Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2023

Subject Code:3160621 Date:14-07-2023

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. **Simple and non-programmable scientific calculators are allowed.**
5. **Use of IS-1893-Part 1(2016), IS 13920 (2016), IS 4326(2013), IS 13827 (R2006), IS 13828 (R2008) IS 875 Part I-V are permitted.**

			MARKS
Q.1	**(a)**	Define Following terms: (1) Epicenter (2) Focus (3) Critical Damping.	**03**
	(b)	Differentiate between the following: (1) Magnitude & Intensity (2) Body Waves and surface waves	**04**
	(c)	Explain four virtues of earthquake resistant design.	**07**
Q.2	**(a)**	Describe importance of shear wall in multistoried Buildings.	**03**
	(b)	Define Following terms: (1) Soft storey (2) Damping ratio (3) Ductility (4) Centre of Rigidity	**04**
	(c)	Differentiate between static and dynamic analysis for earthquake loading. Explain the procedure of Response spectrum method as per Indian Standards.	**07**
		OR	
	(c)	Explain importance of various bands in masonry buildings? Support the answer with suitable sketches.	**07**
Q.3	**(a)**	Differentiate the following terms 1. Storey drift and storey shear 2. Importance factor and response reduction factor	**03**
	(b)	Explain base isolation techniques in details.	**04**
	(c)	In an experiment on a certain structure modelled as an SDOF system, the amplitude of free vibration decreased from 10 mm to 4 mm. If the logarithmic decrement was 0.1018 and undamped natural frequency is 40 rad/s, determine the damping ratio, damped period, and number of cycles completed.	**07**
		OR	
Q.3	**(a)**	Discuss the strong column – weak beam concept.	**03**
	(b)	Enlist required conditions for liquefaction. Also suggest remedial measures for the same.	**04**
	(c)	Determine the free vibration response of an SDOF system shown in **Fig. 1** at time t = 0.20 s for the following data: Natural circular frequency ω= 12 rad/s; Damping factor ξ = 0.15; Initial velocity $\dot{x}$ (0) = 10 cm/s Initial displacement x(0) = 5 cm	**07**

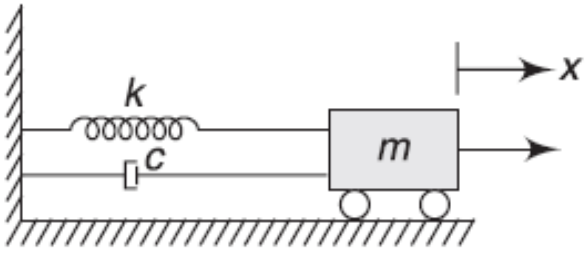

Fig. 1

Q.4 **(a)** Explain Rigid diaphragm in detail. **03**

(b) Distinguish between centre of mass and centre of stiffness. **04**

(c) The plan and elevation of a three-storey RCC Community Hall is shown in **Fig. 2**. The building is located in seismic zone V. The type of soil encountered is medium stiff and it is proposed to design the building with a special moment resisting frame. The intensity of DL is 10 kN/m^2 and the floors are to cater to an IL of 3 kN/m^2. Determine the design seismic loads on the structure by static analysis. **07**

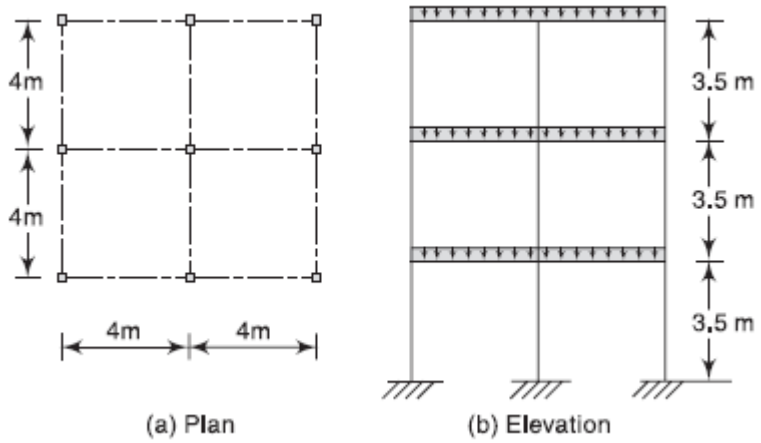

Fig. 2

OR

Q.4 **(a)** How design eccentricity is calculated as per IS: 1893 (1) -2016? **03**

(b) Explain various irregularities found in the civil engineering structures from earthquake point of view. **04**

(c) Explain ductile detailing of beam as per Indian standard 13920 (2016) with neat sketches. **07**

Q.5 **(a)** Write short note on Logarithmic Decrement. **03**

(b) Discuss the capacity design concept in ductile detailing. **04**

(c) Consider a simple one-storey building having two shear walls in each direction as shown in **Fig. 3**. It has some gravity columns that are not considered for analysis. All four walls are in M25 grade concrete, 200 thick and 4 m long. Storey height is 4.5 m. Floor consists of cast-in-situ reinforced concrete. Design shear force on the building is 100 kN in either direction. **07**

Evaluate design lateral forces on different shear walls using the torsion provisions of IS 1893 (Part 1) 2016.

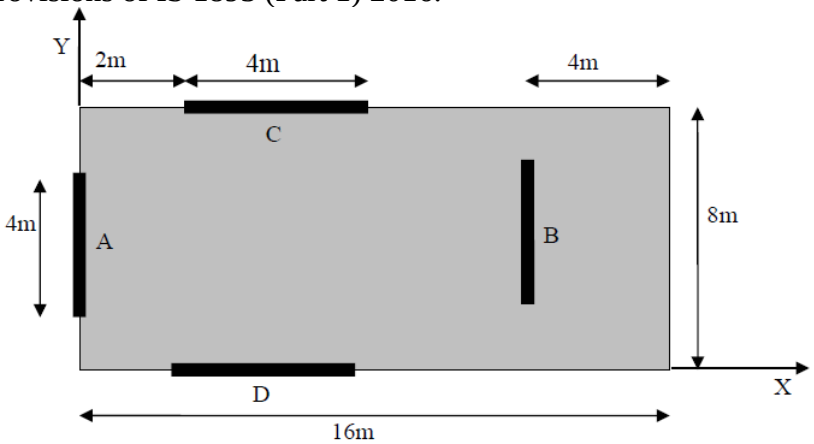

Fig. 3

OR

Q.5 **(a)** Give assumptions made in cantilever method of lateral load analysis. **03**

(b) Explain with neat sketches the techniques of Column Jacketing. **04**

(c) Write the equation of motion for damped free vibration and derive the expressions for the displacement. **07**