

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-I Examination January 2010

Subject code: 711502

Subject Name: Structural Dynamics and Earthquake Engineering

Date: 22 /01 /2010

Time: 12.00 – 2.30 pm

Total Marks: 60

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) , SP-16 are permitted

Q-1 For the two storey residential building frame having lumped masses 10 tone at each floor level and having storey stiffness 100 kN/m with rigid diaphragm, **12**

(i) Draw mode shapes

(ii) Carry out response spectrum analysis to find out design horizontal lateral forces

Take column heights = 4.0 m, Bay width = 6.0 m. seismic zone - III

Q-2 (a) Give your suggestion/s, measures to be taken for the following structural engineering problems **06**

(i) A building is to be constructed at the location where soil is liquefiable

(ii) A five storied RCC framed building is to be constructed with open ground storey

(iii) An existing weak RCC framed structure is to be improved for seismic resistance

(b) Vibrating weights shown in the **Fig.1** is pulled down and releases to vibrate freely. Find out time taken by it to slow down to a level 100th of its initial displacement. **06**

OR

(b) Enlist different magnitude scales used to find out earthquake magnitude. Give suitability and limitation/s for each scale. **06**

Q-3 (a) Derive the response of damped free vibration of SDOF system **06**

(b) A machine assembly weighing 50 kN is fitted on the top of steel tube column as shown in the **Fig.2**. The assembly is subjected to dynamic force which is expressed as $F=1000\sin 1.5t$ N. Find static and steady state displacement. The column is of 400 mm external dia. and 10 mm thick wall. Critical damping is 4 % **06**

OR

Q-3 (a) What is time history analysis? Give the steps of analysis. **04**

(b) For the rigid floor shown in the **Fig.3**, find design lateral forces for the columns as per IS 1893 provisions if design lateral force acting on floor is 100 kN along X direction. All columns are of same height and size 300x900 mm. Mass is uniformly distributed on the floor. **08**

Q-4 Fig.4. shows a plane frame which is part of a special moment resisting RC building frame. The critical moments at critical locations are shown on tension faces along with corresponding provided main reinforcement. Perform following checks/design as per relevant IS standards. The beam is subjected to UDL 25 kN/m (working) and column is subjected to critical axial force 320 kN **12**

- (i) Check the adequacy of the provided reinforcement as per IS -13920 provisions in the beam BC
- (ii) Check the adequacy of main reinforcement in column AB so that column is not to develop hinge prior to beam. Design shear reinforcement for the same
- (iii) Furnish detailing of reinforcement for the above beam and column

OR

Q-4 An elevated square water tank to be constructed in seismic zone V has following data. Find the factor of safety against overturning for tank full condition. You may refer graph no.1 to obtain required dynamic parameters. **12**

- Clear plan dimension of the container : 4.5 m x 4.5 m
 - Staging height 13 m from GL to dead storage level with 4 level of bracing.
 - Water height: 3.30 m including 0.3 m free board.
 - Wall thickness : 200 mm
 - Top slab thickness : 150 mm
 - Bottom slab thickness : 200 mm
 - Base slab beams size : 230 mm x 450 mm (web)
 - Column size : 400 mm x 400 mm
 - Bracing beam size : 230 mm x 450 mm
 - Footing base depth from GL: 2.0 m.
 - Soil strata : soft
 - Footing raft size: 6.5 m x 6.5 m with 600 mm uniform depth.
- Staging lateral stiffness : 1750 kN/m

Q-5 (a) Show earthquake resistance features in a ordinary brick masonry building through sketch/s and label/s. **06**

