Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3160621 Date:13-12-2023

Subject Name:Earthquake Engineering

Time:02:30 PM TO 05:00 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) Weak Story (2) Epicenter (3) Damping.	**03**
	(b)	Differentiate between the following: (1) Magnitude & Intensity (2) Rayleigh Waves and Love waves	**04**
	(c)	What are the four virtues of earthquake resistant design. Explain any one in detail.	**07**
Q.2	**(a)**	What are the known causes of earthquake?	**03**
	(b)	Discuss the strong column – weak beam concept.	**04**
	(c)	Differentiate between static and dynamic analysis for earthquake loading. Explain the procedure of Seismic Coefficient Method method as per Indian Standards.	**07**
		OR	
	(c)	Derive the motion equation for the forced damped vibration?	**07**
Q.3	**(a)**	Differentiate the following terms 1. Storey drift and storey shear 2. Importance factor and response reduction factor	**03**
	(b)	Give details of expected damages by Earthquake in structures with 1. Short columns, 2. Building frames without shear panels, 3. Floating columns, 4. Unsymmetrical plan	**04**
	(c)	A vibrating system consisting of a mass of 50 kg and a spring of stiffness 4×40^4 N/m is viscously damped. The ratio of two consecutive amplitudes is 20:18. Determine the natural frequency of undamped system. Also determine the damping ratio and damped natural frequency.	**07**
		OR	
Q.3	**(a)**	Explain base isolation techniques in details.	**03**
	(b)	How design eccentricity is calculated as per IS: 1893 (1) -2016?	**04**
	(c)	The properties mass m, stiffness k, and natural frequency ω of an undamped SDOF system are to be determined by a harmonic excitation test. At an excitation frequency of 4 Hz the response tends to increase without bound. Then, a weight W of 22 N is attached to the mass m, the resonance occurred at 3 Hz. Determine the dynamic properties of the system.	**07**
Q.4	**(a)**	Explain Rigid diaphragm in detail.	**03**
	(b)	Locate the center of mass and center of stiffness for the **Fig-1**. All column sizes are 350 mm x 650 mm.	**04**

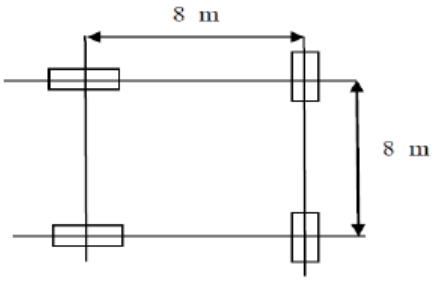

Fig 1

(c) Determine the frequency and design seismic coefficient for an ordinary masonry shear wall in a school building at Allahabad, for the following data. Roof load P = 15 kN/m; Height of wall h = 3.0 m; Width of wall b = 0.2 m; Unit weight of wall w = 19.2 kN/m^3 Soil is medium. **07**

OR

Q.4 **(a)** Enlist required conditions for liquefaction. Also suggest remedial measures for the same. **03**

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

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

Q.5 **(a)** Differentiate between the following: (1) Seismograph & Seismogram (2) Inter-plate & Intra-plate earthquakes. **03**

(b) List assumptions made in Cantilever method of lateral load analysis. **04**

(c) Consider a simple one-storey building having two shear walls in each direction as shown in **Fig. 2**. It has some gravity columns that are not considered for analysis. All four walls are in M25 grade concrete, 200 thick and 5 m long. Storey height is 4.0 m. Floor consists of cast-in-situ reinforced concrete. Design shear force on the building is 200 kN in either direction. Evaluate design lateral forces on different shear walls using the torsion provisions of IS 1893 (Part 1) 2016. **07**

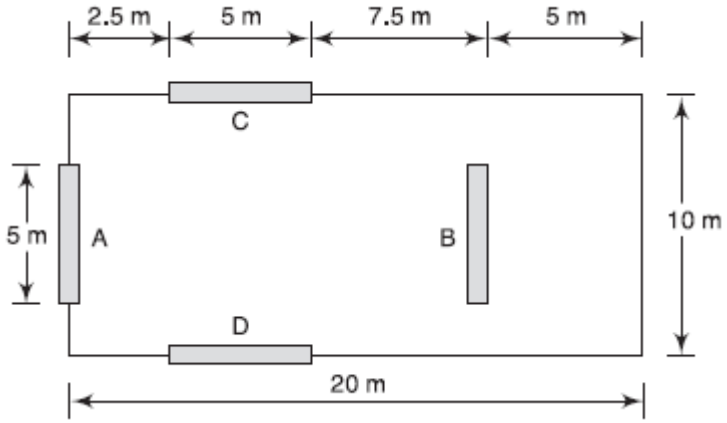

Fig. 2

OR

Q.5 **(a)** Explain the importance of ductility. **03**

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

(c) The plan and elevation of a three-storey RCC Community Hall is shown in **Fig. 3**. 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**

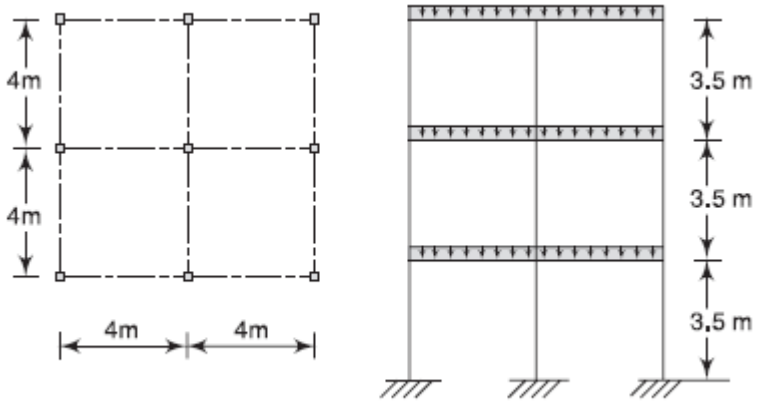

Fig. 3

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