22607

24225

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

Marks

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

(a) List types of failure in case of tension member.

(b) Define effective length and slenderness ratio of the column.

(c) State effective flange width for T & L beam.

(d) State the clause to calculate effective span of stairs spanning on to the edge of landing slab.

(e) State four categories of stairs from design point of view.

(f) Draw detailed diagram showing reinforcement details in case of dog legged staircase.

(g) State any two I.S. specifications for pitch and diameter of lateral ties.

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

(a) A single angle 100 mm × 15 mm × 10 mm is used as a tension member of a truss. The longer leg of the angle is connected to the gusset plate with 4 Bolts of 20 mm diameter. Determine the net effective area if (1) The angle is bolted to the gusset plate (2) The angle is welded to the gusset plate.

(b) Find the area of steel required for a T beam given the following data :

bf = 1000 mm, Df = 100 mm, bw = 230 mm, d = 450 mm, factored moment = 300 kNm concrete M15 and Steel Fe415.

(c) Calculate working load capacity of column 230 × 230 mm. Provided with 4 bars of 16 mm diameter. Use M20 concrete and Fe415 Steel.

(d) Write IS specifications for longitudinal and transverse reinforcement of an axially loaded short column.

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

(a) Design a Lie member using suitable equal angle section to carry a tensile factored load of 200 kN. The connection are with 20 mm dia. bolts and 12 mm thick gusset plate Design strength of 20 mm dia. bolts 45.3 kN, f_y = 250 MPa, f_u = 410 MPa α = 0.8

Sections available

ISA mm	**Area mm^2**
90 × 90 × 8	1137
100 × 75 × 6	1014
125 × 75 × 6	1166

(b) A single unequal angle ISA 100 × 50 × 6 mm is used as a tension member connected to 8 mm gusset plate with 4 No. of 16 mm dia. bolts. The bolts are pitched at 40 mm and edge distance is 30 mm. Determine block shear strength f_u = 4150 MPa, f_y = 250 MPa.

(c) Draw a neat labelled sketch of lacing system and state requirements of lacing to be used.

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

(a) A single angle section 90 × 90 × 8 mm is used as a strut. The centre to centre distance between intersection points at each end is 2.75 m. Calculate the design strength of the strut if it is effectively held in position but not restrained against rotation at both ends, one bolt is provided at each end.

(b) A discontinuous compression member consists of 2 ISA 90 × 90 × 10 mm connected back to back on opposite sides of 12 mm thick gusset plate. Tacking rivets are provided along the length with one bolt at each end. Determine the design compressive strength of the member. The C/C distance of connection is 3 m for single ISA 90 × 90 × 10 mm.

A = 1703 mm^2, r_x = 27.3 mm, $C_x = C_y$ = 25.9 mm., $I_x = I_y = 12.67 \times 10^5$ mm^4

KL/r	80	90	100	110	120	130
fed N/mm^2	136	121	107	94.6	83.7	74.4

(c) Find the moment of resistance of the beam 250 × 500 mm deep if it is reinforced with 4–18 mm diameter bars in tension zone and 2-12 mm diameter in compression zone, each at an effective cover of 40 mm. Assume M15 concrete and Fe415 steel.

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

(a) Design a doubly reinforced section for a rectangular beam at mid span having an effective span of 5 m. The superimposed load is 50 kN/m and size of the beam is limited to 250 × 400 mm overall. Use M20 mix and Fe415.

(b) Design a doubly reinforced beam 230 × 600 mm overall for a factored moment of 300 kNm. Cover on both sides is 50 mm. M20 and Fe415 materials are used.

The table provided for the design compressive strength is

d^1/d	0.05	0.10	0.15
fsc.	355	352	342

(c) For a T beam with following dimensions :

Width of flange = 1500 mm

Width of Web = 300 mm

Effective depth = 500 mm

Depth of slab = 120 mm

Tension steel Ast = 2000 mm^2

Materials M20, Fe415

Calculate ultimate moment of resistance of the section.

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

(a) Calculate the ultimate moment of resistance of a T beam having following data :

(1) Width of flange = 1800 mm

(2) Depth of flange = 100 mm

(3) Depth of beam = 600 mm

(4) Width of rib = 230 mm

(5) Ast = 3000 mm^2

(6) Effective cover = 60 mm

Concrete M15 and Fe415 to be used.

(b) Design a dog legged staircase for residential building having following details :

(1) Floor to floor height = 3.50 m

(2) Staircase hall 3 m × 4.5 m

(3) Live load = 3 KPa

(4) Concrete grade = M20

(5) Steel grade = Fe415

(6) M.F. = 1.60

(c) Design an isolated footing for an axially loaded column 300 × 500 mm carrying a factored load of 800 kN using wide beam theory. The materials used are M20 grade concrete and Fe415 steel. Draw a neat labelled section and plan giving dimensions and details of steel provided in it.

IS : 800-2007 Formulae Sheet

$$f_{cd} = \frac{f_y/\gamma m_0}{\phi + \sqrt{\phi^2 - \lambda^2}} = \frac{\chi f_y}{\gamma m_0} \le \frac{f_y}{\gamma m_0}$$

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

$$\lambda = \sqrt{\frac{f_y}{f_{cc}}} = \sqrt{\frac{f_y (kL/r)^2}{\pi^2 E}}$$

$$\chi = \frac{1}{\phi + \sqrt{\phi^2 - \lambda^2}}$$

$$\lambda_e = \sqrt{k_1 + k_2 \cdot \lambda_{vv}^2 + k_3 \cdot \lambda^2{}_{\phi}}$$

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

$$T < A_n \cdot f_u$$

$$T_{dn} = \frac{T}{\gamma m_1} = \frac{A_n \cdot f_u}{\gamma m_1}$$

$$T_{dn} = 0.9\,\frac{A_{nc} \cdot f_u}{\gamma m_1} + \beta \cdot \frac{A_{go} \cdot f_y}{\gamma m_0}$$

$$\beta = 1.4 - 0.076\,\frac{w}{t} \times \frac{f_y}{f_u} \times \frac{b_s}{L_c}$$

$$T_{db1} = \frac{A_{vg} \cdot f_y}{\sqrt{3} \cdot \gamma m_0} + 0.9\,\frac{A_{tn} \cdot f_u}{\gamma m_1}$$

$$T_{db2} = \frac{A_{tg} \cdot f_y}{\gamma m_0} + 0.9\,\frac{A_{vn} \cdot f_u}{\sqrt{3} \cdot \gamma m_1}$$