

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-VI(NEW) – EXAMINATION – SUMMER 2019****Subject Code:2164001****Date:10/05/2019****Subject Name:Design of Concrete Structures****Time:10:30 AM TO 01:30 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Use of IS 456, IS 875 is allowed.
5. Draw neat and clean sketches.

MARKS

- Q.1** (a) Write advantages of limit state method (LSM) over working stress method (WSM) of structural design philosophy. **07**
- (b) Calculate moment carrying capacity of a rectangular beam with 250 mm × 400 mm overall section and having $A_{st} = 1800 \text{ mm}^2$. Assume effective cover provided is 40 mm at tension side. Adopt M 30 and Fe 415 grade of materials. **07**
- Q.2** (a) Design a reinforced concrete rectangular beam section of size 300 mm × 600 mm overall from architectural considerations. The beam is subjected to design moment of resistance 300 kN.m. The effective cover to reinforcement is taken as 50 mm. Adopt M 20 and Fe 415 grade of materials. **07**
- (b) Design a T-beam section with a flange width of 1250 mm, a flange depth of 100 mm, a web width of 250 mm and an effective depth of 500 mm, which is subjected to a factored moment of 560 kN.m. The concrete mix is to be used is of grade M 20 and steel is grade Fe 415. **07**
- OR**
- (b) Design a cantilever beam of effective span of 2 m to sustain the uniformly distributed load of 20 kN/m. Use M 25 grade of concrete and Fe 415 grade of steel. **07**
- Q.3** (a) Design a shear reinforcement for a simply supported RC beam subjected to U.D.L. of 25 kN/m over a span of 3.6 m and having cross section of 230 mm width and 450 mm overall depth is reinforced with 3 # 16 mm Ø HYSD steel of grade Fe 415, placed at an effective cover of 50 mm. Use grade of concrete M 20. **07**
- (b) Design a slab over a room 4 m × 5 m as per IS code. The slab is supported on masonry walls all round with adequate restraint and the corners are held down. The live load on the slab is 3 kN/m². The slab has a bearing of 150 mm on the supporting walls. Check for limit state of serviceability. **07**
- OR**
- Q.3** (a) A simply supported RC beam of size 350 mm × 550 mm overall is reinforced with 3#20 mm Ø of Fe 415 grade of steel. Determine the anchorage length of the bars at the simply supported end if it is subjected to a factored shear force of 350 kN at the centre of 300 mm wide masonry support. The concrete mix of grade M 20 is to be used. **07**
- (b) Design one way simply supported slab of 9 m × 4 m clear dimension, the width of the support being 300 mm. The live load on the slab is 2 kN/m² **07**

and floor finish load is 1 kN/m^2 . Use M 20 grade of concrete and Fe 415 grade steel. Check for limit state of serviceability.

- Q.4 (a)** Design a dog legged staircase in a residential building with clear dimensions of staircase area as $3150 \text{ mm} \times 5250 \text{ mm}$. Floor to floor height is 3.2 m . Use M 25 grade of concrete and Fe 415 of steel. (Take Riser = 160 mm and Tread = 250 mm). **07**
- (b)** A R.C. short column square in section has to resist a factored axial load of 2000 kN . Consider 2% of longitudinal reinforcement. Adopt M 30 grade of concrete and Fe 415 grade of steel. **07**
- Determine:
- Size of column
 - Area of longitudinal reinforcement
 - Pitch and diameter of lateral ties.
- OR**
- Q.4 (a)** Design a single flight staircase in a residential building, having floor height of 3.2 m . Staircase is supported at top and bottom riser by beam having width 300 mm . Consider Thickness of waist slab is 150 mm , riser is 160 mm and tread is 300 mm . Use M 25 grade of concrete and Fe 415 grade of steel. **07**
- Evaluate :
- The effective span
 - Design load
 - Reinforcement in waist slab.
 - Prepare a detail sketch of staircase.
- (b)** Design a short circular R.C.C. column to carry an axial load of 2000 kN . Use M 35 grade concrete and Fe 415 grade steel. **07**
- Q.5 (a)** Design an isolated pad footing for a square R.C.C. column of size $600 \text{ mm} \times 600 \text{ mm}$ carrying axial load of 2000 kN . Safe bearing capacity of soil is 200 kN/mm^2 . Use M 20 grade concrete and Fe 415 as steel reinforcement. Effective cover for the bottom steel is 60 mm . Check for shear is not required. **07**
- (b)** A basement wall of height 3.75 m above the basement floor slab to soffit of ground floor beam retains soil to its full height. The exterior face of the wall is on the property line. The unit weight of soil and its angle of repose are 19.5 kN/m^3 and 30° , respectively. The safe bearing capacity of soil is 150 kN/m^2 . Design the basement wall using M 20 grade of concrete and HYSD steel of grade Fe 415. **07**
- OR**
- Q.5 (a)** Design a combined rectangular footing for axially loaded columns, which carries 750 kN and 1000 kN loads spaced apart at 4 m center to center. Each columns having size $350 \text{ mm} \times 350 \text{ mm}$. Safe bearing capacity of soil is 300 kN/m^2 . Use M 20 grade of concrete and Fe 415 grade of steel. **07**
- (b)** Design a cantilever retaining wall (T type) to retain earth for a height of 4 m . The backfill is horizontal. The density of soil is 18 kN/m^3 . Safe bearing capacity of soil is 180 kN/m^2 . Take the coefficient of friction between concrete and soil as 0.6 . The angle of repose is 30° . Use M 25 grade of concrete and Fe 415 grade of steel. **07**

TABLE E MAXIMUM PERCENTAGE OF TENSILE REINFORCEMENT $p_{t,lim}$ FOR SINGLY REINFORCED RECTANGULAR SECTIONS

(Clause 2.3)

f_{ck} , N/mm ²	f_y , N/mm ²		
	250	415	500
15	1.32	0.72	0.57
20	1.76	0.96	0.76
25	2.20	1.19	0.94
30	2.64	1.43	1.13

[Reference: TABLE F, SP16, PG. 13]

TABLE F STRESS IN COMPRESSION REINFORCEMENT f_{sc} , N/mm² IN DOUBLY REINFORCED BEAMS WITH COLD-WORKED BARS

(Clause 2.3.2)

f_y , N/mm ²	d'/d			
	0.05	0.10	0.15	0.20
415	355	353	342	329
500	424	412	395	370
