Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE SEM-VI Examination-Nov/Dec-2011

Subject code: 160605   **Date: 30/11/2011**
Subject Name: Earthquake Engineering
Time: 10.30 am -1.00 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)** Calculate the base shear for a five storey hospital building having special **07** moment resisting frame (SMRF) located in Ahmedabad on medium soil with following data using seismic coefficient method.
 (i)   No. of bay in *x* and *y*-direction = 4
 (ii)   Width of each bay = 5m
 (iii)   Thickness of slab =150 mm
 (iv)   Storey height = 3 m
 (v)   Size of beam and column = 300 mm x 450 mm
 (vi)   Amount of damping = 10 % of critical damping
 (vii)   Live load = 4 kN/m^2
Assume any additional data if required and neglect the weight of the infill wall panels.

(b) Calculate the lateral forces at each floor level of hospital building of Q.1 (a) **07** using seismic coefficient method.

Q.2 **(a)** Define (i) isoseismal (ii) soft storey (iii) epicenter (iv) magnitude (v) **07** resonance (vi) seismogram (vii) Intensity

(b) A spring mass model consists of 6 kg mass and spring of stiffness 3 N/mm **07** was tested for viscous damped vibration. The test recorded two consecutive amplitude is 1.5 cm and 1.2 cm respectively. Determine (i) natural frequency of undamped system (ii) logarithmatic decrement (iii) damping ratio (iv) damping coefficient (v) damped natural frequency of system.

OR

(b) Derive the equation of motion for the free damped single degree of freedom **07** system.
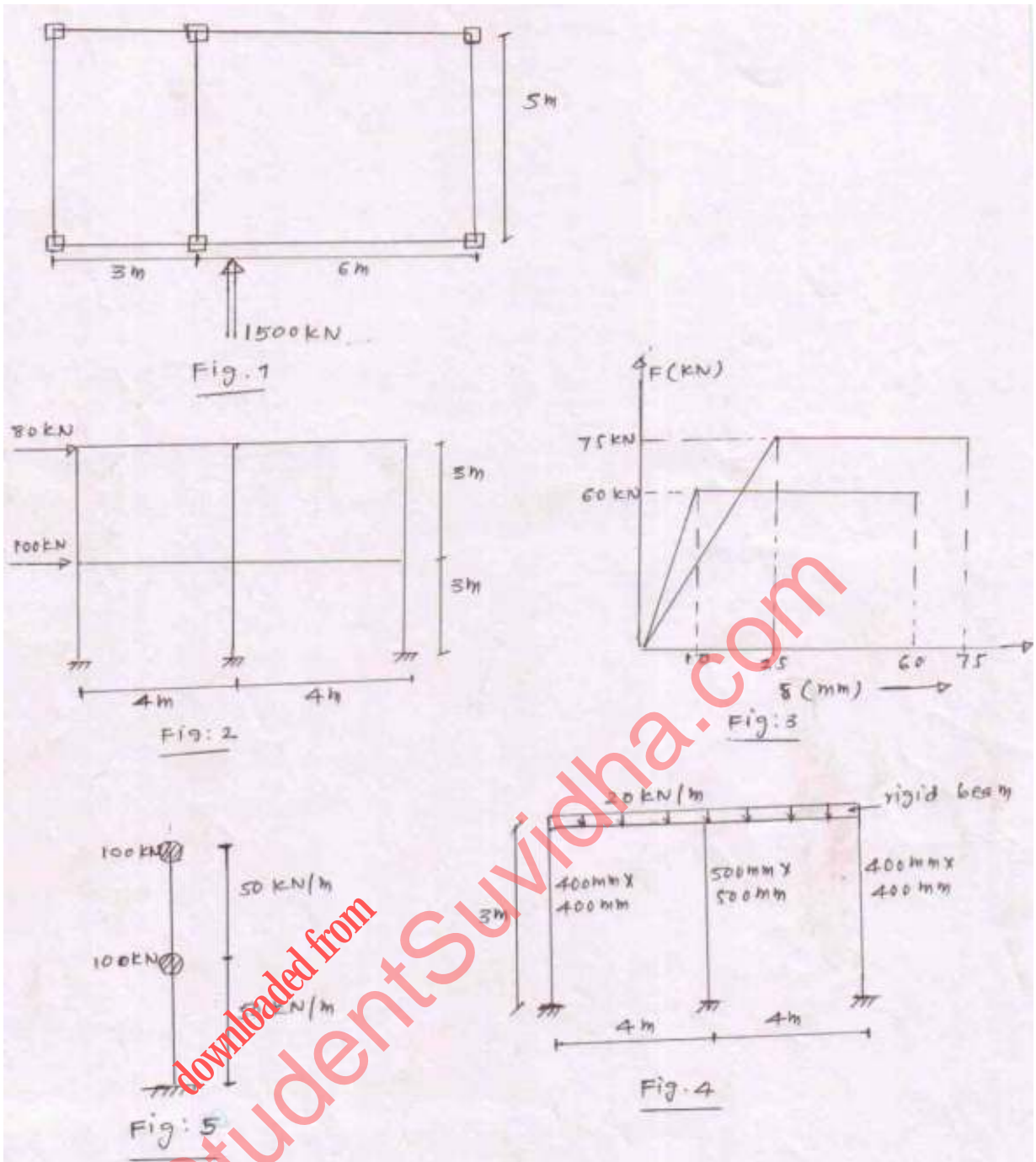
Q.3 **(a)** Calculate the torsion moment developed on a typical floor level due to **07** lateral load of 1500 kN as shown in Fig. 1 according to IS1893-2002. All the columns are of 300 mm × 300 mm. Assume uniform mass distribution.

