Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering - SEMESTER - VI EXAMINATION - SUMMER 2025

Subject Code: 3160621 **Date: 30-05-2025**

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) Isoseismal (2) Hypocentre (3) Aftershocks	**03**
	(b)	(i) **Differentiate** between Magnitude & Intensity of earthquake. (ii) **Discuss** the physical significance of MSK 7 Intensity earthquake.	**04**
	(c)	Explain the four virtues of earthquake resistant design.	**07**
Q.2	**(a)**	Describe importance of shear wall in multistoried Buildings	**03**
	(b)	Write short notes on the following: (i) Strong Ground Motion; (ii) Modified Mercalli Scale	**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 (0) = 10 cm/s Initial displacement x(0) = 5 cm	**07**

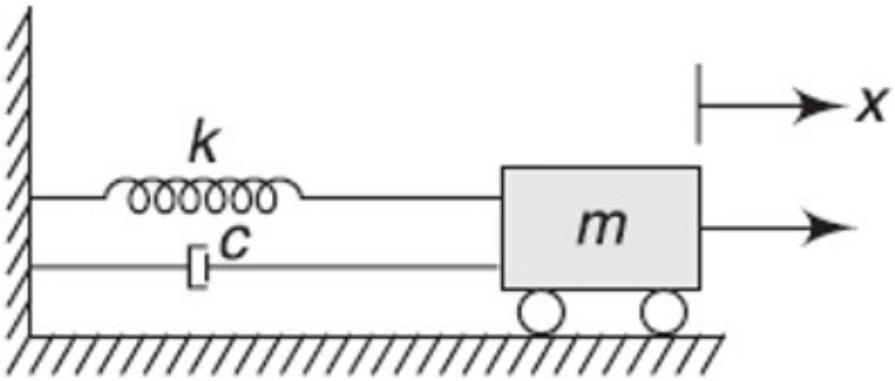


Fig. 1

OR

	(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**

Q.3 **(a)** **State** the reasons for the poor performance of masonry buildings in seismic areas. **03**

