**
1. Explain Dynamic DOF. Write all your assumption to reduce dynamic DOF of RCC frame structure.
 2. Explain causes of Liquefaction & also give remedial measures
 3. Explain response of various nonstructural components & its structural considerations in brief.
- (b) RCC frame building shown in fig. 1 located in Sikkim** **07**
- (a) Prove that damping don't have significant effect on natural frequency of vibration for the side sway of the frame.
 - (b) Calculate peak displacement for first seven cycles if roof is displaced by 150 mm & suddenly released. Also plot amplitude envelope curve.

(c) Calculate maximum bending moment stress in the column.
 Size of the column is 300 mm x 300 mm.
 Concrete grade is M 25. Assume suitable damping ratio.

OR

Q.3 (a) Attempt following - **Any three** **07**

1. Explain the deficiencies of building exposed in recent Sikkim earthquake. Also write remedial measures of each deficiency.
2. Differentiate magnitude & intensity. Give expression for
 (i) Local magnitude, (ii) surface magnitude, (iii) Moment magnitude
3. Define & explain base isolation.
4. Enlist structural controls & explain yielding dampers in detail.

- (b)** **07**
1. Two separate pendulums are hanging on an ideal spring with equal mass. The period of vibration for the pendulums is 1.73 sec & 3 sec respectively. What is the stiffness of the second pendulum with respect to first?
 2. A spring mass (k_1 , m_1) system has a natural frequency f_1 . Calculate the value of stiffness of other spring which when connected to k_1 in parallel increases the frequency by 70%.
 3. The dimension of the column is 450 mm x 450 mm. If the these dimensions become doubled, what should be the increase in the lateral load carrying capacity of the column with respect to column with earlier dimension

Q.4 (a) Derive expression for the response of free un-damped SDOF structural system. Consider the spring mass system shown in **fig. 2** **07**

- What is the number of static & dynamic degrees of freedom for this system?
- Draw free body diagram & develop equation of motion.
- Obtain natural frequency of the system.

- (b)** **07**
- Calculate the forces in four columns located in corner due to lateral load of 1200 kN acting in X direction for the single storey building having slab dimension 12m x 8m. Intensity of loading is 10 kN/m² which is uniform. All columns are identical square column. Use all provisions of IS 1893 – 2002 Part-I including torsion provision.

OR

Q.4 (a) Answer following question from the graph of force Vs deformation of two materials given in **fig 3** **07**

- Which material is more flexible A or B?
- Which material is stronger A or B?
- Which material is more ductile A or B?
- Which material absorbs more energy A or B?

- (b)** **07**
- A simply supported beam of negligible mass spanning 8 m supports a machine of 30 kN at center with an unbalanced rotor applying a vertical force of $60 \sin 55t$ kN. The damping force is 0.4 kN-s/m & Flexural rigidity of beam is 30000 kN-m². Determine (i) maximum amplitude of vibration (ii) amplitude of vibration at resonance

Q.5 **14**

Carry out response spectrum analysis of two storey single bay RC frame structure supported by four corner columns. Building located in Sikkim has lumped floor weights of 150 kN at every floor level. It has storey stiffness 80 kN/m at second floor level. Consider all joints as rigid joint & all support are hinged support. Perform free vibration analysis.

- (i) Identify the deficiency of the structure. What will you do to avoid deficiency identified?
- (ii) Calculate natural frequency by approximate methods & compare with results of dynamic analysis.
- (iii) What should be the increase in stiffness of ground storey required to make storey stiffness of the all floor same?

OR

- Q.5 (a) Explain** **07**
- Combined D-V-A plot
 - Missing mass correction
- (b) Explain earthquake resisting features of masonry structures & list out failures observed in past earthquake.** **07**

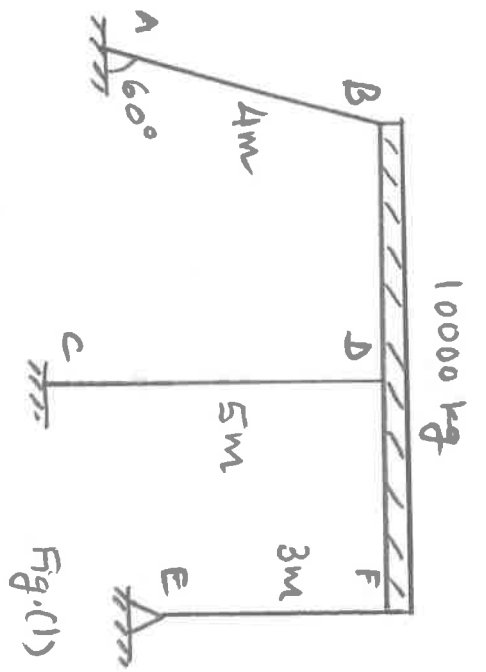


Fig.(1)

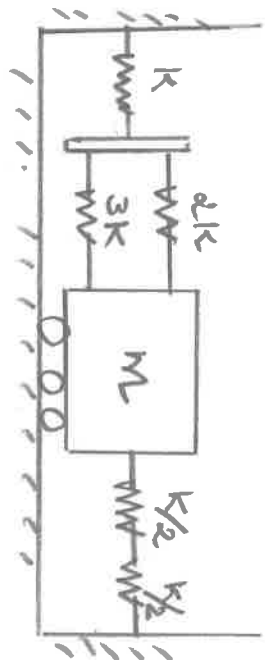


Fig.(2)

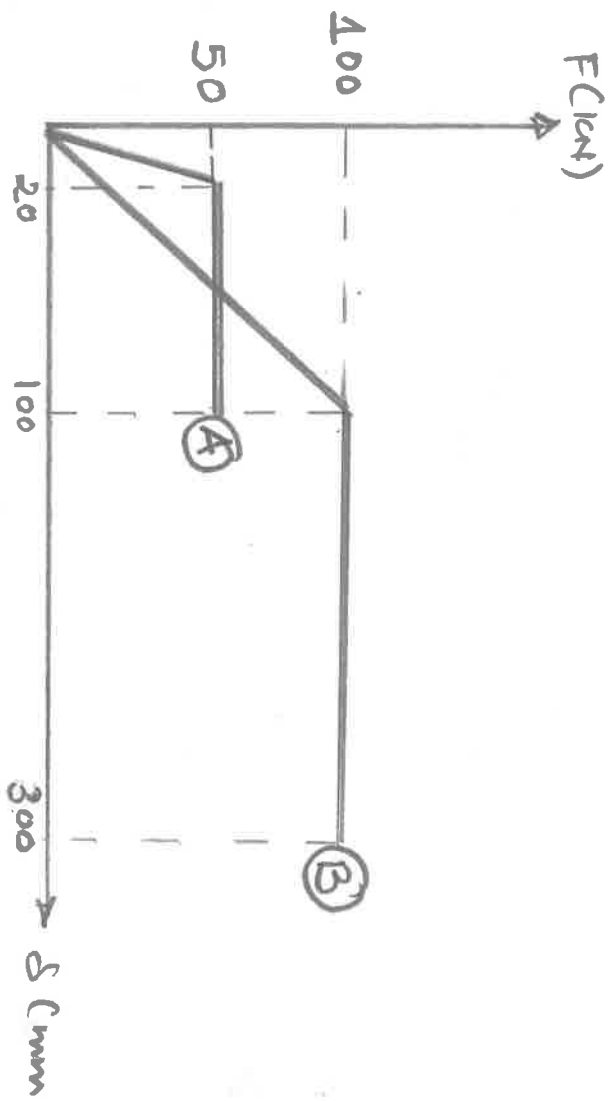


Fig.(3)