Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI- EXAMINATION – SUMMER 2016

Subject Code:160605 **Date:11/05/2016**

Subject Name:Earthquake Engineering

Time: 10:30 AM to 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 1893 and IS 13920 is permitted.**

Q-1 **(a)** Define following terms: **6**
(1) Epicentre (2) Base Shear (3) Soft storey
(4) Damping Ratio (5) Frequency Ratio (6) Dynamic Magnification Factor

(b) Differentiate between the following: **8**
(1) Magnitude & Intensity
(2) Seismograph & Seismogram
(3) Iso-seismal & Meizo-seismal
(4) Inter-plate & Intra-plate earthquakes

Q-2 **(a)** Derive the expression of displacement for free vibration of damped SDOF system with usual notations. **7**

(b) A spring mass model consists of 10 kg mass and spring of stiffness 15 N/mm was tested for viscous damped vibration. The test recorded two consecutive amplitude is 1.8 cm and 1.3 cm respectively. Determine (i) Natural frequency of un-damped system (ii) Logarithmic decrement (iii) Damping ratio (iv) Damping coefficient (v) Damped natural frequency of system. **7**

OR

(b) A SDOF system consists of 6 m high column of 500 mm diameter which supports the heavy mass of 10,500 kg at its top. The system is subjected to a harmonic force of 2000sin80t N. Consider 10% damping and $E = 2 \times 10^5$ MPa. Calculate the steady state amplitude and also state whether the system will have resonance or not? **7**

Q-3 **(a)** Draw Mathematical Model and Free body diagrams for following: **7**

(i) Un-damped Free Vibration of SDOF system
(ii) Un-damped (harmonic) excitation of SDOF system
(iii) Damped (harmonic) excitation of SDOF system

(b) A two storey building is idealized as two springs and masses having the values of the same as k_1 = 2 kN/m, k_2 = 4 kN/m, m_1 = 200 kg and m_2 = 100 kg respectively from the foundation. Calculate all the natural frequencies and all the normalized mode shapes. **7**

OR

Q-3 **(a)** Locate the center of mass and center of stiffness for the Figure – 1. All column sizes are 300 mm x 600 mm. **7**

(b) Explain various bands and vertical reinforcements for earthquake resistant masonry structures. **7**

Q-4 **(a)** Explain four virtues of earthquake resistant design. **6**

(b) Attempt **ANY TWO:** **8**

(1) Explain various irregularities found in the civil engineering structures from earthquake point of view.

(2) Enlist various codes of practice along with correct name related to earthquake engineering.

(3) Elastic rebound theory

OR

Q-4 For a RCC framed office building, find the design lateral forces and its distribution along the height, using static coefficient method. Consider following data: **14**

a) No. of storeys = 4
b) No. of bays in X & Y direction = 5
c) Storey height = 4 m
d) Width of each bay = 6 m
e) Size of beam = 300 mm × 500 mm
f) Size of column = 400 mm × 400 mm
g) Thickness of slab = 150 mm
h) External wall thickness = 230 mm
i) Internal wall thickness = 150 mm
j) Parapet wall = 150 mm with 1 meter height
k) Live load = 4 kN /m^2
l) Location = Ahmedabad
m) Type of soil = medium soil

Q-5 **(a)** Analyze the structure as shown in the Figure.2 by Portal method and draw the bending moment diagram. **7**

(b) (i) Define: Liquefaction and state its effects. **3**

(ii) Write a note on Structural Control **4**

OR

Q-5 **(a)** Analyze the structure as shown in the Figure.2 by Cantilever method and draw the bending moment diagram. **7**

(b) Discuss in detail the concepts of the ductile detailing in Column and Footing. **7**

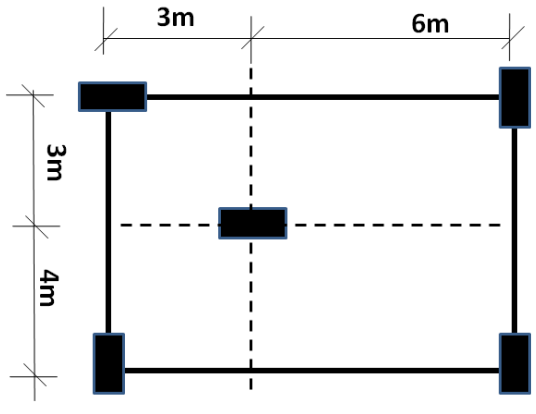

Figure – 1

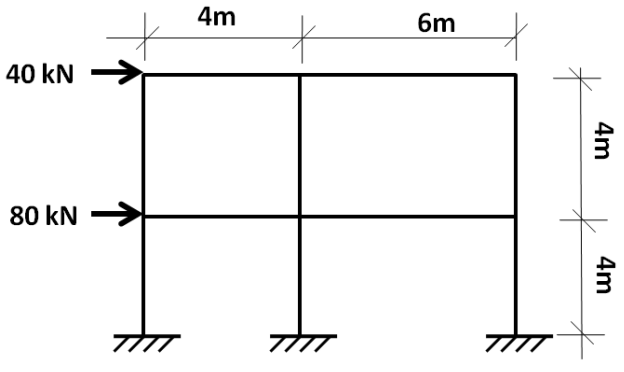

Figure – 2