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

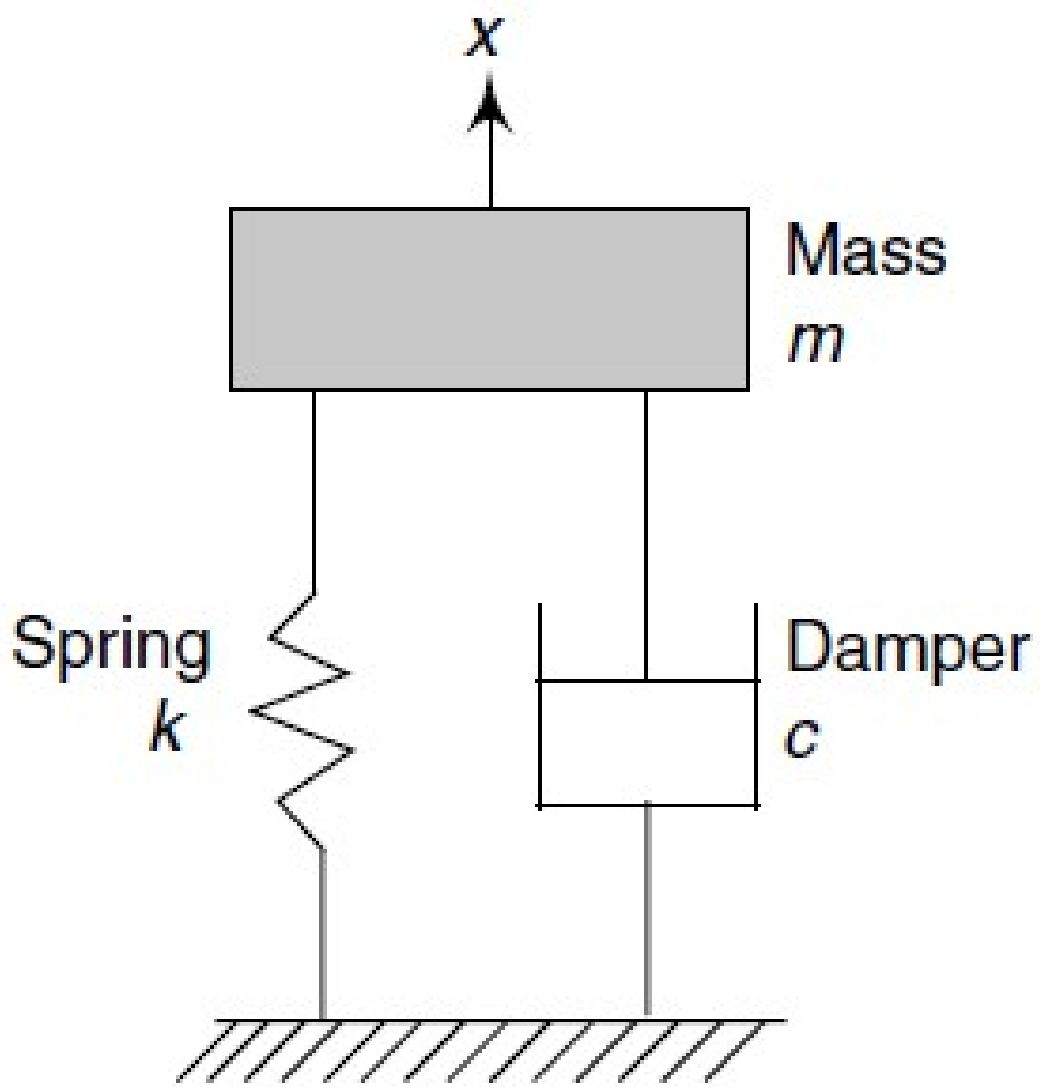
(c) A mass of 0.07 kg is suspended from a spring of stiffness 45 N/m. The mass is pulled downwards by 15 mm from its equilibrium position and then released.The upward velocity observed was 25 mm/s. Determine the maximum velocity,maximum acceleration, and the phase angle. **07**

OR

(a) Differentiate the following terms **03**
(i) Storey drift and storey shear
(ii) Importance factor and response reduction factor

(b) **Enlist** required conditions for liquefaction. Also suggest remedial measures for the same. **04**

(c) An SDOF system is modelled as shown in Fig. 2. It has the following properties.Mass, m = 2 kg; Stiffness, k = 15,000 N/m; Coefficient of damping, c = 45 N/m/s. Determine the natural circular frequency, damping factor, and damped frequency of the system shown in Fig. 2 Write the equation of free response for determining the time history response of the system. **07**



Q.4 **(a)** **How** design eccentricity is calculated as per IS: 1893 (1) -2016? **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. 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. Evaluate design lateral forces on different shear walls using the torsion provisions of IS 1893 (Part 1) 2016. **07**

