17505

21718

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

*(8) Formula sheet is **allowed**.*

Marks

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

a) State the functions of :

i) Transmission tower

ii) Steel water tank

iii) Roof truss

iv) Steel chimney.

b) List different types of loads coming on steel structures and explain any one.

c) List any four common standard types of steel sections used with their applications.

d) Define and explain shear lag effect.

B) Attempt **any one** : **(1×6=6)**

a) Design a suitable fillet weld to connect plate 60 mm × 10 mm to 150 mm × 12 mm thick plate. Design the joint for full strength of the plate and assume welding on all three sides. Take f_y = 250 MPa, and f_u = 410 MPa.

b) The double angle 60 × 60 × 8 mm tension member is connected to the both sides of 10 mm gusset plate with 2 blots in a line with 18 mm diameter bolt at a pitch of 50 mm and gauge of 35 mm. Determine the block shear strength of given tension member. Take f_y = 250 MPa, and f_u = 410 MPa.

2. Attempt **any two** : **(2×8=16)**

a) Design suitable bolted connection for a single angle strut made up of ISA 100 × 100 × 10 mm using 12 mm gusset plate for a factored compressive load of 175 kN. Assume 20 mm bolts of grade 4.6. Draw connection details.

Marks

b) A discontinuous strut 3.2 m long of a roof truss consists of a double angle section 90 × 90 × 8 mm connected to 10 mm thick gusset plate by welding. Calculate load carrying capacity.

Assume – Properties of ISA 90 × 90 × 8 mm; f_y = 250 N/mm^2 Area = 1380 mm^2, $C_{xx} = C_{yy}$ = 25.1 mm $r_{xx} = r_{yy}$ = 27.5 mm r_{vv} = 17.5 mm $I_{xx} = I_{yy} = 104 \times 10^4$ mm^4

KL/r :	80	90	100	110	120	130
fcd (N/mm^2) :	136	121	107	94.6	83.7	74.4

c) A simply supported beam has span 5 m and it carries a load of 35 kN at its centre. Check whether ISLB 600 is suitable for i) shear and ii) deflection. The section properties of ISLB 600 are b_f = 210 mm, t_f = 15.5 mm, tw = 10.5 mm, R_1 = 20 mm, $Z_{xx} = 2430 \times 10^3$ mm^3, $Z_p = 2798.56 \times 10^3$ mm^3, $I_{xx} = 728 \times 10^6$ mm^4 (Ignore self weight of beam).

3. Attempt **any four** : **(4×4=16)**

a) Define :
   i) Pitch
   ii) Gauge distance
   iii) Edge distance
   iv) End distance in bolted connections.

b) Enlist with sketch types of joints.

c) Define :
   i) Roof truss
   ii) Purlin
   iii) Pitch of truss
   iv) Ridge.

d) Purlin is subjected to bi-axial bending : Illustrate with diagram.

e) Explain the different selection criteria for type of truss.

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

   a) Draw four built up section forms of compression members.

   b) State the functions of lacing and battening systems and general requirements for lacing as per IS 800.

   c) State with reason whether ISA 90 × 90 × 8 is of semi-compact class or not. Take f_y = 250 MPa.

   d) Calculate effective length of a 7 m long column for the standard cases of end conditions
      i) both ends are fixed
      ii) one end is fixed and other is hinged.

Marks

B) Attempt **any one** : **(1×6=6)**

a) Explain with sketches three modes of failure in axial tension member.

b) Design a suitable angle section as a tie member in a truss to carry factored load of 350 kN. Use double angle section connected back to back on both sides of 10 mm thick gusset plate by means of 4 bolts of 20 mm dia. in one line.

Given α = 0.8, f_y = 250 MPa, f_u = 410 MPa.

Available sections	**Gross Area (mm^2)**
ISA 80 × 50 × 8	978
ISA 100 × 75 × 6	1014
ISA 125 × 75 × 6	1166

5. Attempt **any two** : **(2×8=16)**

a) An industrial building of size 16 m × 25 m is provided with Fink type trusses at 6 m c/c. Calculate panel point load in case of Dead load and Live load from following data :

i) Unit weight of roofing material = 160 N/m^2

ii) Self weight of purlin = 115 N/m^2

iii) Weight of bracing = 50 N/m^2

iv) Rise to span ratio = 1/5

v) No. of panels = 8.

b) A hall has Howe trusse of 6 panels for 15 m span, are spaced at 4.2 m c/c and rise of truss is 3 m. Calculate panel point load in case of Live load and Wind load.
Given Data : V_b = 39 m/s; probability factor K_1 = 1, terrain factor K_2 = 0.9, topography factor K_3 = 1; Coefficient of external wind pressure = –0.7 and normal permeability. (Cpi = ± 0.2).

c) Design a suitable slab base for an ISHB 450 to transfer a factored load of 1300 kN to foundation stratum having bearing capacity 400 kN/m^2. Assume concrete of grade M20. Draw the details.

For ISHB 450 : b_f = 250 mm, t_f = 13.7 mm f_y = 250 MPa, f_u = 410 MPa.

6. Attempt **any four** : **(4×4=16)**

a) Why laterally supported beam always preferred ? Explain any two methods to support beam laterally.

b) Explain with sketch :

i) Web buckling

ii) Web crippling.

c) Draw neat labelled sketch of bolted plate girder showing details.

d) Differentiate between gusseted base and slab base.

e) State components of a slab base with their functions.

IS : 800-2007 Equations (Formula Sheet)

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

$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$, $V_{npb} = 2.5 k_b d\, t\, f_u$

$T_{dn} = \frac{0.9 A_{nc} f_u}{\gamma_{m1}} + \beta \frac{A_{go} f_y}{\gamma_{m0}}$ where $\beta = 1.4 - 0.076\,(w/t)\,(f_y/f_u)\,(bs/Lc) \le (f_u \gamma_{m0} / f_y \gamma_{m1})$ ≥ 0.7

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

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

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

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

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

$t_s = \sqrt{\left[2.5w(a^2 - 0.3b^2)\gamma_{m0}/fy\right]} > t_f$

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