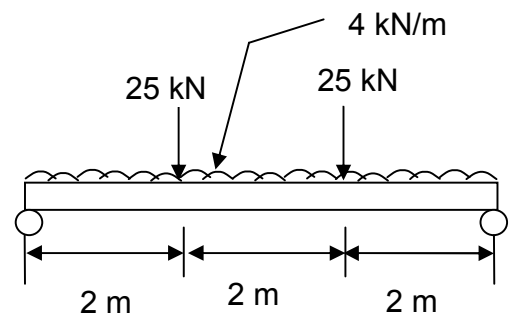
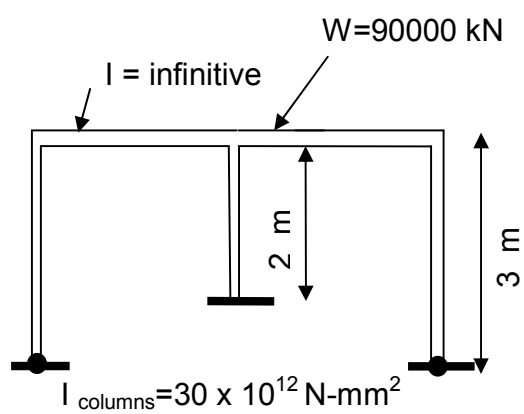
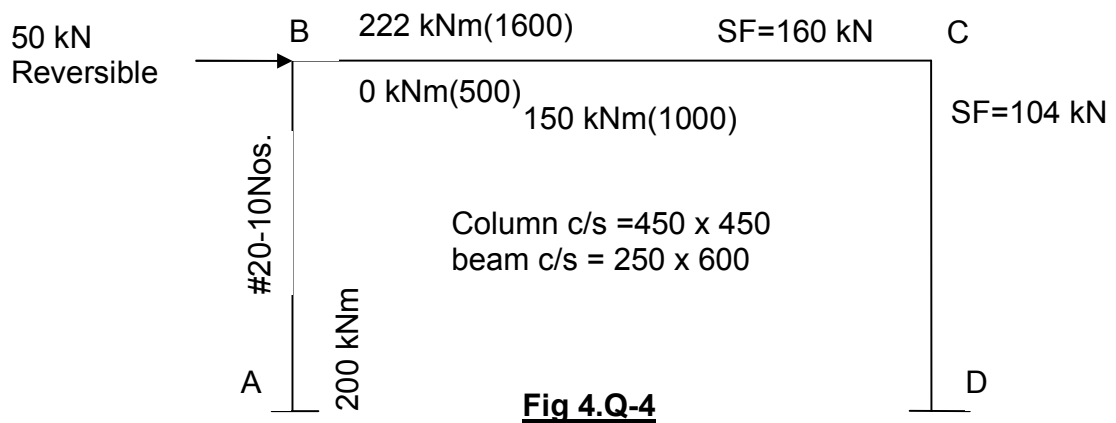
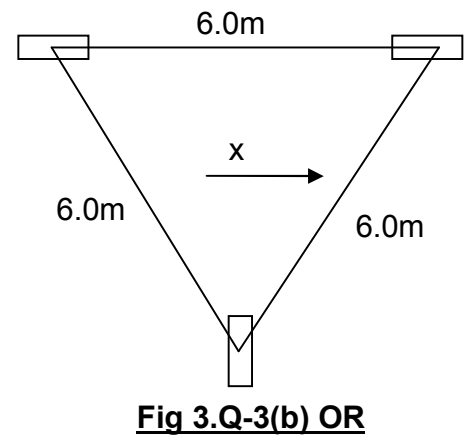
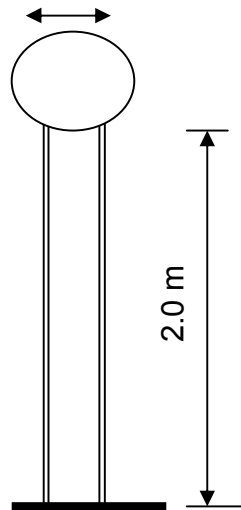
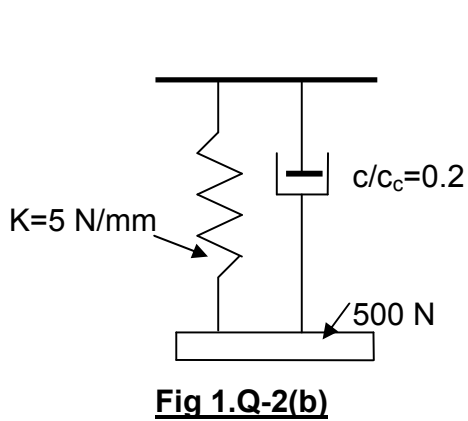
(b) Do as directed. **06**