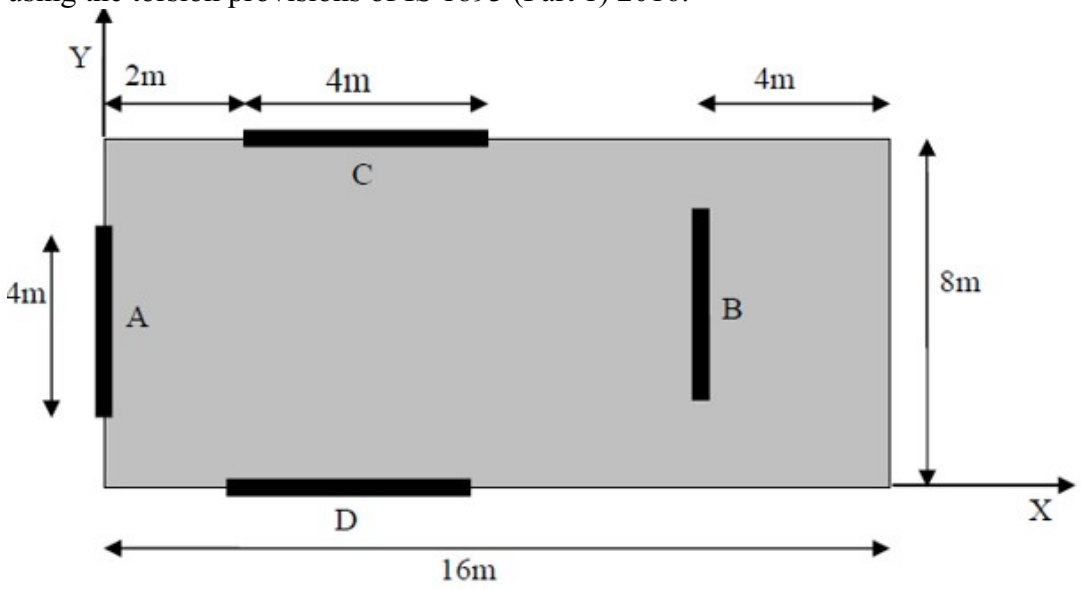


Fig. 3

OR

(a) Explain various irregularities found in the civil engineering structures from earthquake point of view. **03**

(b) Locate the center of mass and center of stiffness for the **Fig-4**. All column sizes are 350 mm x 650 mm. **04**

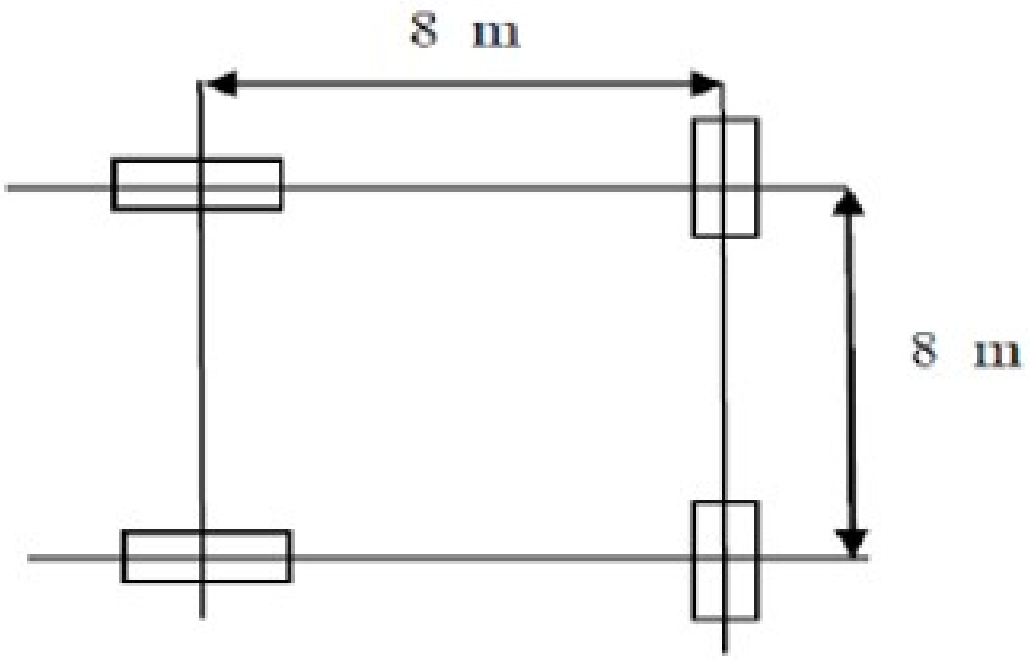


Fig 4

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

Q.5 **(a)** Explain Rigid diaphragm in detail. **03**

(b) **Explain** base isolation techniques in details. **04**

(c) The plan and elevation of a three-storey RCC Community Hall is shown in **Fig. 5**. 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 Seismic Coefficient Method. **07**

.

