GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER II– EXAMINATION – WINTER - 2016

Subject Code: 2722010

Subject Name: Structural Dynamics and Earthquake Engineering

Time: 2:30 pm to 5:00 pm

Instructions:

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.
- 4. Use of IS $1893-2002 \ and IS \ 13920-1993$ is permitted
- Q.1 (a) State whether following statements are true or false and also justify your 06 answer in short.

(1) Energy released in an earthquake of magnitude 6, is double compared that released in magnitude 3 earthquake.

(2) Natural frequency of vibrating system will remain unchanged if damping level is increased.

(3) Over damped system comes to rest, faster than critically damped system.

(4) Moment resisting capacity of a column should be more than that of beam framing on it.

(5) A building is located on the boundary of zone III & IV will be designed for average values of Z for zone III and IV.

(6) Love wave in combination with Rayleigh wave are more damaging.

(**b**) Answer the followings:

08

(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) Give your comment (a) Importance factor depends on performance of the building, and (b) Base isolation is preferred in high rise building,(3) Capacity design concept,

- (4) Give four virtue of good earthquake resistant design.
- Q.2 (a) A platform having weight 18 kN is supported on four equal columns 07 which are fixed to the foundation as well as to the platform. The lateral stiffness of each column is 500 kN/m. Taking damping as 5 % of critical damping determine (i) Undamped natural frequency, (ii) Absolute damping coefficient, (iii) Logarithmic decrement, and (iv) the number of cycles and time required for the amplitude of motion to be reduced from an initial value of 0.3 cm to 0.03 cm.
 - (b) Derive expression for the response of SDOF free damped structural **07** system.

OR

- (b) A propped cantilever beam has span 4 m, with lumped mass 500 kg at 07 the centre and flexural rigidity 18 kN-m². If the beam is pulled down by 6 mm at the centre and then released, derive the equation of motion. Neglect the self weight of beam.
- Q.3 (a) A simply supported beam has a span of 8 m and flexural rigidity 22000 07 kN-m². A rotating pump of weight 15 kN is placed at the center of beam. The unbalanced mass 100 kg rotates at 1500 rpm at an eccentricity of

Date: 18/11/2016

Total Marks: 70

120 mm. The damping ratio of beam is 0.02. Derive the equation of steady state condition from the basic differential equation.

(b) Explain concept of ductile detailing and explain factor affecting the 07 ductility of structures in detail. Also explain ductile detailing of beamcolumn joint as per IS 13920 – 1993.

OR

- Answer the followings, 0.3 (a) 1. Explain short column effect. 2. A spring mass system with stiffness, k_1 , and mass, m_1 , has natural frequency f_1 . Calculate the value of stiffness of other spring which when connected to k_1 in parallel increases the frequency by 60%. **(b)** Explain the structural irregularities in Reinforced Concrete buildings. 07
- **O.4** Explain: (i) Modal mass participation, and (ii) Missing mass correction. 07 (a) **(b)** Briefly describe response spectrum and combined D-V-A spectrum. 07

OR

- Q.4 For a two storied single bay RC residential building located in seismic 14 zone IV and resting on firm soil, calculate design lateral forces, storey shear and storey drift using response spectrum method of analysis as per IS:1893-2002. The structural elements of the building will be detailed as per IS:13920-1993. The mass on each floor is 1800 kg and story stiffness is 220 kN/m for both storey. Height of each floor is 3.2 m and bay width 4m.
- Answer the followings: 0.5 (a)
 - 1. Explain Liquefaction.

2. Differentiate magnitude & intensity. Give expression for (i) Local magnitude, (ii) surface magnitude, (iii) Moment magnitude

(b) For a typical floor as shown in Fig. 1, carry out lateral force distribution 07 as per IS:1893-2002. All columns are of size 300 mm x 450 mm. Assume uniform mass distribution.

OR

- **Q.5** Answer the followings: (a)
 - 1. Give the concept of base isolation.
 - 2. Enlist structural controls and explain yielding dampers in detail.
 - (b) Explain failures of masonry structures observed in past earthquakes and 07 how will you improve performance of masonry building.



Figure 1

07

07

07