DESIGN OF R.C.C STRUCTURES
(CIVL 3105)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The maximum strain in concrete at the outer most fibre is
(a) 0.002 (b) 0.003 (c) 0.0035 (d) 0.0025.

(ii) The factor of safety used for concrete is
(a) 1.5 (b) 1.15 (c) 1.3 (d) 2.0.

(iii) The acceptable limit of safety and serviceability before failure occurs is called as
(a) Ultimate state (b) Failure state
(c) Limit state (d) Working state.

(iv) The maximum percentage of longitudinal steel in a column is
(a) 6% (b) 8% (c) 5% (d) 7%.

(v) The maximum strain in steel at failure is
(a) $\frac{f_y}{1.15E_s}+0.002$ (b) 0.002 (c) $\frac{f_y}{1.15E_s}+0.0035$ (d) 0.0035

(vi) The moment of resistance of balanced section is given by
(a) $0.87f_yA_{st}(d-0.36x_u)$ (b) $0.87f_yA_{st}(b-0.36x_u)$
(c) $0.87f_{ck}A_{st}(d-0.4x_u)$ (d) $0.87f_yA_{st}(d-0.42x_u)$.

(vii) The nominal cover in a column is
(a) 40mm (b) 50mm (c) 35mm (d) 30mm.

(viii) For a balance section
(a) $x_u = x_{u\,max}$ (b) $x_u > x_{u\,max}$ (c) $x_u < x_{u\,max}$ (d) $x_u \approx x_{u\,max}$.

(ix) As per IS 456-2000 minimum thickness at the edge of isolated footings should be
(a) 10 cm (b) 15 cm (c) 20 cm (d) 5 cm.

(x) Isolated footings are not designed for
(a) Bending moment (b) One-way shear
(c) Two-way shear (d) Torsion.

Group – B

2. (a) (i) State the assumptions of limit state of collapse (Flexure).
   (ii) Differentiate between working stress method and limit state method.

   (b) Find the moment of resistance of an R.C.C beam 325 mm wide and 525 mm effective depth is reinforced with 3 bars of 16 mm. Use M20 concrete and Fe415 steel. Use the working stress method of design.

(3 + 3) + 6 = 12

3. (a) What is balanced, under reinforced and over reinforced section? Explain with a schematic diagram.

   (b) A simply supported RCC beam of 250 mm × 500 mm has a clear span of 5.5m. The beam has 2-20 mm diameter bars going into the support. Factored shear force is 140KN. Check for development length if Fe 415 and M20 grade of concrete is used.

6 + 6 = 12

Group – C

4. (a) A doubly reinforced concrete beam constructed with M20 concrete and Fe415 steel has 250 mm width and 450 mm effective depth. The beam section has 2 bars of 12mm diameter in compression face with an effective cover of 40 mm and 4 bars of 20 mm diameter in tensile face respectively. Determine the flexural strength of the beam section according to IS:456-2000.

   (b) Find the Moment of resistance of a T- beam section having the following details: b_f = 700mm, d = 350 mm, b_w = 250mm, A_{st} = 5 bars of 20mm diameter (Fe-415), D_f = 100 mm, M20 grade of concrete.

7 + 5 = 12

5. (a) Differentiate between the one-way slab and two-way slab.

   (b) A simply supported slab of a corridor of a hospital building has a clear span of 2.5m and is supported on beams 230 mm in width. Design the slab if the slab is carrying a live load of 5kN/m^2. Use M20 concrete and Fe415 steel bars.

2 + 10 = 12

Group – D

6. Design a dog-legged staircase for an office building in a room measuring 3.0m × 6.0m (Clear dimension). Floor to floor height is 3.5m. The building is a public building liable to over-crowding. Stairs are supported on brick walls of 230mm thick at the end of landings. Use M20 concrete and Fe415 steel.

12

7. (a) Find the ultimate load-carrying capacity and allowable load for a short column of size 450 mm × 450 mm. The column is reinforced with 4-25mm diameter bars. Use M20 concrete and HYSD grade Fe415 steel Assume e_{min} <0.05D.

(b) An R.C.C. short column of size 400 × 500 mm is carrying a factored load of 2900 kN. Design the column using design chart. Assume e_{min} < 0.05D. Use M25 concrete and Fe 415 steel.

5 + 7 = 12

Group – E

8. Design a square R.C.C footing for a column of 425 mm × 425 mm subjected to a load of 1100 kN and a uniaxial bending moment of 450 kN-m at service state. Unit weight of soil = γ_s=19kN/m^3. The angle of repose =φ =30˚.
Safe bearing capacity of soil q= 150 kN/m^2 at a depth of 1.5 m. Use M20 concrete and Fe415 steel.

12

9. Design Pre-cast pile to carry an R.C.C column with axial load 1200kN.
   - Uniaxial moment=75kN-m
   - Shear Force= 70kN
     Field investigation-
   - Soil=medium sand
   - The angle of repose φ =30˚
   - K=1.25
   - Unit weight γ=19.5kN/m^3
   - Permanent surcharge q_0 =24kN/m^2

   Use M20 concrete and Fe 415 steel.

12

Department & Section	Submission link:
CE	https://classroom.google.com/w/MjQ0Mzk1MzU3MTA2/t/all