17505

16172

4 Hours / 100 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) *Use of Steel tables, logarithmic, Mollier's chart is* ***permitted****.*

Marks

1. A) Attempt **any three** : **(3×4=12)**

a) State six advantages and two disadvantages of steel as a construction material. **4**

b) Explain the limit states of serviceability applicable to steel structure. **4**

c) State types of loads to be considered while designing a steel structure. Also state respective I.S. codes. **4**

d) Enlist four types of sections used as a tension member along with sketches. **4**

B) Attempt **any one** : **(1×6=6)**

a) Design the lap joint for the plates of sizes 100 × 12 mm and 100 × 8 mm thick connected, so as to transmit a factored load of 80 kN using single row of 16 mm dia bolts of grade 4.6 and plates of 410 grade.

b) The longer leg of a single angle 100 × 75 × 8 mm is connected to the gusset plate with 3 bolts in a line of 20 mm dia. at a pitch of 60 mm, for this tension member. Determine block shear strength.

Marks

2. Attempt **any two** of the following : **16**

a) A lap joint consists of two plates 180 × 10 mm connected by means of 20 mm dia. bolts of grade 4.6. All bolts are in one line. Calculate strength of single bolt and no. of bolts to be provided.

b) A discontinuous compression member consists of 2 ISA 90 × 90 × 10 mm connected back to back on opposite sides of 10 mm thick gusset plate. Tacking rivets are provided along the length along with one bolt at each end. Determine the design compressive strength of the member. The centre to centre distance of connection is 2.8 m. For single ISA 90 × 90 × 10 mm, $A = 1703\ mm^2$, $\gamma x = 27.3$ mm , Cx = Cy = 25.9 mm, $Ix = Iy = 12.67 \times 10^5\ mm^4$.

KL/γ	80	90	100	110	120	130
fcd (MPa)	136	121	107	94.6	83.7	74.4

c) An ISMB 400 @ 6043 N/m is used as a simply supported beam for 3 m span. The compression flange of beam is laterally supported through out the span. Determine design flexural strength of member. Also calculate working u.d.l. the beam can carry per m span.
Take $Zp = 1176.18 \times 10^3\ mm^3$, $\gamma mo = 1.1$, $\beta b = 1$, fy = 250 MPa.

3. Attempt **any four** : **16**

a) Explain any two types of failure of bolted joint along with drawing of respective sketches.

b) State two advantages of welded joints and two disadvantages of bolted joint.

c) Draw neat sketch of PRATT and FINK type trusses. Mark panel, panel point, rafter and tie in any one truss.

d) Draw neat sketches of connection of an angle purlin with principal rafter at panel point.

e) Write any four selection criteria of type of roof truss.

4. A) Attempt **any three** : **12**

i) Draw and label any four form of builtup compression member.

ii) Define radius of gyration and slenderness ratio. Also state maximum values of slenderness ratio for any two condition of compression member.

iii) State the function of lacing and battening. Draw neat sketches of single lacing and battening.

iv) State IS requirement of lacing to be used.

Marks

B) Attempt **any one** : **6**

i) Explain gross section yielding and net section rupture in case of design strength of tension member. Also write two measures to be taken to prevent rupture.

ii) Design a tie 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, fy = 250 MPa, fu = 410 MPa, $\alpha = 0.8$ sections available.

ISA --- mm	Area --- mm^2
$90 \times 90 \times 8$	1137
$100 \times 75 \times 6$	1014
$125 \times 75 \times 6$	1166.

5. Attempt **any two** : **16**

a) Design a slab base for column ISHB 350@710.2 N/m to carry factored axial compressive load of 1500 kN. The base rests on concrete pedestal of grade M20. For ISHB 350, tf = 11.6, bf = 250 mm, fy = 250 MPa, fu = 410 MPa, $\gamma mo = 1.1$.

b) A industrial building has pratt roof truss having 12 m span. Take G.I. sheet covering weighing 160 N/m^2, eight panel length along the tie member, pitch of roof = $\frac{1}{6}$ and weight of purlin is 60 N/m^2. Assume self weight of truss as 100 N/m^2. Calculate panel point loads for dead and live load.

c) A industrial building has trusses for 16 m span. Trusses are spaced at 4 m c/c and rise of truss is 3.5 m. Calculate panel point load in case of live load and wind load using following data :
Co-efficient of external wind action = – 0.7

Coefficient of internal wind action = ± 0.2

Design wind pressure = 1.2 KPa

No. of panels = 12.

