22607

21222

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

15 minutes extra for each hour

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 & show it with neat sketch.

(b) List the two end conditions of column along with their equivalent length.

(c) Write the formula for effective flange width of T & L beam giving meaning of terms used.

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

(e) State the effective span of stairs for two cases with sketch.

(f) State two conditions for providing a doubly reinforced beam.

(g) State the formula for calculating the minimum eccentricity in design of columns.

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

(a) Design a tension member consisting of single unequal angle connected to gusset plate of 12 mm thick to carry a factored tensile load of 300 kN. Assume single row of 20 mm bolted connection length of member is 2.5 m. Take Fu = 415 MPa.

Section (mm)	Area (mm^2)
ISA 100 × 75 × 8	1336
ISA 125 × 75 × 8	1588
ISA 150 × 75 × 8	1748

(b) An R.C. T-beam section reinforced for tension has the following dimension : b_f = 1250 mm, b_w = 300 mm, d = 550 mm, D_f = 100 mm, A_{st} = 1884 mm^2. Use of M20 concrete & Fe415 steel is made. Calculate limiting moment of resistance.

(c) A circular column of 500 mm diameter is provided with 6 bars of 20 mm diameter. Calculate the working load carrying capacity if Fe415 steel & M20 concrete are used. Check column for min. eccentricity if the effective length is 3 m.

(d) A 4 m high column is effectively held in position at both ends & restrained against rotation at one end. If the dia. of the column is restricted to 420 mm, calculate the reinforcement to carry a factored axial load of 2000 kN. Use M20 grade concrete & Fe415 steel.

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

(a) Determine the tensile strength of a roof truss member 2 ISA 90 × 60 × 6 mm connected to the gusset plate of 8 mm by 18 mm diameter bolts.

(b) Design a single angle section for a tension member of roof truss to carry a factored tensile load of 225 kN. The length of the member is 3 m. Use 20 mm shop bolts of grade 4.6 for the connection.

Angle sections available are

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

(c) A discontinuous strutt 3.2 m long of a roof truss consists of double angle section 90 × 90 × 8 mm connected to 10 mm gusset plate. Calculate the load carrying capacity.

Properties of ISA 90 × 90 × 8 mm, f_y = 250 N/mm^2, A = 1380 mm^2, $C_{XX} = C_{YY}$ = 25.1 mm, $r_{XX} = r_{YY}$ = 27.5 mm, r_{VV} = 17.5 mm, $I_{XX} = I_{YY}$ = 104 × 10^4 mm^4.

KL/r	80	90	100	110	120	130
f_{cd}(N/mm^2)	136	121	107	94.6	83.7	74.4

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

(a) A builtup column consists of 2 ISMC-225 placed face to face at 120 mm between their centres. The length of column is 6 m & both ends are hinged. Find design strength of the column for ISMC-225.

A = 330/mm^2, I_{YY} = 1.872 × 10^6 mm^4

I_{XX} = 26.946 × 10^6 mm^4, C_{XX} = 23.1 mm.

(b) Design principal rafter of roof truss carrying a service load of 200 kN in compression & having c/c length of 2.36 m between the joints. Thickness of Gusset plate may be taken as 10 mm. Angle sections available are

ISA 9060 × 8 mm

ISA 8050 × 10 mm

ISA 9060 × 10 mm

Use steel tables.

(c) Calculate the area of steel reqd. for RCC section 200 × 450 mm effective to resist an ultimate BM of 150 kN M.

Assume M30 concrete & Fe415 steel.

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

(a) Find the moment of resistance of the beam 250 × 500 mm deep if it is reinforced with 4 bars 20 mm diameter in tension zone & 2 bars 12 mm diameter in compression zone, each at an effective cover of 40 mm. Assume M20 concrete, Fe415 steel. Take f_{sc} = 353 N/mm^2.

(b) A doubly reinforced beam 230 × 500 mm (overall) is subjected to a factored moment of 280 kN M. Find the area of steel required on compression & tension side if effective cover on both sides is 40 mm. Use M25 mix & Fe500 steel.

(c) Calculate the area of steel in a singly reinforced flanged beam having following data :

(i) Eff. span = 6 m (ii) Spacing of T beam ribs = 2.75 m

(iii) Live load = 40 kPa (iv) Slab thickness = 100 mm

Use M20 mix & Fe415 steel

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

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

(i) Flange width = 1.5 m (ii) Depth of flange = 100 mm

(iii) Depth of beam = 550 mm (iv) Width of rib = 230 mm

(v) Ast = 3000 mm^2 (vi) Eff. cover = 60 mm

Use M20 mix & Fe415 steel.

(b) Design a dog legged stair case having floor to floor distance = 3.3 m. The stair hall measured 3 m × 4.5 m internally. Live load = 3 kN/m^2. Use M20 mix & Fe415 steel.

Take modification factor as 1.6.

(c) Design a column footing for following data :

(i) Load on column = 600 kN

(ii) Size of column = 200 mm × 300 mm

(iii) Safe bearing capacity of soil = 150 kN/m^2

Use M20 mix & Fe415 steel.

Check for two way shear may not be taken.

———————