22607

12425

4 Hours / 70 Marks Seat No. | | | | | | | | |

Instructions : (1) All Questions are *compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

(8) Use of steel table is permitted.

Marks

1. Attempt any FIVE of the following : **10**

(a) List two types of steel sections used as tension members and show it with neat sketch.

(b) Define – Radius of gyration, slenderness ratio.

(c) State IS 456 code provisions for calculating effective flange width of T-beams.

(d) Draw a neat sketch of staircase showing reinforcement details.

(e) State any two conditions where in doubly reinforced section is to be used.

(f) Define – short column, long column.

(g) State four types of stairs from design point of view.

2. Attempt any THREE of the following : **12**

(a) A tension member consist of 2 ISA 90 × 90 × 10 mm connected back to back same side of 10 mm thick gusset plate. Calculate it's net area if 20 mm diameter bolts are used for connections.

(b) An R.C. T-beam section reinforced for tension has the following dimensions : bf = 1250 mm, bw = 300 mm, d = 550 mm, Df = 100 mm, Ast = 1884 mm^2. Use M20 concrete & Fe415 steel. Calculate limiting moment of resistance.

(c) Calculate the safe load carrying capacity of a column of diameter 550 mm reinforced with 6 bars of 20 mm dia. M20 concrete and Fe415 steel. Check column for minimum eccentricity if the effective length is 4 m.

(d) A short circular column carries an ultimate axial load of 1800 kN. Design a suitable section for 1% steel. Use lateral ties. Use M20 concrete and Fe415 steel.

3. Attempt any TWO of the following : **12**

(a) The tension member of a truss consist of 2 ISA 70 × 70 × 6 mm connected on the same side of a 8 mm thick gusset plate. Take dia. of bolt is 20 mm thick and area of single angle is 806 mm^2. Determine the design tensile strength of member. (Block shear strength not expected.)

(b) A single angle ISA 75 × 75 × 6 is used as a strut of length 2.5 m. Calculate maximum forced carried by the member if it is effectively held in position and restrained against rotation at both ends. Properties of the section are- A = 866 mm^2, γ_{min} = 14.6 mm, α = 0.49.

(c) Design a single angle section for a tension member of roof truss to carry a factored load of 250 kN. The length of the member is 3 m. Use 20 mm bolts of grade 4.6 for the connection. Angle sections available are

Size	Area
100 × 75 × 8	1336
90 × 60 × 10	1401

4. Attempt any TWO of the following : **12**

(a) A discontinuous double angle strut consist of 2 ISA 80 × 80 × 8 mm, having A = 1221 mm^2, $I_{xx} = I_{yy} = 72.5 \times 10^4$ mm^4, $\gamma_{xx} = \gamma_{yy} = 24.4$ mm, $C_{xx} = C_{yy} = 22.7$ mm. The angle section is welded back to back on each side of gusset plate 10 mm thick. Calculate the design strength of the strut.

(b) Draw a neat sketch of battening system and state any three requirements of battening to be used.

(c) A beam having dimensions of 230 × 500 mm (effective) is reinforced with 4 bars of 20 mm diameter on tension side and 3 bars of 12 mm diameter on compression side. Calculate ultimate moment of resistance of the beam if M20 concrete and Fe415 steel is used. Take d' = 50 mm and f_{SC} = 345 N/mm^2.

5. Attempt any TWO of the following : **12**

(a) A simply supported beam of span 6 m and size 325 × 725 mm overall, has to resist an ultimate udl of 75 kN/m over entire length. Design suitable reinforcement for the beam with material M20 and Fe415. Assume f_{SC} = 355 MPa

(b) A doubly reinforced beam 230 × 500 mm (overall) is subjected to a factored moment of 320 kN.m. Find the area of steel required on compression and tension side if effective cover on both side is 40 mm. Use M25 and Fe500 material.

(c) Find ultimate moment of resistance of a T-beam with the following data :

(i) Width of flange = 1500 mm

(ii) Width of rib = 300 mm

(iii) Effective depth = 600 mm

(iv) Slab thickness = 100 mm

Area of tensile steel = 4500 mm^2. Use M20 & Fe415.

6. Attempt any TWO of the following : **12**

(a) Calculate the area of reinforcement for a T-beam to resist ultimate bending moment of 325 kN.m.

(i) Width of flange = 1200 mm (ii) Depth of flange = 110 mm

(iii) Effective depth = 600 mm (iv) Width of rib = 300 mm.

Use M20 & Fe415 material. Effective cover = 35 mm.

(b) Design a dog legged staircase having floor to floor height = 3 m. The stair hall measured 3 m × 4 m internally. Live load = 3 kN/m^2. Rise = 150 mm, Treade = 230 mm. Width of landing = 1 m. Use M20 and Fe415 material. Take modification factor is 1.6.

(c) Design a column footing for following data :

(i) load on column = 1500 kN (ii) size of column = 400 mm × 400 mm

(iii) safe bearing capacity = 150 kN/m^2. (iv) Use M20 mix & Fe415 steel

Check for two way shear may not be taken.

Formulae sheet = IS800 – 2007

$$F_{cd} = \frac{F_y/\delta_{mo}}{\phi + \sqrt{\phi^2 - \lambda^2}} \leq \frac{F_y}{\gamma_{mo}}$$

$$\phi = 0.5\,[1 + \alpha(\lambda - 0.2) + \lambda^2]$$

$$\lambda = \sqrt{\frac{F_{yy}}{F_{cc}}} = \sqrt{\frac{F_{yy}(KL/\gamma)^2}{\pi^2 \cdot E}}$$

$$\lambda_e = \sqrt{K_1 + K_2 \cdot \lambda_{vv}^2 + K_3 \cdot \lambda^2 \phi}$$

$$\lambda_{yy} = \frac{(l/r_{vv})}{\sqrt{\frac{\pi^2 E}{250}}} \text{ and } \lambda_\phi = \frac{(b_1 + b_2)}{\sqrt{\frac{\pi^2 \cdot E}{250} \times 2t}}$$

$$T < A_n \cdot F_u$$

$$Td_n = \frac{A_n \cdot F_u}{\gamma m_1},\ Tdg = \frac{A_g \cdot F_y}{\gamma m_o}$$

$$Td_n = 0.9\ \frac{A_{nc} \cdot F_u}{\gamma\, m_1} + \beta \cdot \frac{A_{go} \cdot F_y}{\gamma\, m_o}$$

$$\beta = 1.4 - 0.076 \cdot \frac{w}{t} \times \frac{F_y}{F_u} \times \frac{b_s}{L_c}$$

$$Tdb_1 = \frac{Avg \cdot F_y}{\sqrt{3} \cdot \gamma\, m_o} + 0.9\ \frac{Atn \cdot F_u}{\gamma\, m_1}$$

$$Tdb_2 = \frac{Atg \cdot F_y}{\gamma\, m_o} + 0.9\ \frac{Avn \cdot F_u}{\sqrt{3} \cdot \gamma\, m_1}$$