Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER–V • EXAMINATION – SUMMER 2015

Subject Code: X50602 **Date:11/05/2015**
Subject Name: Earthquake Engg.
Time: 02:30 pm - 05:00 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 (Part 1), IS 13920 (1993), IS 4326 (1993), IS 13828 (1993) is permitted.**

Q.1 (a) Attempt following.(All) **07**

1. Explain in detail - Over damped system comes to rest, faster than critically damped system or underdamped system
2. Differentiate - Ductility Vs Flexibility
3. Differentiate - Gravity load distribution Vs lateral load distribution1. Enlist required condition for liquefaction.
4. Give four virtue of good earthquake resistant design.
5. Explain in detail - Moment resisting Capacity of a column should be more than that of beam framing on it.
6. Differentiate - Seismograph Vs Seismogram
7. Explain logarithmic decrement.

(b) State whether following statements are true or false with justification. (Any seven) **07**

1. Soft storey & weak storey are same.
2. Damping can be neglected in the dynamic analysis of buildings.
3. Design philosophy for gravity loads & design philosophy for lateral loads due to earthquake are same.
4. Surat situated in South of Gujarat near sea coast has highest seismic risk.
5. P & S waves are responsible for maximum damage to structures.
6. Natural frequency of vibrating system will remain unchanged if damping level is Increased.
7. Energy released in an earthquake of magnitude 8, is double compared that released in magnitude 4 earthquakes.
8. Generally shallow focus earthquakes are more destructive compared to deep focus earthquakes of same magnitude.

Q.2 (a) A SDOF system consists of 6 m high column of 300 mm diameter which supports the heavy mass of 15 Ton at its top. The system is subjected to a harmonic force of 1500 Sin 50t N. Consider 10% damping & $E = 2 \times 10^5$ N/mm^2. Calculate the maximum dynamic amplitude. Also state whether system will have resonance or not? **07**

	(b)	Determine the magnification factor of forced vibration produced by an oscillator fixed at the middle of the beam at a speed of 500 rpm. The weight concentrated at the middle of the beam is W is equal to 5500 N and produces a static deflection of beam equal to (δ_{st}) 0.040 cm. Neglect the weight of beam and assume that the damping co efficient is equal to 20 N-S/m.	**07**
		OR	
	(b)	A mass initially at rest is allowed to displaced through 25 mm and released to vibrate. Determine undamped and damped natural frequencies. Natural period and amplitude after 5 cycles. And Nos. Of cycles when amplitude reaches to 1 mm. Assume damping constant is equal to 10 N s/mm. (Figure.1)	**07**
Q.3	**(a)**	Calculate base shear in the critical direction only for building located in Ahmedabad with following data by static coefficient method. Assume damping by 10 percent. (a) No. of storey = 6 (b) No. of bay in x direction = 2 (c) No. of bay in y direction = 3 (d) storey height = 4.0 m (e) Width of each bay = 4 m (f) Size of beam = 300 x 400 mm (g) size of column = 300 x 600 m (h) LL = 4 kN/m^2 (i) Thickness of slab = 160 mm Assume suitable data if required. Write all your assumptions & clauses of IS 1893 (2002).	**07**
	(b)	Ref Q 3 (a) Calculate lateral forces in the critical direction only at each floor Level. Also draw distribution of lateral force at each floor level.	**07**
		OR	
Q.3	**(a)**	**Attempt All** 1. Enlist various codes of practice along with correct name related to Earthquake engineering. 2. Give very short answers for the following : (i) Explain Shear Walls & its significance (ii) Enlist component of seismograph (iii) Can I make building earthquake proof?	**07**
	(b)	1. Two pendulums are hanging on an ideal spring with equal mass. The period of vibration for the pendulums is 4 sec & 12 sec respectively. What is the stiffness of the second pendulum with respect to first? 2. A SDOF system having the amplitude of vibration in successive cycle are 0.70, 0.35, 0.18, 0.09 units respectively. Determine damping ratio of the System. Also determine logarithmic decrement.	**07**
Q.4	**(a)**	Derive expression for the response of free damped SDOF structural system.	**07**
	(b)	Explain ductile detailing of column as per IS 13920 – 1993	**07**
		OR	
Q.4	**(a)**	Explain mathematical modeling in detail. Draw mathematical model for any Three structural systems.	**07**
	(b)	Explain in detail with suitable sketches., a) Pounding b) Storey Drift c) Floating Column.	**07**
Q.5	**(a)**	Explain in details a.) Center of mass b.)Center of Stiffness	**07**
	(b)	The figure as shown in plan of 6 m high hospital parking shed. Carry out lateral load distribution as per IS 1893(I)-2002. If recorded acceleration at roof level is 0.20 m/s^2. (Figure.2)	**07**
		OR	

Q.5 **(a)** Discuss the preventive measures against liquefaction of soil. **07**

(b) For the two storey building frame having lumped masses 10 tonne at floor level having storey stiffness 100 kN/m. Perform free vibration analysis & draw all mode shapes. Calculate natural frequency. **07**

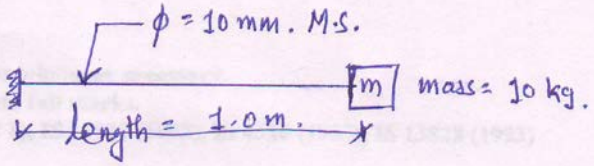

Figure. 1 [Q. 2 (B) optional].

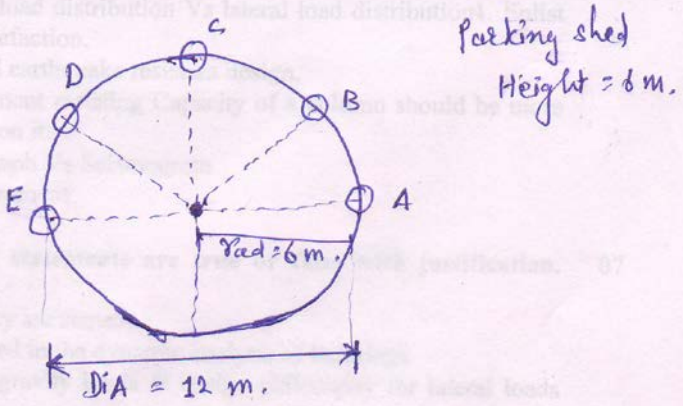

Figure. 2 [Q. 5 (B)]