6. Attempt **any four** : **16**

a) An ISMB 250 is used as simply supported beam for 3 m span to carry 20 kN/m load. Take fy = 250 MPa, check the section for shear only, tw = 6.4 mm.

b) Differentiate between laterally supported and laterally unsupported beam.

c) Draw neat labelled plan and sectional elevation of gusseted base.

d) State the necessity of column bases. Also state function of cleat angle and anchor bolts in slab base.

e) State four classification of cross sections of beam based on moment-rotation behaviour as per IS 800-2007.

IS:800-2007 Equations (Formula Sheet)

$$V_{nsb} = \left(\frac{f_u}{\sqrt{3}}\right)(n_n A_{nb} + n_s A_{sb}) \;,\; V_{dsb} = \frac{V_{nsb}}{\gamma_{mb}} \;,\quad V_{dpb} = \frac{V_{npb}}{\gamma_{mb}}$$

$$T_{dg} = \frac{A_g f_y}{\gamma_{m0}} \;,\; T_{dn} = \frac{0.9 f_u A_n}{\gamma_{m1}} \qquad V_{npb} = 2.5 k_b\, d\, t\, f_u \qquad k_b = \left[\frac{e}{3d_0}, \frac{p}{3d_0} - 0.25, \frac{f_{ub}}{f_u}, 1.0\right]$$

$$f_{wd} = \frac{f_u}{\sqrt{3}\,\gamma_{mw}}$$

$$T_{dn} = \frac{0.9 A_{nc} f_u}{\gamma_{m1}} + \beta \frac{A_{go} f_y}{\gamma_{m0}}$$ where $\beta = 1.4 - 0.076\,(w/t)\,(f_y/f_u)\,(b_s/L_c) \le (f_u \gamma_{mo}/f_y \gamma_{m1}) \times 0.9$

≥ 0.7

$$T_{dn} = \frac{\alpha A_n f_u}{\gamma_{m1}} \;,\quad T_{db1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}} \;,\quad T_{db2} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$$

$$P_d = A_e f_{cd} \;,\qquad P_z = 0.6\, V_Z^{\,2} \;,\qquad V_z = V_b\, k_1\, k_2\, k_3$$

$$f_{cd} = \chi \frac{f_y}{\gamma_{m0}} \;,\qquad \chi = \frac{1}{\phi + \sqrt{\phi^2 - \lambda_e^2}}$$, where $\phi = 0.5[1 + \alpha(\lambda_e - 0.2) + \lambda_e^2]$

$$\lambda_e = \sqrt{k_1 + k_2 \lambda_{vv}^2 + k_3 \lambda_\varphi^2}$$

where $$\lambda_{vv} = \frac{\left(\frac{l}{r_{vv}}\right)}{\varepsilon\sqrt{\frac{\pi^2 E}{250}}}$$ and $$\lambda_\varphi = \frac{(b_1 + b_2)/2t}{\varepsilon\sqrt{\frac{\pi^2 E}{250}}}$$

$$M_z = \frac{\beta_b \cdot Z_p \cdot f_y}{\gamma_{mo}}$$

$$V_{dz} = \frac{f_y \times t_w \times h}{\gamma_{mo}\sqrt{3}}$$

$$t_s = \sqrt{[2.5w(a^2 - 0.3b^2)\gamma_{mo}/f_y]} \qquad > t_f$$

Values of χ and fcd (N/mm^2) for different values of KL/r_{min} as per buckling curve 'c'

KL/r_{min}	10	20	30	40	50	60	70	80	90
χ	1.000	0.987	0.930	0.870	0.807	0.740	0.670	0.600	0.533
fcd	227	224	211	198	183	168	152	136	121

KL/r_{min}	100	110	120	130	140	150	160	170	180
χ	0.471	0.416	0.368	0.327	0.291	0.261	0.234	0.212	0.192
fcd	107	94.6	83.7	74.3	66.2	59.2	53.3	48.1	43.6