GUJARAT TECHNOLOGICAL UNIVERSITY PDDC SEMESTER V- EXAMINATION - SUMMER 2017

Subject Code: X50602 Date: 02/05/2017 **Subject Name: Earthquake Engineering** Time: 02.30PM to 05.00PM **Total Marks: 70** Instructions: 1. Attempt all questions. 2. Make suitable assumptions wherever necessary. 3. Figures to the right indicate full marks. 4. Permit use of IS-1893 and IS-13920 7 **Q.1** Α Differentiate between Gravity load distribution Vs lateral load distribution 1. 2. Magnitude & Intensity Surface waves and Body wave 3. Hypocenter and Epicenter 4. 5. Inter-plate Earthquake and Intra-plate Earthquake 6. Ductility Vs Flexibility Seismograph and seismogram 7. State whether following statements are true or false. If your answer is false, Q.1 B 7 write correct answer in short 1. Base isolation is preferred in high rise building India is divided into five seismic zones. 2. Over damped system comes to rest, faster than critically damped system. 3. 4. Energy released in an earthquake of magnitude 6, is double compared that released in magnitude 3 earthquake. 5. Masonry structures offers less damping as compared to steel structures Liquefaction is only possible in cohesive soil. 6. Love-waves are most damaging seismic waves. 7. Explain Earthquake Resistant Design Philosophy & Differentiate between Q.2 (a) 07 Earthquake Proof Design and Earthquake Resistant Design. **(b)** Write the equation of motion for undamped forced vibration and derive the 07 expressions for the displacement. OR (b) A water tank is idealized as a single degree of freedom having equivalent weight 07 of 10000kN, damping ratio as 4% and stiffness factor as 20000kN/m. Calculate (1) the natural time period, (2) the damped time period, (3) the damping constant and (4) the maximum horizontal displacement at the top of the water tank if it is loaded by a seismic force equivalent to 20*sin(5t) N. Q.3 Two separate pendulums are hanging on an ideal spring with equal mass. The 03 **(a)** 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? Explain Mathematical Modeling with appropriate example 04 **(b)** Calculate the forces in columns due to lateral load of 5000 kN acting once in X-07 (c) direction and then in Y- direction for the single storey building as shown in Fig. 1. Rectangular, Square & Circular columns are used and Area of these columns is equal. Size of Rectangular column is 450mm x 900 mm. Consider system is torsionally uncoupled. OR Q.3 Discuss in detail the advantage of horizontal bands and vertical reinforcement in 04 **(a)**

the masonry buildings.

- (b) For the RCC frame shown in the fig.2 carry out the response spectrum 10 analysis to find storey shears and design lateral forces. K=1000 kN/m Natural frequencies : $\omega 1 = 5.662$ rad/s , $\omega 2 = 21.632$ rad/s Mode shape coefficients corresponding to above frequencies : $\varphi_{11} = 1$, $\varphi_{12} = 0.893 \ \Phi_{21} = 1$, $\varphi_{22} = .56$
- Q.4 (a) Explain concept of ductile detailing & explain factor affecting the ductility of 04 structures.
 - (b) Enlist different approximate methods used for lateral load analysis. Analyse the frame shown in the Fig.3 using an appropriate approximate method and construct BM,SF and axial force diagrams. Give the assumptions made in the analysis. All columns are of same cross section 300 x 300 mm.

OR

- Q.4 (a) Enlist the different methods of structural control and explain any one in detail. 04
 - (b) Calculate base shear in the critical direction for six storey school building in Bhuj
 with following data by seismic coefficient method.

(a) No. of bay in x direction $= 4$	(b) No. of bay in y direction $= 4$
(c) Storey height = 3.0 m	(d) Width of each bay = 4 m
(e) Total DL on roof = 10 kN/m^2	(f) Total DL on floor = 15 kN/m^2
(g) $LL = 5 \text{ kN/m}^2$	(h) Thickness of slab = 150 mm
(h) Damping = 5%	

All columns having their longer side in X direction. Neglect weight of infill walls. Assume suitable data if required. Write all the clauses of IS 1893 (2002). What will be the base shear if Building is provided with additional yielding dampers which will increase damping by 4 %.

- Q.5 (a) Sketch the qualitative L/S of 6 m long RCC beam of special moment resisting 03 frame having cross section 300 mm wide 600 mm deep.
 - (b) What is the natural period of vibration of the second system with respect to first 04 if both systems are identical except support condition First system has hinge support & second system has fixed support.
 - (c) Explain in brief base isolation technique.

07

03

04

OR

- **Q.5** (a) Explain in brief soil liquefaction phenomenon.
 - (b) Explain ductile detailing of column as per IS 13920 1993.
 - (c) Explain failures of masonry structures observed in past earthquakes & how will you 07 improve performance of masonry building.

