

GUJARAT TECHNOLOGICAL UNIVERSITY
PDDC - SEMESTER – V • EXAMINATION – WINTER 2012

Subject code: X 50602**Date: 17/01/2013****Subject Name: Earthquake Engineering****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. IS 1893 2002 Part I & IS 13920 1993 codes are allowed

- Q.1 (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**
- Q.2 (a)** Explain mathematical modeling in detail. Draw mathematical model for any three structural system. **07**
- (b)** A two bay single storey RCC plane frame in which lumped mass of 15 tonne is supported on three columns (AB, CD & EF) having fixed support. **07**
- $L_{AB} = 0.5 L_{CD} = 0.25 L_{EF} = 10 \text{ m}$
- Calculate BM & SF at support for the RCC frame after five cycles of vibration if floor is displaced horizontally by 100mm & suddenly released. Assume rigid diaphragm action. Take $f_{ck} = 25 \text{ MPa}$ & size of column 500 mm x 500 mm. Assume suitable damping. **OR**
- (b)** A SDOF system consists of 6 m high column of 400 mm diameter which supports the heavy mass of 15000 kg at its top. The system is subjected to a harmonic force of $1500 \sin 50t \text{ N}$. Consider 10% damping & $E = 2 \times 10^5 \text{ N/mm}^2$. Calculate the maximum dynamic amplitude. Also state whether system will have resonance or not?
- Q.3 (a)** Calculate base shear **in the critical direction only** for building in Bhubaneswar with following data by static coefficient method. **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 mm (h) LL = 5 kN/m^2
- (i) Thickness of slab = 150 mm
- Assume suitable data if required. Write all your assumptions & clauses of IS 1893 (2002).
- (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 any two **07**
1. Explain liquefaction and give remedial measures for it.
 2. Explain Base Isolation technique.
 3. Enlist various codes of practice along with correct name related to earthquake engineering.
 4. Give very short answers for the following :
 - (i) Name inter plate interaction
 - (ii) Enlist component of seismograph
 - (iii) Can my building withstand a magnitude 10 earthquake?
- (b)** 1. Two pendulums are hanging on an ideal spring with equal mass. The period of vibration for the pendulums is 3 sec & 9 sec respectively. What is the **07**

- 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.

Q.4 (a) Explain following (Any three) 07

- (i) Philosophy of Earthquake resistant design.
- (ii) Plate tectonics
- (iii) Seismic waves
- (iv) Enlist two major/great Indian intra-plate & two interpolate earthquake with usual details.
- (v) Elastic rebound theory

(b) Attempt following 07

1. Explain the deficiencies of building exposed in any recent earthquake after 2009. Also write remedial measures of each deficiency.
2. Explain earthquake resistant feature of masonry structure.
3. Differentiate :
 - (a) Epicentre & hypocentre
 - (b) Earthquake proof structure Vs earthquake resistant structure.
 - (c) Soft storey & weak storey

OR

Q.4 (a) Analyze the 3 bay two storey RC frame by any appropriate approximate method of analysis if 400 kN & 200 kN forces are acting at first & ground storey. Draw axial force, shear force & bending moment diagram. 07

Q.4 (b) A single storey RC building having plan (SDOF) dimension 24 m x 12 m & height of 10 m. Carry out lateral load distribution as per IS 1893 Part I 2002 if 2000 kN force is acting at floor level. Size of columns are 600 mm x 600 mm 07

Q.5 (a) State whether following statements are true or false. Give logical reason for your answer : 07

1. Iso seismal & Meizo Seismal are same.
2. Liquefaction is only possible in clayey soil.
3. Code specifies lower value of R for building having better performance.
4. Any structure is designed as earthquake proof structure.
5. Concrete structures offer more damping as compared to steel structures.
6. Dahod is having maximum earthquake risk.
7. 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.

(b) A SDOF vibrating system is having following parameters. 07

$m = 50 \text{ kg}$, $k = 180 \text{ N/m}$, $c = 35 \text{ N – sec / m}$. 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 80%.

OR

Q.5 (a) For the two storey building frame having lumped masses 10 tonne at floor level having storey stiffness 120 kN/m. Perform free vibration analysis & draw all mode shapes. 07

(b) Ref Q 5(a) OR 07

- (a) Calculate natural frequency by approximate method.
- (b) It was decided to retrofit ground storey & stiffness of ground storey increased by 50% due to retrofitting. Draw mode shape & interpret the result. Give your valuable comment about the result.
