Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering - SEMESTER - VI EXAMINATION - WINTER 2025

Subject Code: 3160621 **Date: 25-11-2025**

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: 1893-2016 Part-1, IS: 13920-2016, is permitted.**

			Marks
Q.1	**(a)**	Explain the following terms in Brief: (i) Meizoseismal and Isoseismal (ii) Focus of an Earthquake (iii) Seismograph	**03**
	(b)	Differentiate: (i) Magnitude and Intensity of an Earthquake (ii) Body Waves and Surface waves	**04**
	(c)	Explain the earthquake resistant Design Philosophy and provide four virtues of a good earthquake resistant design.	**07**
Q.2	**(a)**	"Can your house sustain an Earthquake having an magnitude of 8.0 on Ritcher Scale?" Answer this question giving suitable explanation.	**03**
	(b)	"Frequency of a spring-mass system will decrease with the increase in mass of the system". State whether is statement is True or False giving proper justification. Also calculate the frequency of a spring mass system in Hertz if the mass of the system is 2 tonnes and stiffness is 200 N/mm.	**04**
	(c)	Derive the equation of motion for displacement at any given time for damped free vibration of an SDOF system.	**07**
		OR	
	(c)	A free vibration test was performed on a single storey one bay portal frame having a mass of 200 kg, by displacing it horizontally and suddenly released. The initial displacement was observed to be 1.52 mm and after three cycles the displacement was recorded to be 0.371 mm. The time taken to finish three cycles of vibration was 0.285 second. Determine the stiffness 'k' and damping coefficient 'c' of the portal frame.	**07**
Q.3	**(a)**	Explain in detail with examples Rigid Diaphragm and Flexible Diaphragm.	**03**
	(b)	Explain in detail; (i) Soft Storey and Weak Storey (ii) Mass Irregularity and Stiffness Irregularity	**04**

(c) A 6.8 kg mass is suspended by a linear spring. The mass receives an impact resulting in motion with no initial displacement but with an initial velocity. The natural period of system was measured to be 0.25 sec, and the displacement amplitude of 50mm. Find (a) the spring constant for the system, (b) the initial velocity imparted on the mass and displacement of the system at t = 0.63 sec considering an undamped system. **07**

OR

(a) "Can you build an earthquake proof building?" Answer the question with proper justifications **03**

(b) Explain the role of Base isolation and Dampers installed in structures. In which type of structures, base isolation will be ineffective and why? **04**

(c) Formulate the governing equation of motion for undamped vibrations for a three storey structure having mass of m_1, m_2, & m_3 and storey stiffness of k_1, k_2, & k_3 for first, second, and third storey respectively. **07**

Q.4 **(a)** Explain the concept of ductility and describe the measures used to make RCC structures more ductile? **03**

(b) Describe confined masonry structures and discuss why they perform better than normal brick masonry buildings. **04**

(c) Describe in detail about the various methods prescribed by IS: 1893-2016 for elastic analysis of structures to evaluate the design lateral forces during an earthquake. Also give the suitability of each method for different types of structures. **07**

OR

(a) Write a short note on the possible damages to RC buildings in earthquake-prone urban regions. **03**

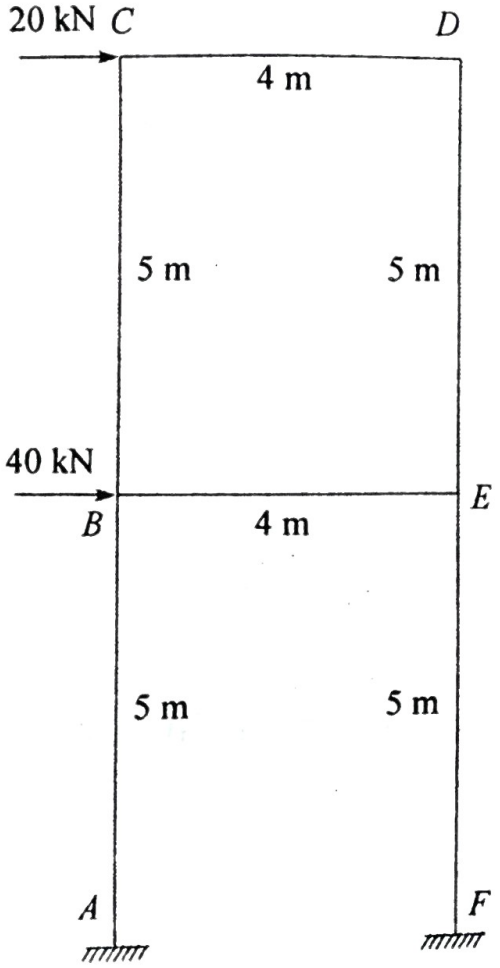
(b) Explain with neat sketches the various construction features that can be adopted to improve the earthquake resistance of brick masonry structures. **04**

(c) A 5-storey RCC structure located in Bhopal has storey height of 3.5m and built up area of 350 m^2. The dead weight on each floors including partitions and structural members can be considered as 375 kN and 415 kN for terrace. Consider a live load of 3.5 kN/m^2 on each floor and 1.5 kN/m^2 for terrace. Assuming the structure is used as a Shopping Center, having foundation on medium soil and provisions of IS: 13920-2016 have been followed in detailing, evaluate the design lateral forces and base shear for each storey of the structure using equivalent static method as per the provisions of IS: 1893-2016. Mention the clause numbers of the provisions used from IS: 1893-2016. **07**

Q.5 **(a)** Describe the salient point of difference between ductile detailing and normal reinforced RCC Column. **03**

(b) Differentiate between Passive and Active structural control systems installed in the structures. **04**

(c) Analyze the portal frame shown in Figure-1 using Portal method and draw the BM diagram **07**



OR

(a) When an RCC building is designed with an intermediate storey having no walls, unlike the storeys above and below, a structural irregularity arises. Identify the type of irregularity caused in such a case and explain the remedial measures recommended by the IS:1893-2016 to mitigate it. **03**

(b) In a ductile detailing design, explain how the shear capacity of beams is ensured against brittle failure. **04**

(c) Compare torsionally coupled and uncoupled systems under lateral load. Explain, with sketches, how torsional irregularity affects structural response. **07**

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