Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. Sem-VI Examination May- 2011

Subject Code: 160605

Subject Name: Earthquake Engineering

Date: 23/05/2011 **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:1853 , 875 part II and 13920 is permitted**

Q.1 (a) Evaluate any seven of the following statements as true/false giving justification/reason. **07**

(i) Energy released in an earthquake of magnitude 6,is double compared that released in magnitude 3 earthquake.

(ii) Intensity scale X is the highest intensity scale.

(iii) Generally shallow focus earthquakes are more destructive compared to deep focus earthquakes of same magnitude.

(iv) Natural frequency of vibrating system will remain unchanged if damping level is increased.

(v) During Liquefaction, underground lighter objects are raising up.

(vi) Over damped system comes to rest, faster than critically damped system.

(vii) Moment resisting Capacity of a column should be more than that of beam framing on it.

(viii) Ductility of RCC column increases by providing sufficient confining reinforcement

(ix) Love-waves are most damaging seismic waves.

(x) Damping can be neglected in the dynamic analysis of buildings.

(b) Attempt any two of the following **07**

(i) What is jacketing? Explain the jacketing of beams and column with illustrative sketches.

(ii) Earthquake resisting features of unreinforced brick masonry structure.

(iii) Explain plate tectonics

Q.2 (a) Write the motion equation for free damped vibration and derive the expressions for the displacement. **07**

(b) Find the natural frequency of the system shown in the fig.1. **07**

OR

(b) Derive the expression for the dynamic load factor for the forced damped vibration with usual notations. **07**

Q.3 For a RCC framed office building, find the design lateral forces and its distribution along the height, using static co-efficient method. Consider following data. **14**

(i) Location : Gandhidham

(ii) Soil condition : Medium soil

(iii) Plan dimensions : 5 bays of 6 m each along X direction and 6 bays of 5 m each along Y direction

(iv) Elevation : 6 storey including Ground storey , each with 3.5 m floor height

(v) Columns : 400 x 400 mm all

(vi) Beams : 300 x 500 mm

(vii) Slab : 150 mm thick RCC

(viii) Walls : outer 230 mm brick masonry, inner 150 mm brick masonry

(ix) Parapet walls : 230 mm thick 1 m ht.brick masonry.

What change in the lateral forces will occur, if this building is to be constructed using Steel frame?

OR

Q.3 For the RCC frame shown in the fig.2 carry out the response spectrum analysis to find storey shears and design lateral forces. K=1000 kN/m **14**
Natural frequencies : $\omega_1 = 5.662$ rad/s , $\omega_2 = 21.632$ rad/s
Mode shape coefficients corresponding to above frequencies : $\varphi_{11} = 1$, $\varphi_{12} = 0.893$
$\Phi_{21} = 1$, $\varphi_{22} = -0.560$

Q.4 (a) Find the natural frequency and natural period for the building frame shown in the fig.3. During test the frame is given 50 mm initial lateral displacement and released from the rest to vibrate freely. Find the displacement after 5 seconds and number of cycles when amplitude reduced to 1/10 of maximum. Consider 10% damping. Take $EI_{column} = 1.5 \times 10^{12}$ Nmm, $EI_{beam} = \infty$. **07**

(b) Do as directed : (i) Explain philosophy of earthquake resistant design (ii) Give suggestions for good earthquake resistant design of a high-rise building. **07**

OR

Q.4 What is mode shape? Plot the mode shapes for the frame shown in the fig.4. and indicate the fundamental mode. Take $EI_{column} = 1.5 \times 10^{12}$ Nmm, $EI_{beam} = \infty$. **14**

Q.5 (a) Enlist different approximate methods used for lateral load analysis. Analyse the frame shown in the fig.5 using an appropriate approximate method and construct BM,SF and axial force diagrams. Give the assumptions made in the analysis. All columns are of same cross section 300 x 300 mm . **07**

(b) Enlist the different methods of structural control and explain any one in detail **07**

OR

Q.5 (a) Find the lateral loads in the columns of a rigid floor shown in the fig.6.All columns are of same height and mass is uniformly distributed. **07**

(b) Do as directed : (i) Sketch the reinforcement details for c/s of RCC column 400 x 400 mm , having 8 nos. 20 mm dia. main bars as ductile requirement (ii) Sketch the qualitative L/S of 6 m long RCC beam of special moment resisting frame having cross section 300 mm wide 600 mm deep. **07**

