DESIGN OF RCC STRUCTURES
(CIVL 3102)

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 anchorage value of a 90^0 hook is
(a) 12Ø (b) 16Ø (c) 15Ø (d) 8Ø.

(iii) The minimum length of the bar which must be embedded in concrete to develop full stress is called as
(a) Anchorage length (b) Flexural length
(c) Development length (d) Bond length.

(iv) If R is the riser, T is the tread and d is thickness of waist slab, then the load of waist slab per m width of stair in plan will be _____ multiplied by density of R.C.C.
(a) $\frac{d^2}{T} \times \sqrt{R^2 + T^2}$ (b) $\frac{d}{T} \times \sqrt{R^2 + T^2}$
(c) $\frac{T}{d} \times \sqrt{R^2 + T^2}$ (d) $\frac{T^2}{d} \times \sqrt{R^2 + T^2}$

(v) The pitch of lateral ties should not be more than
(a) 200 mm (b) 300 mm (c) 250 mm (d) 100 mm.

(vi) A simply supported beam has an effective span of 10 m. What shall be the limiting ratio of span to effective depth as per IS 456-2000?
(a) 26 (b) 20 (c) 12.5 (d) 7.

(vii) Nominal shear stress developed in a one way slab of effective depth 200 mm for a factored shear force of 35 KN/m is
(a) 0.153 MPa (b) 0.175 MPa (c) 0.244 MPa (d) 0.189 MPa.

(viii) The main reinforcement of an RC slab consistsof 8 mm bars at 15 cm spacing. If it is desired to replace 8 mm bars by 10 mm bars, then the spacing of 10 mm bars should be
(a) 20 cm (b) 30 cm (c) 35 cm (d) 15 cm.

(ix) The bending moment developed at interior support for a three-span continuous beam of effective span 4.5 m subjected to a dead load intensity of 10KN/m and live load of 12KN/m is

(a) 35.26 KNm (b) 62.4 KNm
(c) 47.25 KN-m (d) 27.54 KNm.

(x) The minimum percentage of reinforcement in pile shaft as per IS 2911:2010 is

(a) 0.15 % (b) 0.6% (c) 0.4% (d) 0.8%.

Group – B

2. (a) Find the moment of resistance of an R.C.C. cantilever beam of 300 mm width and 450 mm effective depth, reinforced with 2 bars of 16 mm diameter. Use M20 concrete and Fe 415 steel. Also find the safe load, including its self-weight, if the span of the beam is 2 m. Use the working stress method of design.

(b) An R.C.C. beam 400x600 mm effective depth is reinforced with 2 bars of 25 mm diameter. The beam is subjected to a bending moment 150kNm. Find the stresses set up in steel and concrete. Use M20 concrete and Fe 415 steel. Use working stress method of design.

5 + 7 = 12

3. (a) A rectangular beam is 200 mm wide and 400 mm deep up to the centre of reinforcement. Find the area of reinforcement required if it has to resist a moment of 25kNm. Use M20 concrete mix and Fe 415 steel. Use limit state method of design.

(b) A simply supported rectangular beam section of 300 mm width and 600 mm effective depth is reinforced with 5 bars of 25 mm diameter. It carries a uniformly distributed load of 80kN/m (including its own weight) over an effective span of 6 m. Out of 5 main bars, 2 bars can be bent up safely near the supports. Design the shear reinforcement for the beam. Consider concrete of grade M20 and steel of grade Fe 415. Use limit state method of design.

5 + 7 = 12

Group – C

4. (a) An RC beam has a width of 250 mm and an effective depth of 550 mm. The effective covers for tension and compression reinforcement are 50 mm and 30 mm, respectively. The beam is reinforced with three bars of 25 mm diameter in tension and three bars of 20 mm diameter of Fe 500 grade in compression. Assuming M25 concrete. Calculate the ultimate moment carrying capacity of the beam.

(b) Design only the flexural reinforcement for a 250 mm by 500mm (overall depth) simply supported beam of effective span 5 m subjected to the dead load of 20 kN/m and live load of 15kN/m at (service state). Consider M25 and Fe 500 steel. Also, sketch the reinforcement detail.

6 + 6 = 12

5. (a) Determine the ultimate moment of resistance of isolated singly reinforced T-beam, having a span of 6.5 m and cross-sectional dimensions as follows- width of flange, b_f= 1000 mm, the width of the web, b_w = 300 mm, the thickness of the flange, D_f = 110 mm, effective depth, d_{eff} = 600 mm. The total area of steel, A_{st}= 5 numbers of 25 mm diameter bars. Use M25 concrete and Fe 500 steel.

   (b) The slab of a residential building of size 4.25 m × 6.3 m is simply supported on all four sides on 250 mm walls. Assuming an imposed load of 3 KN/m^2 and load due to finishes of 1.5 KN/m^2, design the floor slab. Use M25 concrete and Fe 500 steel. Assume mild exposure.

6 + 6 = 12

Group – D

6. Design a two flight staircase with steps on waist slab for floor-to-floor height of 3.3 m, width of flight equal to 1.25 m and superimposed load of 4kN/m^2. It is simply supported at the end of the landing slabs which span in the direction of flight. Consider weight of surface finish of 0.5 kN/m^2 and concrete of grade M20 and steel of grade Fe415.

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7. Design the reinforcement for a column of size 300mm × 400mm having an effective length of 3.5 m. An axial load of 1000 kN and a moment of 150kNm about the major axis of the column. Using M25 concrete and Fe 415 steel, provide the reinforcement:
   (i) On two side
   (ii) On all the four side.

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Group – E

8. (a) State the various advantages and disadvantages of prestressed concrete over reinforced concrete.

   (b) A rectangular concrete beam of cross-section 300mm depth and 250mm width is prestressed using 10 wires of 5 mm diameter located 50mm from the bottom of the beam and 5 wires of diameter 5mm, 30mm from the top. Consider the prestress in the steel as 850N/mm^2, Compute the stresses at the extreme fibers of the mid-span section when the beam is supporting its own weight over a span of 6m. Imposed load on the beam is 10kN/m. Assume density of concrete 24KN/m^3.

4 + 8 = 12

9. Design an isolated footing for a column, 300 mm × 400 mm, reinforced with 6-16φ bars with Fe 500 steel and M 25 concrete subject to a factored axial load P_u=750 kN and a factored uniaxial bending moment of 25 kN-m (with respect to major axis) at the column base. Assume that the moment is entirely due to dead loads and hence irreversible. The Safe bearing capacity of soil may be taken as q= 200 kN/m^2 at a depth of 1.5 m. Unit weight of soil = Υ_s=19 kN/m^3. The angle of repose =φ =30°. Use M 25 concrete and Fe 500 steel for the footing.

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Department & Section	Submission link:
CE A	https://classroom.google.com/w/MjAyODQzNTY4NDg5/t/all
CE B	https://classroom.google.com/w/MTI2NTQxODExMTAz/t/all