

N.B.

1. Question no. 1 is compulsory. Attempt any Four out of remaining Six questions.
2. Assume suitable data if necessary but justify the same.
3. Use of IS code is NOT permitted.

Q.1 Attempt any FIVE

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- a. Explain Ultimate Load Design philosophy. State the limitations of the same. (4)
- b. Explain the terms mild, moderate, severe and very severe with regard to exposure condition. Why it is important to consider exposure at the time of design? (4)
- c. Under what circumstances a doubly reinforced beam is required? How will you ensure that a doubly reinforced beam is under reinforced? (4)
- d. What is the difference between behavior of short column and long column? State the procedure to design an axially loaded short columns. (4)
- e. Why it is necessary to provide transverse steel in one way slabs? Sketch typical reinforcement detailing in one way slab. (4)
- f. Where it is required to provide combined footing? Sketch a typical SF and BM diagram for a combined footing for two axially loaded columns. (4)

Q.2 Attempt the following.

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- a. Design most economical section for a simply supported rectangular beam of 6 m span carrying a UDL of 23 kN/m, inclusive of its self-weight. Use M 25 and TMT bars of Fe 415. (8)
- b. A beam of size 250 x 550 mm overall has a span of 4 m and carries a UDL of 80 kN/m inclusive of its self-weight. Compute the reinforcement required at the effective cover of 50 mm. Use M 20 and Fe 415. (12)

d'/d	0.095	0.100	0.105
f_{sc} MPa	352.70	351.93	351.12

Q.3 Attempt the following

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- a. A reinforced concrete beam of 300 x 550 mm overall is reinforced with 6 bars of 20 mm ϕ HYSD steel of grade Fe 415, placed at an effective cover of 50 mm. The beam carries a factored UDL of 110 kN/m over a simply supported clear span of 7 m. Design the shear reinforcement if half of the bars are bent up at support making an angle of 45° . Use M 20 and Fe 415. (10)

pt%	0.60	0.62	0.64
τ_c MPa	0.514	0.521	0.527

TURN OVER

- b. A tee beam having 1200 mm effective width of flange has a thickness of flange equal to 125 mm. The effective depth of the beam is 550 mm and width of the web is 300 mm. It is reinforced with 8 bars of 20 mm ϕ on the tension side. Determine ultimate moment of resistance if M 20 and Fe 415 is used. (10)

Q.4 Attempt the following. 20

- a. A short circular RCC column is subjected to a load of 1250 kN within the limit of minimum eccentricity. Design the column and show reinforcement details. Use M 30 and Fe 415. (6)
- b. A hall of a residential building measures 4.5 m x 7 m. It is supported by 230 mm thick wall on all four sides. Design the simply supported slab using M 25 and HYSD Fe 415 steel. Sketch the reinforcement detailing along both spans. (14)

L_y/L_x	1.4	1.5	1.75
α_x	0.099	0.104	0.113
α_y	0.051	0.046	0.037

Q.5 Attempt the following. 20

- a. With the help of a neat sketch illustrate the requirements of beam to behave as a flanged beam. (4)
- b. A rectangular beam of size 230 x 400 mm overall is reinforced with 3 bars of 16 mm ϕ as tension reinforcement. It is subjected to a shear force of 15 kN and a bending moment of 20 kN m. In addition to this it also carries a torsional moment of 1.2 kN m. Comment whether the beams requires the torsional reinforcement. (6)
- c. A simply supported one way slab of a passage of a public building has a clear span of 2.8 m. It is supported on 230 mm thick wall. Design the slab using M 25 and Fe 415 steel. Take Live load as 5 kN/M². Sketch the reinforcement details. (10)

Q.6 Design the combined footing for columns of size 300 x 300 mm spaced at 3 m apart. Column C 1 carries a dead load of 500 kN and a live load of 180 kN. Column C 2 carries a dead load of 600 kN and live load of 200 kN. Width of the footing is restricted to 2 m. The SBC of the soil is 180 kN/m². Use M 20 and Fe 415. (20)

- Q.7 a. What do you understand by column interaction diagram? State the uses of interaction diagram in design of columns. (4)
- b. What is development length? Derive a relation for development length. (4)
- c. Design a footing for a column of 400 x 400 mm carrying a load of 900 kN. SBC of the soil is 200 kN/m². Use M 20 and Fe 415 (12)