

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. IST Semester–Remedial Examination – July- 2011

Subject code: 711502

Subject Name: Structural Dynamics & Earthquake Engineering

Date: 08/07/2011

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 456-2000, IS 13920 – 1993, IS 4326, SP 16 is allowed

Q.1 (a) Attempt any seven

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1. Consider the natural period 'T' & acceleration 'a' of a SDOF system. When mass M of the system increases, how 'T' & 'a' affected?
2. What is the natural period of vibration of the second system with respect to first if both systems are identical except height? Take $h_1 = 2h_2$
3. Force acting at the top of a building frame as shown in fig 1. What is the shear force distribution in the column if column having different moment of inertia? Take $(I)_1 = 3 (I)_2 = 6 (I)_3$
4. A SDOF system having 90 kg mass & spring stiffness 10 kN/m. The amplitude of vibration in successive cycle are found to be 72, 61, 49, 36, ...mm. Determine frequency of damped vibration & value of damping coefficient along with damping force.
5. Enlist required condition for liquefaction.
6. Give four virtue of good earthquake resistant design.
7. Give your comment
Importance factor depends on performance of the building.
8. Give your comment
Base isolation is preferred in high rise building.

(b) State whether following statements are true or false & also justify your answer. (Any seven)

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1. As per IS 1893 2002, Gujarat is divided in Zone III, IV & V only.
2. Ductile detailing is compulsory for RCC building located in Gujarat.
3. Buildings in Gujarat can resist 9 magnitude earthquakes.
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. Performance of shear walls which are located near geometric centre of building is better than the identical shear wall located on periphery.
8. Non structural members will not contribute anything to stiffness of the RCC structure.
9. As per IS 13920-1993, steel reinforcement of grade more than Fe 500 or more is preferred to introduce more ductility.

Q.2 (a) A SDOF vibrating system is having following parameters.

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$m = 10 \text{ kg}$, $k = 160 \text{ N/m}$, $c = 8 \text{ N – sec / m}$.

Determine (i) the damping factor (ii) the natural frequency of damped vibration (iii) logarithmic decrement (iv) the ratio of two successive amplitudes & (v) the number of cycles after which the original amplitude is reduced to 25 %

(b) Derive expression for the response of SDOF structural system to earthquake ground motion.

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OR

- (b) Derive expression for the response of SDOF forced damped structural system. 07
- Q.3** (a) Explain concept of ductile detailing & explain factor affecting the ductility of structures in detail. Also explain ductile detailing of beam – column joint as per IS 13920 – 1993 07
- (b) RCC frame building shown in fig. 2 located in Dehradun 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 six cycles if roof is displaced by 200 mm & suddenly released. Also plot amplitude envelope curve.
- (c) Calculate maximum bending moment stress in the column.
- Size of the column is 600 mm x 600 mm.
- Concrete grade is M 25. Assume suitable damping ratio.
- OR**
- Q.3** (a) Attempt following any three 07
1. Differentiate magnitude & intensity. Give expression for (i) Local magnitude, (ii) surface magnitude, (iii) Moment magnitude
 2. Explain the deficiencies of building exposed in recent Chile earthquake. Also write remedial measures of each deficiency.
 3. Define & explain base isolation.
 4. Explain structural controls
 5. Differentiate : (i) Gravity load distribution Vs lateral load distribution (ii) Ductility Vs Flexibility
- (b) 1. Differentiate (i) Magnitude & Intensity (ii) Iso-seismal & Meizo-seismal (iii) Seismograph Vs Seismogram (iv) S wave & P wave 07
2. Explain Dynamic DOF. Write all your assumption to reduce dynamic DOF of RCC frame structure.
- Q.4** (a) The fig. 3 shows the plan of 9 m height Industrial shed. Carry out lateral load distribution as per IS 1893 Part I 2002 if recorded acceleration at roof level is 0.9g. 07
- (b) You can change structural layout as per your choice to overcome the deficiency identified above. Reanalyze the problem & compare the result. 07
- OR**
- Q.4** (a) Explain failures of masonry structures observed in any recent earthquake & how will you improve performance of masonry building 07
- (b) 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 $50 \sin 55t$ 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 07
- Q.5** (a) A two storey single bay RC frame is supported by four corner columns. Building located in Dahod has lumped floor weights of 120 kN at every floor level. It has storey stiffness 70 kN/m at second floor level. Consider all joints as rigid joint & all support are hinged support. 07
- Perform free vibration analysis and
- (i) Determine all natural frequencies & sketch mode shape. Interpret the result of mode shape & identify the deficiency of the structure. What will you do to avoid deficiency identified?
 - (ii) Calculate natural frequency by approximate methods & compare with above results.
 - (iii) If construction of RC shear wall is permitted on ground storey, what should be the length of shear wall required to make storey stiffness of the all floor same? Take thickness of the wall = 300 mm, $f_{ck}=25$ MPa
- (b) Carry out response spectrum analysis for the structure defined in Q 5 (a) 07

OR

- Q.5** **(a)** Explain **07**
- Orthogonality property of normal modes
 - Missing mass correction
- (b)** Explain various methods of dynamic analysis. Explain Time History Analysis in detail. **07**