(b) Calculate the additional lateral forces in columns of typical floor level of **07** Fig. 1 due to torsional moment.

OR

Q.3 **(a)** Analyse the RC frame shown in Fig. 2 by any approximate method of **07** analysis and draw the bending moment diagram only. Take c/s area of all the columns as constant.

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(b) A SDOF system consists of 5 m high column of 600 mm diameter which supports the heavy mass of 10500 kg at its top. The system is subjected to a harmonic force of $1800\sin 50t$ N. Consider 20% damping and $E = 2 \times 10^5$. Calculate the maximum dynamic amplitude and also state whether the system will have resonance or not? **07**

Q.4 **(a)** If a column of size 350 mm × 550 mm is having the longitudinal reinforcement of 1.75 % of the gross cross sectional area. Detail the longitudinal reinforcement of the column satisfying all criteria of IS 13920-1993 and workout the special confining hoop reinforcement as per the code along with neat sketch of longitudinal section. Take the clear height of the column = 4 m. Take concrete grade = M20, steel grade = Fe 415 and clear cover to longitudinal reinforcement = 40 mm **07**

(b) Force deformation curve of two building is shown in Fig.3, calculate (i) Stiffness of building A and B (ii) Ductility factor of building A and B (iii) Energy absorption capacity of building A and B (iv) Maximum load capacity of building A **07**

OR

Q.4 **(a)** Draw and detail the typical qualitative reinforcement detailing of two span reinforced concrete continuous rectangular beam of dimension 230 mm × 500 mm as per IS 13920-1993 (ductile detailing provisions). **07**

(b) (i) Explain in brief soil liquefaction phenomenon **04**
(ii) Explain in brief base isolation technique **03**

Q.5 **(a)** Find the natural frequency of building frame shown in Fig.4. Assume beam at roof level as rigid. **07**

(b) For a two degree of freedom system shown in Fig. 5, obtain the natural frequencies and corresponding mode shapes. **07**

OR

Q.5 **(a)** (i) Define response spectrum and discuss its significance **05**
(ii) Enlist the various seismic waves **02**

(b) (ii)Explain the earthquake resistance feature of masonary structures **07**

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Fig. 1

Fig: 2

Fig: 3

Fig: 5

Fig. 4