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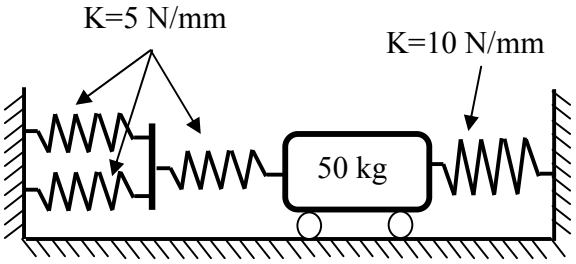

Fig.1 Q-2(b)

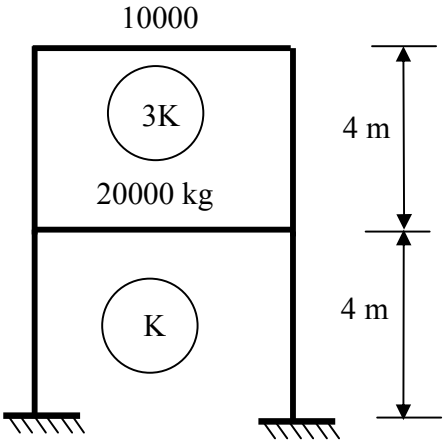

Fig.2 Q-3 OR

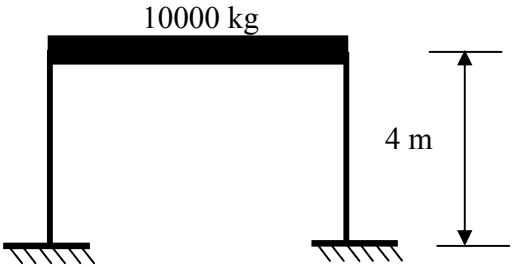

Fig.3 Q-4(a)

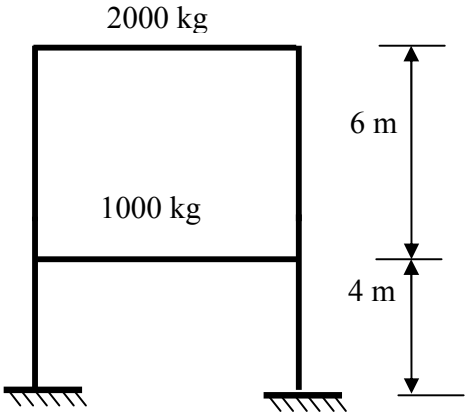

Fig.4 Q-4 OR

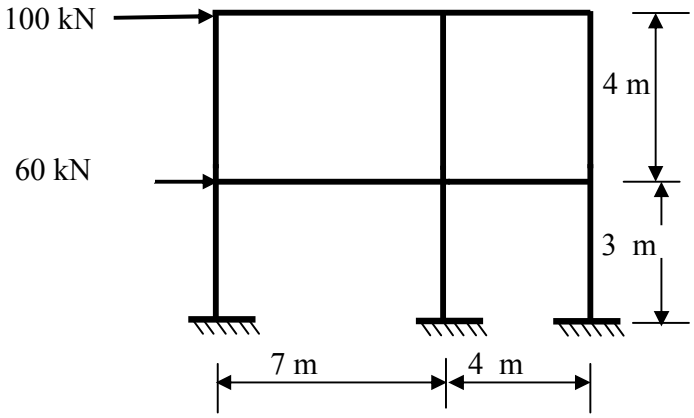

Fig.5 -Q-5(a)

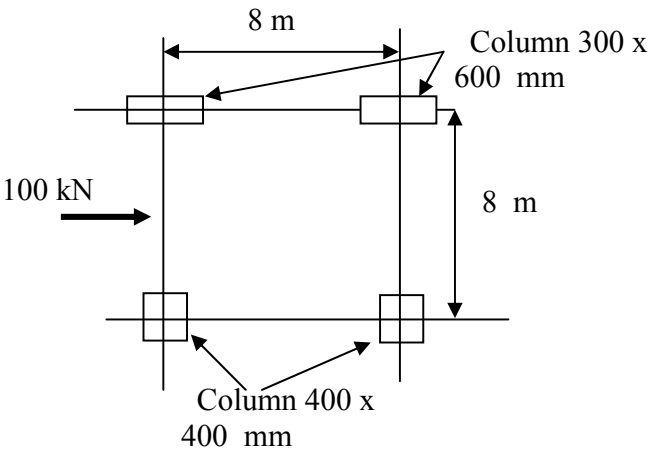

Fig.6 Q-5 (a) OR