

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER-V • EXAMINATION – SUMMER 2013

Subject Code: X50602

Date: 14-05-2013

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 Part 1 2002 & IS 13920 – 1993 are allowed in the examinations

Q.1 (a) Derive expression for the response of forced damped SDOF structural system. **07**

(b) Explain ductile detailing of beam as per IS 13920 – 1993 **07**

Q.2 (a) Differentiate Static DOF & Dynamic DOF. **07**

Explain assumptions to reduce dynamic DOF of multi-storey building.

(b) A single storey building frame is having slab supported on four columns at corners fixed at support. Following data are given **07**

Dimensions of slab = 4m x 6m

Thickness of slab = 100 mm

Storey height = 5 m

Damping = 5% of critical damping

Size of column = 300mm x 300mm

Grade of concrete = M 25

Determine (i) Natural frequency of damped vibration (ii) Peak displacement of first five cycle of vibration Also draw amplitude envelop for five cycle of vibration if the floor is displaced horizontally by 100mm & suddenly released.

OR

(b) Explain steady state & transient component of vibration. Explain the phenomenon of resonance.

A simply supported beam of negligible mass spanning 10 m supports a machine of 40 kN at center with an unbalanced rotor applying a vertical force of $40 \sin 55t$ kN. The damping force is 0.4 kN-s/m & Flexural rigidity of beam is 20000 kN-m². Determine (i) Amplitude of vibration after 10 secs (ii) amplitude of vibration at resonance

Q.3 (a) Calculate base shear for building of Tata Motors in Sanad with following data **07**
by static coefficient method.

(a) No. of storey = 4

(b) No. of bay in x direction = 3

(c) No. of bay in y direction = 3

(d) storey height = 5.0 m

(e) Width of each bay = 4 m

(f) Size of beam = 300 x 450 mm

(g) size of column = 300 x 300 mm

(h) LL = 3 kN/m²

(i) Thickness of slab = 100 mm

Assume suitable data if required. Write all your assumptions & clauses of IS 1893 (2002).

(b) Ref Q 3 (a) Calculate lateral forces 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 mathematical modeling in detail. Draw mathematical model for any three structural system.

2. Explain liquefaction and give remedial measures for it.
- (b)
1. Two pendulums are hanging on an ideal spring. The frequency of first pendulum is twice the frequency of second pendulum & the mass of first pendulum is four times the mass of second pendulum. What is the stiffness of the second pendulum with respect to first? 07
 2. A spring mass (k_1, m_1) system has a natural frequency f_1 . Calculate the value of stiffness of other spring which when connected to k_1 in series decreases the frequency by 50%.

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

- (i) Philosophy of Earthquake resistant design.
- (ii) Enlist various codes of practice along with correct name related to earthquake engineering.
- (iii) Differentiate (i) Magnitude & Intensity (ii) Iso-seismal & Meizo-seismal (ii) Seismograph Vs Seismogram (iv) S wave & P wave
- (iv) Elastic rebound theory

(b) Attempt following (Any three) 07

1. Explain the deficiencies of building exposed in any recent earthquake after 2011. Also write remedial measures of each deficiency.
2. Enlist two major/great Indian intra-plate & two interpolate earthquake with usual details.
3. Explain earthquake resistant feature of masonry structure.
4. Differentiate :
 - (a) Epicentre & hypocentre
 - (b) Earthquake proof structure Vs earthquake resistant structure.
 - (c) Soft storey & weak storey

OR

Q.4 (a) Analyze the 2 bay two storey RC frame by any appropriate approximate method of analysis if 1000 kN & 500 kN forces are acting at first & ground storey. Draw axial force, shear force & bending moment diagram. 07

Q.4 (b) A 8 m high petrol pump is a single storey RC building having plan (SDOF) dimension 30 m x 15 m. Carry out lateral load distribution as per IS 1893 Part I 2002 if 5000 kN force is acting at floor level. Size of columns are 300 mm x 300 mm 07

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

1. Masonry structures offers less damping as compared to steel structures.
2. Code specifies lower value of R for building having better performance.
3. Any structure is designed as earthquake proof structure.
4. Peak ground acceleration (PGA) & Zero period acceleration (ZPA) are same.
5. Two identical building to be constructed in zone IV & V. Building in zone IV should be designed for higher lateral load than building in zone V.
6. A building is located in the boundary of zone III & IV. It will be designed as if it is in zone III.
7. Performance of shear walls which are located near geometric centre of

building is better than the identical shear wall located on periphery.

- (b) A mass of 2000 kg under SDOF with viscous damping of 40% has spring constant 6 MN/m. Calculate undamped & damped natural frequencies. Also calculate peak displacement of first two cycles provided initial displacement was 100mm & suddenly released. **07**

OR

- Q.5** (a) For the two storey building frame having lumped masses 20 tonne at floor level having storey stiffness 60 kN/m. Perform free vibration analysis & draw all mode shapes. **07**
- (b) **Ref Q 5(a) OR** **07**
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.