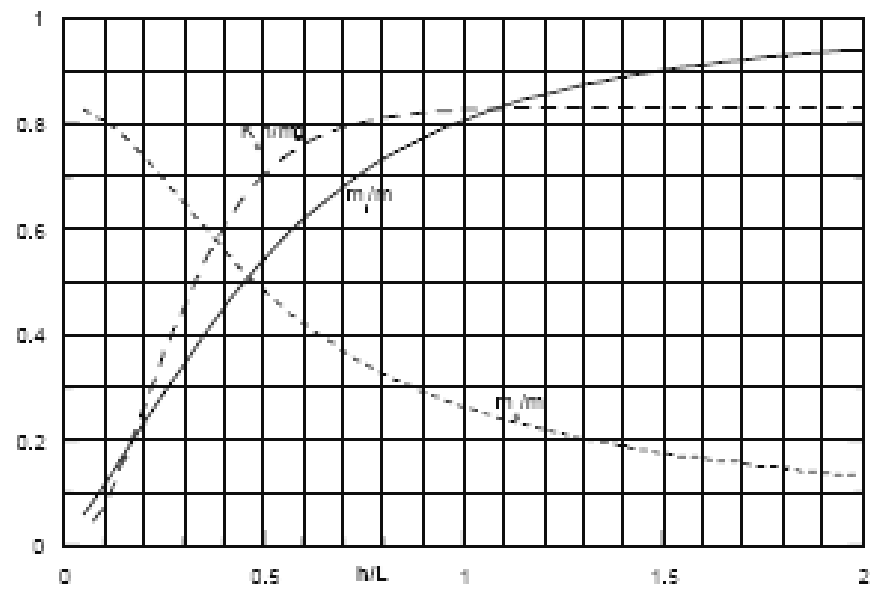
- (i) Calculate A_h value for a structure having natural period 0.08 s corresponding to fundamental mode. The structure is to be constructed in zone IV. Soil strata is medium. Importance factor is 1.5 and response reduction factor is 3.
- (ii) Give total number of load combinations required as per IS 1893 for a
 - Regular Building to include horizontal shaking effect only
 - Irregular Building to include three directional shaking effect
- (iii) What is structural control? Classify the structural controls giving suitable examples.

OR

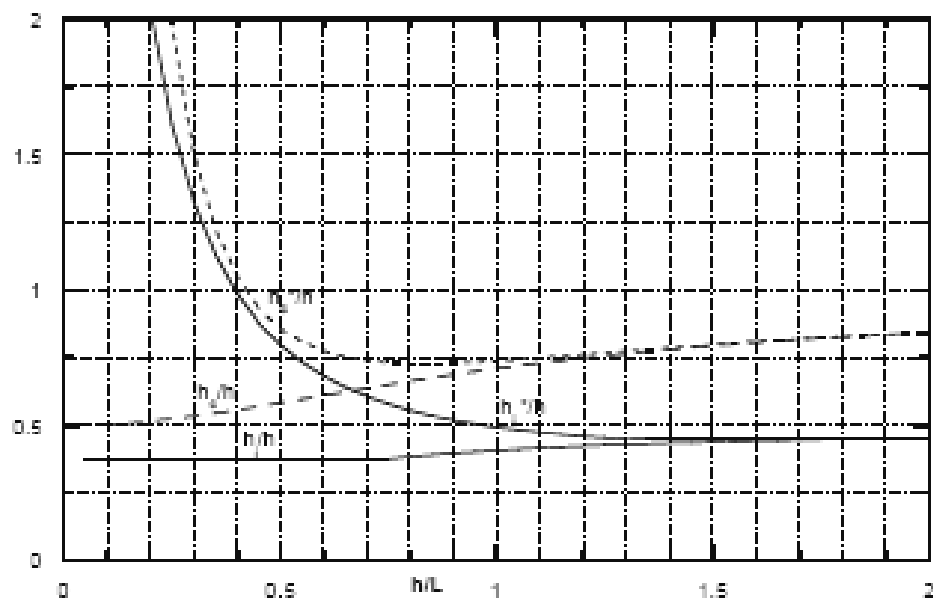
Q-5 (a) For a building frame shown in the Fig.5, find the period corresponding to free horizontal vibration. Find the amplitude and displacement after 1 second if initial velocity and initial displacements are 20 mm/s² and 20 mm/s . **06**

(b) Using Dunkerly's method, determine the frequency for the beam shown in Fig.6. Take $E = 2 \times 10^5 \text{ N/mm}^2$, $I = 2250 \text{ cm}^4$. **06**





(a) Impulsive and convective mass and convective spring stiffness



(b) Heights of Impulsive and convective masses

Graph no.1