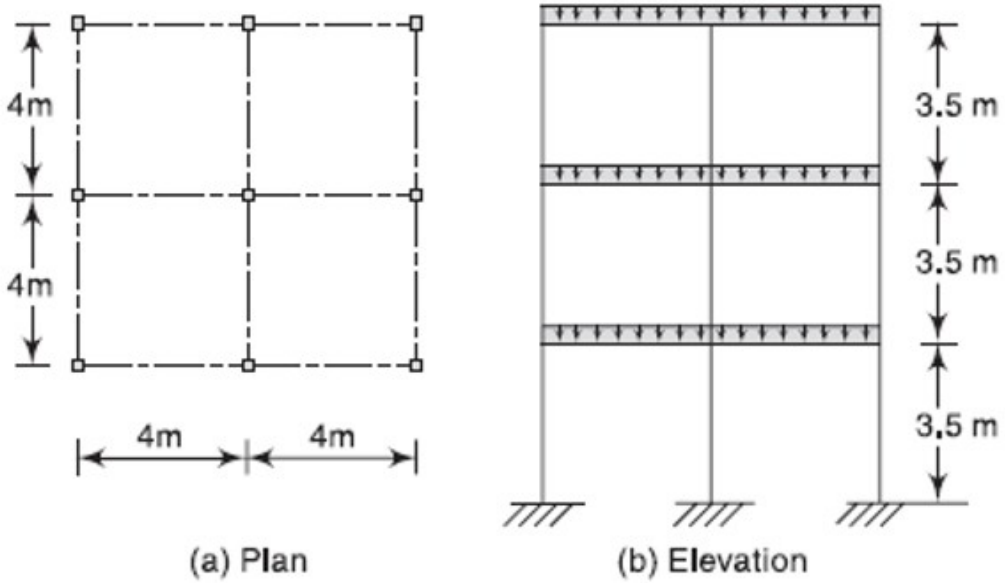


Fig. 5

OR

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

(b) Explain the procedure of Response spectrum method as per Indian Standards. **04**

(c) Consider a four-storey reinforced concrete office building shown in Fig. 6. The building is located in Shillong (seismic zone V). The soil conditions are medium stiff and the entire building is supported on a raft foundation. The R. C. frames are infilled with brick-masonry. The lumped weight due to dead loads is 12kN/m^2 on floors and 10 kN/m^2 on the roof. The floors are to cater for a live load of 4 kN/m^2 on floors and1.5 kN/m^2 on the roof. Determine design seismic load on the structure as per IS 1893-Part 1 (2016). **07**

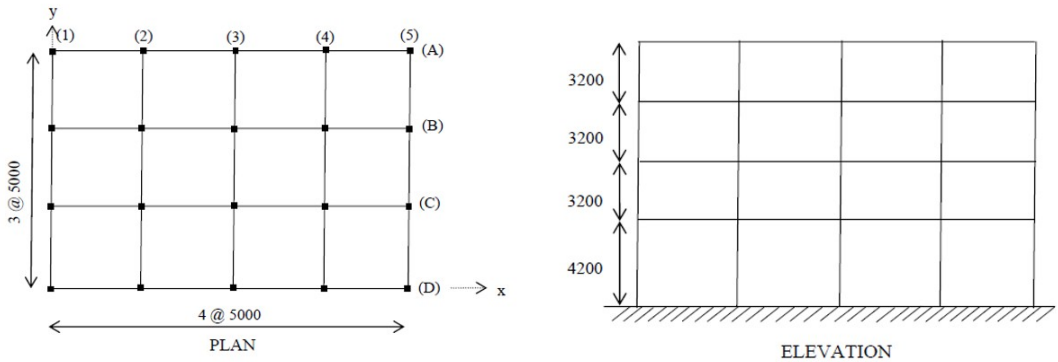


Fig 6

***