Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER–V • EXAMINATION – WINTER 2013

Subject Code: X 50602 **Date: 06-12-2013**

Subject Name: Earthquake Engineering

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 (Part 1), IS 13920 (1993), IS 4326 (1993), IS 13828 (1993) is permitted**

Q.1	**(a)**	Derive the equation of motion for the free damped single degree of freedom system using D-Alembert principle.	**07**
	(b)	Derive Equation for a torsional vibration for single degree of freedom for a vertical shaft, assume suitable data.	**07**
Q.2	**(a)**	Derive equation of motion for forced vibration of single degree of freedom system. Also mention resonant frequency, resonant frequency ratio and deformation response factor.	**07**
	(b)	A vertical cantilever beam of m.s. section is 3 m long and kept as shown in figure. This supports 5.5 kg weight And system has harmonic excitation of 1.0 kN amplitude and 5 Hz frequency. Assume Damping as 5% of critical. The M.S. section has 200 mm dia. And having wall thickness of 6 mm. Calculate maximum steady state displacement and bending stress in m.s. section.	**07**
		OR	
	(b)	A Spring mass model consists of 6 kg mass and spring with stiffness of 4.5 N/mm., was selected for viscous damped vibration. Two successive amplitudes are recorded as 1.6 & 1.35. Calculate 1. Logarithmic decrement 2. Natural frequency of undamped system 3. Damping ratio 4. Damping Coefficient and Damped natural Period.	**07**
Q.3	**(a.1)**	Explain Base Isolation technique. Comment whether it is active or passive type?	**07**
	(a.2)	Enlist various codes of practice along with correct name related to earthquake engineering.	
	(b.1)	Two pendulums are hanging on an ideal spring with equal mass. The period Of vibration for the pendulums is 4 sec & 10 sec respectively. What is the Stiffness of the second pendulum with respect to first?	**07**
	(b.2)	A SDOF system having the amplitude of vibration in successive cycle are 0.75, 0.40, 0.20, 0.10 units respectively. Determine damping ratio of the system.	
		OR	

Q.3 **(a)** Calculate base shear in the critical direction only for building in Vadodara with following data by static coefficient method. Assume suitable data if required. Write all your assumptions & clauses of IS1893 (2002). **07**

(a) No. of storey = 5 (b) No. of bay in x direction = 3
(c) No. of bay in y direction = 2 (d) storey height = 4.0 m
(e) Width of each bay = 4 m (f) Size of beam = 300 x 450 mm
(g) size of column = 300 x 600 m (h) LL = 5 kN/m^2
(i) Thickness of slab = 150 mm

(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**

Q.4 **(a)** State whether following statements are true or false. Give logical reason for your answer : (any Seven) **07**

1. Iso seismal & Meizo Seismal are same.
2. Code specifies lower value of R for building having better performance.
3. Concrete structures offer more damping as compared to steel structures.
4. Mumbai is located on sea coast, So it's having maximum earthquake risk.
5. Two identical building to be constructed in zone IV & V. Building in Zone V should be designed for lower lateral load than building in zone IV.
6. Masonry structures offers less damping as compared to steel structures.
7. Peak ground acceleration (PGA) & Zero period acceleration (ZPA) are same.
8. Performance of shear walls which are located near geometric centre of bldg. is good?

(b) Analyze the 3 bay two storey RC frame by any appropriate approximate method **07**
of analysis if 300 kN & 250 kN forces are acting at first & ground storey. Draw axial force, shear force & bending moment diagram.

OR

Q.4 **(a)** Explain following (Any three) **07**
(i) Explain in detail – Response Spectrum Method.
(ii) Plate tectonics
(iii) Seismic waves
(iv) Explain MCE & DBE with its importance.

(b) It was decided to retrofit ground storey such that soft story effect can be removed. Calculate the size & stiffness of shear wall need to be added at ground Storey. Draw mode shape & interpret the result. Give your valuable comment about the result. **07**

Q.5 **(a)** Discuss in detail the concepts of the ductile detailing in Beams. **07**

(b) Discuss the capacity design concept in ductile detailing. **07**

OR

Q.5 (a) Attempt following 07

1. Explain liquefaction with adequate mathematical expression of shear strength.
2. Give four virtue of good earthquake resistant design.
3. Differentiate - Soft storey & weak storey
4. Differentiate - Ductility Vs Flexibility
5. Differentiate - Gravity load distribution Vs lateral load distribution
6. What is PGA? Explain its importance.
7. Differentiate - Seismograph Vs Seismogram

(b) Attempt following any three 07

1. Explain mathematical modeling with two examples of SDOF & MDOF.
2. Explain the deficiencies of Fukushima Nuclear Site building (reactor) exposed in recent Japan earthquake.
3. Define & explain liquefaction along with remedial measures.
4. Enlist three latest great earthquake of the world after 2009. Name two Inter plate & two intra plate earthquakes of India.

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