Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. - SEMESTER – VI • EXAMINATION – WINTER 2012

Subject code: 160605 **Date: 07/01/2013**

Subject Name: Earthquake Engineering

Time: 02.30 pm - 05.00 pm **Total Marks: 70**

Instructions:

1. **Attempt any five questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Attempt any seven **07**

1. According to IS 1893 (Part 1) – 2002, India is divided into _____ Seismic zones.
2. The ground motion during a Richter magnitude 8 earthquake is _____ times larger than the ground motion during a Richter magnitude 6 earthquake.
3. How many seismograph stations are needed to locate the epicenter of an earthquake?
4. A soft storey is one in which the lateral stiffness is less than _____ percent of that in the storey above or less than _____ percent of the average lateral stiffness of the three storeys above.
5. A weak storey is one in which the storey lateral strength is less than _____ percent of that in the storey above.
6. According to IS 1893 (Part 1) – 2002, the ratio (I/R) shall not be greater than_____.
7. After the 2001 Bhuj (Gujarat) earthquake, the four-storey Bhuj Hospital building was built with Base Isolation using _____
8. For an earthquake of magnitude 8.0, the maximum intensity on MMI scale would be about _____.

(b) Attempt any seven **07**

1. According to MSK (64) scale of intensity, the total number of intensity classes (or grades) is _____.
2. When does the natural building period coincide with the earthquake period?
3. According to IS 13920 : 1993, for all buildings which are more than 3 storeys in height, the minimum grade of concrete shall preferably be _____
4. As per IS 13920 : 1993, the thickness of any part of the shear wall shall preferably, not be less than _____.
5. Which is thickest layer in the cross section of Earth?
6. Which are the fastest & the slowest waves?
7. The distance between focus & epicenter is known as _____.
8. Which is the most difficult structural element to retrofit?

Q.2 **(a)** Derive expression for the response of SDOF free damped structural system. **07**

(b) 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**

OR

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

Q.3 **(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) A SDOF vibrating system is having following parameters. **07**
m = 200 kg, k = 160 N/m, c = 40 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 50%.

OR

Q.3 **(a)** **State whether following statements are true or false & also justify your answer in short. Attempt any seven** **07**

1. Liquefaction is only possible in cohesive soil.
2. As per IS 1893 2002, Gujarat is divided in Zone III, IV & V only.
3. Ductile detailing is compulsory for RCC building located in Gujarat.
4. Design philosophy for gravity loads & design philosophy for lateral loads due to earthquake are same.
5. Performance of shear walls which are located near geometric centre of building is better than the identical shear wall located on periphery.
6. Non structural wall will fail before structural wall.
7. IS 13920-1993 has given special detailing for beam-column joint.
8. Concrete structures offer less damping as compared to steel structures.
9. Code specifies higher value of R for building having better performance.
10. Any structure is designed as earthquake proof structure.

(b) A simply supported beam of negligible mass spanning 6 m supports a machine of 50 kN at center with an unbalanced rotor applying a vertical force of 60 sin 5 t kN. The damping force is 0.3 kN-s/m & Flexural rigidity of beam is 25000 kN-m^2. Determine (i) maximum amplitude of vibration (ii) amplitude of vibration at resonance **07**

Q.4 **(a)** Calculate base shear **in the critical direction only** for BSNL office in Kohima with following data by seismic coefficient method. **07**

(a) No. of storey = 4
(b) No. of bay in x direction = 3
(c) No. of bay in y direction = 1
(d) storey height = 3 m
(e) Width of each bay = 5 m
(f) Total DL on roof = 12 kN/m^2
(g) Total DL on floor = 10 kN/m^2
(h) LL = 4 kN/m^2
(i) Thickness of slab = 120 mm

All columns having their longer side in X direction. Neglect weight of infill walls. Assume suitable data if required. Write all your assumptions & clauses of IS 1893 (2002). Building is provided with additional viscous dampers which will increase damping by 3%.

(b) Calculate lateral forces **in the critical direction only** at each floor level along with diagram of distribution of lateral force at each floor level. Refer data given in Q 4 (a). Also discuss (only) following **07**

- If the same building is located in Ahmedabad, is there any change in design lateral force?
- The functional purpose of the building is changed & now it is used as hospital, what will be the change in design lateral force?

OR

Q.4 **(a)** Analyze the two bay two storeys RC frame by any appropriate approximate method of analysis. Lateral force of 120 kN & 80 kN is acting at first & second floor **07**

respectively. Storey height = 3 m & bay width of each bay =.4 m. Draw axial force, shear force & bending moment diagram

Q.4 **(b)** Attempt following any two **07**

1. Enlist three latest great earthquake of the world after 2007. Name two inter plate & two intra plate earthquakes of India.
2. Define & explain liquefaction. Also give remedial measures for the liquefaction.
3. Explain four virtue of good earthquake resistant design.

Q.5 A three storey single bay RC frame is supported by four corner columns. Building is located in Surat has lumped floor weights of 180 kN & having storey stiffness 80 kN/m at every floor level. Perform free vibration analysis and determine all natural frequencies & sketch all mode shape. **14**

OR

Q.5 **(a)** Calculate the forces in four columns located in corner due to lateral load of 2000 kN acting in X direction for the single storey building acting at slab level.. All columns are identical square column. Use all provisions of IS 1893 – 2002 Part-I including torsion provision. **07**

(b) Attempt any two **07**

1. 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.
2. The dimension of the column is 600 mm x 600 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
3. Explain Base isolation technique in detail.

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