

GUJARAT TECHNOLOGICAL UNIVERSITY

BACHELOR OF ENGINEERING – SEMESTER 6 – EXAMINATION – SUMMER 2026

Subject Code: 3160612

Date: 05/06/2026

Subject Name: Design of Reinforced Concrete structures

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. IS: 456 (2000), IS-1893-1(2016), IS-13920(2016), IS-3370(2021 latest Code Part 1 to 4), SP-16, SP-34, IS-875 (Part 1 to 5) is permitted.
6. Use M20 grade of concrete and Fe415 grade of steel, until otherwise stated.

- Q.1**
- (a) Draw neat sketch of behaviour of various components of the cantilever retaining wall. 03
 - (b) List out assumptions made to analyse the flat slab by Equivalent Frame Method. 04
 - (c) Explain different types of vertical and mass irregularities in the buildings for earthquake resistant design. 07
- Q.2**
- (a) Explain the structural plan density and aspect ratio for G+3 RC Framed residential building. 03
 - (b) Prepare structural layout and nominate all the members like slabs, beams, columns of G+3 building (whole structure) of having 3 bays of 4 m in X –direction and 4 bays of 4 m in Y-direction. 04
 - (c) A multistoried unbraced building as shown in Fig. 1 having 20m X 30m plan dimension and overall height of 30m is to be designed in Palanpur in developed outskirts area with scattered buildings of its height. Determine the designed wind pressure acting on the internal frame of building and draw the pressure diagram. Assume bay width 5m each, Ground storey height 5m, Roof parapet 1m high and remaining storey height 4m each. 07

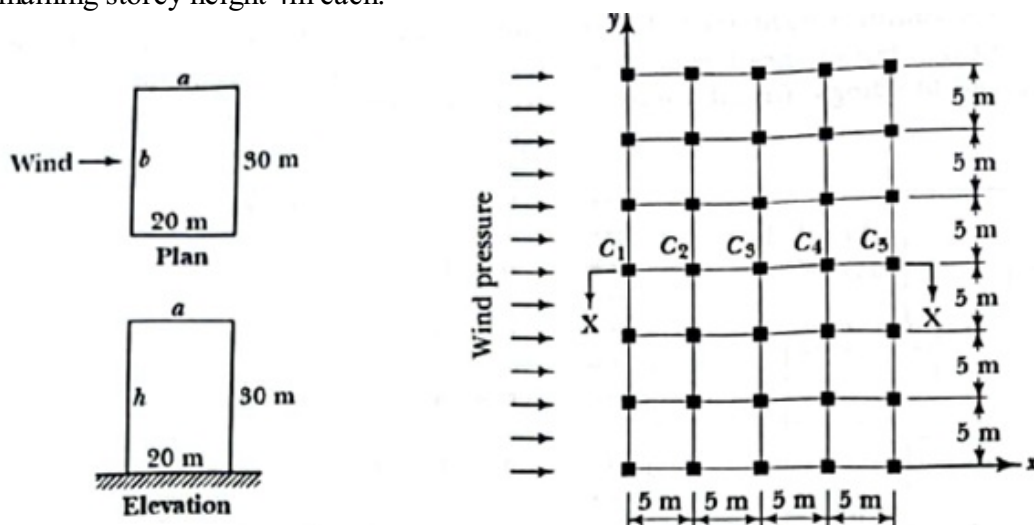


Fig. 1
OR

- Q.2**
- (c) Explain Ductile detailing of beam as per IS 13920 (2016) with neat sketches. 07

- Q.3**
- (a) Draw the Intze tank and explain various structural elements of Intze tank. **03**
- (b) Discuss briefly various types of retaining walls with neat sketches and situations where a particular type is used. **04**
- (c) A retaining wall is constructed to retain the earth 4m high. The top surface is horizontal behind the wall. The soil behind the wall is well drained medium dense sand with following properties: Unit Weight = 17 kN/m^3 , angle of internal friction, $\phi=30^\circ$. The material under wall base is same as above with safe bearing capacity of 150 kN/m^2 . The coefficient of friction between the base and soil is 0.55. Use M20 grade and HYSD reinforcement of grade Fe 415. Determine the coefficient of earth pressure, base width, thickness of stem and base slab for the retaining wall. **07**

OR

- Q.3**
- (a) Which are the conditions to be fulfilled for the design of flat slab by Direct Design Method? **03**
- (b) Enlist the minimum reinforcement criteria for the structures retaining liquid in context to IS 3370 (2021). **04**
- (c) A slab of water retaining structure is 300 mm thick. Assuming the construction has movement joints placed at 13 m c/c, and construction is being carried out in summer . Determine the maximum spacing of cracks and distribution steel (or reinforcement for moisture and temperature) for the slab. The grade of concrete is M30 and HYSD steel grade of Fe 500 is used for design. **07**

- Q.4**
- (a) Discuss the expected damages by Earthquake in structures having (i) Soft storey (ii) Floating columns **03**
- (b) Determine the fundamental natural period of four storied MRF building $13.5\text{m} \times 13.5\text{m}$ in plan and height of 16.25m, if (i) It is considered without masonry infill; (ii) It is considered with masonry infill. **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**

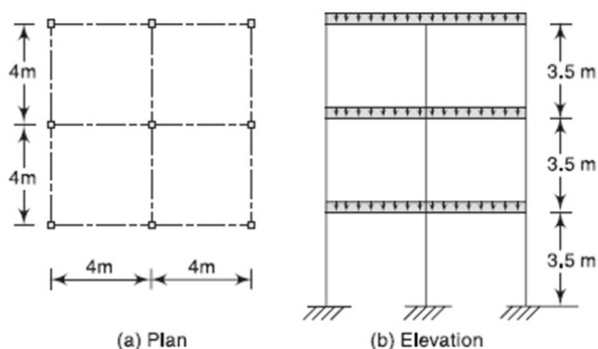


Fig 2.

OR

- Q.4**
- (a) Define Following terms: (1) Epicenter (2) Focus (3) Critical Damping. **03**
- (b) Explain ductile detailing criteria for spacing of links over the entire length of the beam. **04**

- (c) A counterfort retaining wall with height 6m, footing depth 1 m, with 450mm thick base having width 4.5m is constructed to retain the earth of 6m. The top surface is horizontal behind the wall. The counterforts are provided at a 3m c/c. The soil behind the wall is a well drained medium dense soil (unit weight = 16.2 kN/m^3 , angle of internal friction, $\phi=30^\circ$; Safe bearing capacity of soil 150 kN/m^2). The coefficient of friction between the base and soil is 0.6. Estimate the horizontal and vertical loads and moments. Wall is designed with grade M20 concrete and Fe 415 steel. **07**

- Q.5** (a) Which are the assumptions made to analyze the flat slab by Equivalent Frame Method. **03**
(b) Classify different jointing material used in the water tank. Explain any one in detail. **04**
(c) A cantilever wall of water retaining structure is free at top and fixed at bottom is 4 m high and is subjected to water pressure to full height. Determine minimum thickness required for flexure. The water tank is designed with M30 concrete and Fe 500 steel grade. **07**

OR

- Q.5** (a) What are the reasons of cracks in Water Tank? How are they overcome? **03**
(b) What are the flat slab and conventional slab-beam diaphragms? Explain with suitable examples. **04**
(c) Explain the load path from super structure to sub structure with neat sketch. Also describe occurrence of various possible load on G+3 RC buildings. **07**
