16/12/24 (FN)

ADDITIONAL CONTROLLER OF EXAMINATIONS AU CHENNAI 600 025

Roll No.

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. / B.Tech / B.Arch (Full Time) - END-SEMESTER EXAMINATIONS, NOV-DEC 2024

CIVIL ENGINEERING

V Semester

CE5504 DESIGN OF REINFORCED CEMENT CONCRETE STRUCTURES

(Regulation 2019)

Indian Standards IS 456, IS 3370 (Parts 1 and 2) and selected charts/tables from SP 16 are permitted

Time: 3 hours Max. Marks: 100

CO1	Explain the various design concepts and design a beam under flexure and draw the reinforcement details
CO2	Design the beam under shear and torsion, calculate the anchorage and development length and check the serviceability requirements for RC structural elements
CO3	Design a RC slab and staircase and draw the reinforcement details
CO4	Design short columns and strip, isolated and combined footings and draw the reinforcement details
CO5	Design a retaining wall, water tank and a framed RC building and draw the reinforcement details

BL – Bloom's Taxonomy Levels

(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART - A (10 x 2 = 20 Marks)

Q. No.	Questions	Marks	CO	BL
1	State the limitations of the ultimate load method used in reinforced concrete design.	2	1	L1
2	How to calculate an effective width of flange of a flanged beam?	2	1	L1
3	Calculate the development length for a 20 mm diameter bar placed in M20 grade concrete, under tension. Take f_y = 415 N/mm^2; $\sigma_s = 0.87\ f_y$.	2	2	L2
4	Explain the types of deflections expected to occur in an RC structure.	2	2	L2
5	Differentiate between one-way slab and two-way slab.	2	3	L1
6	What are the limitations of the Direct Design Method used to design flat slabs?	2	3	L2
7	Calculate the axial load capacity of a short column of cross-section 400 mm × 400 mm, consisting of 4 numbers of 20 mm diameter bars as longitudinal reinforcement. Consider M 20 concrete and Fe 415 steel.	2	4	L2
8	Two columns are located close to one another, and one of these is very close to the property line of the corresponding building. What type of footing is recommended in this scenario? Justify.	2	4	L2
9	Draw and indicate the components of a cantilever retaining wall.	2	5	L1
10	What are the structural actions in a water tank with circular and rectangular configurations?	2	5	L1

PART - B (5 x 13 = 65 Marks)

Q. No.	Questions	Marks	CO	BL
11 (a)	A simply supported doubly-reinforced RC beam of rectangular cross-section, with width 200 mm and overall depth 400 mm, is reinforced with 3 Nos. of 25 mm diameter longitudinal reinforcement in its tension zone and 2 Nos. of 25 mm diameter longitudinal reinforcement in its compression zone. Assuming M 20 grade concrete and Fe 250 steel, compute the stresses in concrete and steel under a service load moment of 150 kN-m. Consider an effective cover of 40 mm.	13	1	L3
	OR			
11 (b)	A singly-reinforced RC cantilever beam of span 6 m, has cross-sectional dimensions 250 mm × 400 mm. It carries a live load of 3 kN/m^2 and floor finish load of 1 kN/m^2, in addition to its self-weight. Design it for bending and check for serviceability, adopting limit state method. Use M 20 concrete, Fe 415 steel, Clear cover of 20 mm.	13	1	L3
12 (a)	A simply supported singly-reinforced RC beam of rectangular cross-section, with width 200 mm and overall depth 400 mm, is supported on masonry walls of thickness 230 mm. The centre-to-centre span of the beam is 5 m. It carries a dead load of 4 kN/m and a live load of 8 kN/m, in addition to its self-weight. Consider M 20 concrete, Fe 415 steel and an effective cover of 40 mm. Area of longitudinal tension reinforcement provided is 1000 mm^2. Design the shear reinforcement.	13	2	L4
	OR			
12 (b)	A rectangular beam section 300 mm wide and 700 mm deep, is subjected to an ultimate twisting moment of 150 kN-m, combined with an ultimate hogging bending moment of 180 kN-m and an ultimate shear force of 120 kN. Use M 25 concrete, Fe 415 steel and 50 mm effective cover. Design for torsion.	13	2	L4
13 (a)	Design a cantilever one-way slab with a clear span of 3.5 m. It carries a live load of 3 kN/m^2 and a floor finish load of 1 kN/m^2, in addition to its self-weight. Use M 20 concrete, Fe 415 steel, Clear cover of 25 mm.	13	3	L4
	OR			
13 (b)	A room with clear dimensions 3.5 m × 4.5 m, has 230 mm thick masonry walls around. Design and detail its roof slab, to support a surface finish load of 2.5 kN/m^2 and live load of 5.0 kN/m^2, in addition to its self-weight. Its three edges are discontinuous and one long edge is continuous. Its corners are prevented from lifting up. Use M 20 concrete, Fe 415 steel, Effective cover of 30 mm.	13	3	L4
14 (a)	A column with cross-section 200 mm × 300 mm and unsupported length 2.5 m, is effectively held in position and restrained against rotation at both the ends. It is subjected to a factored axial load of 400 kN and factored major axis moment of 70 kN-m. Design the column, considering M 25 concrete, Fe 415 steel and a clear cover of 40 mm.	13	4	L4
	OR			

14 (b)	Design a footing for a column of cross-sectional dimensions 400 mm × 400 mm, carrying an axial load of 1200 kN. Consider the safe bearing capacity of the soil below to be 150 kN/m^2. Use M 20 concrete, Fe 415 steel, Clear cover of 50 mm.	**13**	4	L4
15 (a)	A cantilever retaining wall is to support a 4 m high bank of earth on its toe side. The backfill is levelled and it is subjected to a surcharge pressure of 35 kN/m^2. It comprises of granular soil with a unit weight of 16 kN/m^3 and an angle of shearing resistance of 25°. Good supporting soil is available at a depth of 1.2 m below the ground level, with a safe bearing capacity of 150 kN/m^2. Proportion the retaining wall and design the stem of the retaining wall, considering M 20 concrete and Fe 415 steel. Consider the friction coefficient between the soil and concrete to be 0.5.	**13**	5	L4
	OR			
15 (b)	Design the wall and base slab of a cylindrical water tank of capacity 250 m^3, with a height of 3.5 m. It shall rest on the ground, has an open top and an ideal sliding joint at the base of the wall. The crack width shall be limited to 0.1 mm. Use M 20 concrete, Fe 415 steel.	**13**	5	L4

PART - C (1 x 15 = 15 Marks)

(Q. No.16 is compulsory)

Q. No.	Questions	Marks	CO	BL
16.	Design a waist slab type dog-legged staircase for a building with the following data: Height between the floors: 3 m Riser: 160 mm Tread: 270 mm Width of both flight and landing: 1.3 m Live load: 4 kN/m^2 Floor finish load: 1 kN/m^2 Stairs are supported on 230 mm thick masonry walls at the outer edges of the landing, parallel to the risers. Use M 20 concrete, Fe 415 steel, Clear cover of 20 mm.	**15**	3	L5