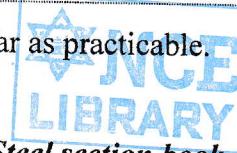


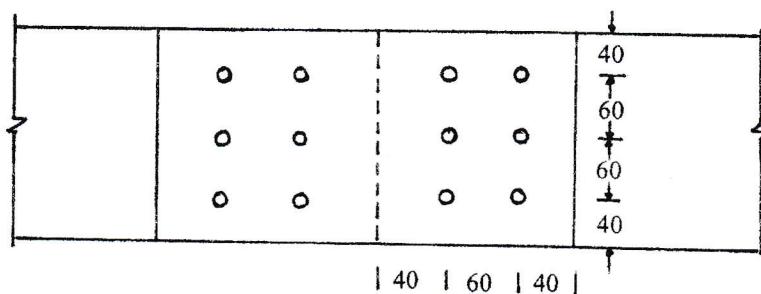
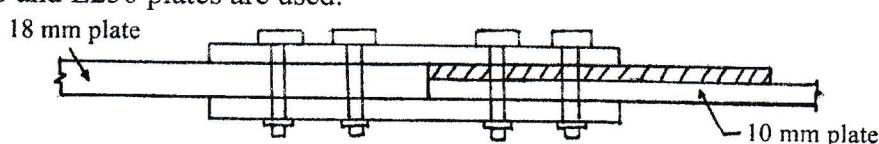
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Design of Steel and Timber Structure (CE651)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ IS 800:2007 (Code of Practice for General Construction in Steel), Steel section book, IS 875:1987 and IS 883: 1994 (Design of Structural Timber in Building) are allowed to use.
- ✓ Assume suitable data if necessary.



1. Two plates, 10 mm and 18 mm thick are connected by a double cover butt joint using 6 mm plates as shown in figure below. Find the strength of the joint. Given M20 bolts of grade 4.6 and E250 plates are used. [8]



[All dimensions in mm]

2. Which design philosophies are used for the design of steel structures? [4]
3. Design welded connection to connect ISA 100×100×10 with gusset plate of thickness 12mm. [6]
4. Design of braced built-up column using double channel-section, having unsupported length 3.0m, subjected to factored axial load of 1600 kN. Use single lacing as lattice member and bolted connection to connect lacing and column. The ends of the columns are effectively held in position at both ends but not restrained against rotation. [14]
5. Draw neat sketch of column slab base and write down design procedure. [6]
6. Design a laterally supported beam of 4 m span subjected to design imposed load of 45 kN/m and a concentrated load of 100 kN at mid span. The load is transferred through stiff bearings of 300 mm width at the supports. The depth of beam is limited to 350 mm. Also check for deflection. [12]
7. Describe process to determine optimum size of web and flange plate in plate girder. [3+3]
8. Describe design procedure of steel purlins in roof truss. [6]
9. A roof truss building (20m ×30m) has height 5m up to eaves level and rise of a truss is 2m and is designed for the highly- dense city (Kathmandu). The minimum lifetime of the structure is 50 years. The site should be located 15m above the mean ground level and 100m far. If the crest level of the ridge is 200m from mean ground level, determine the maximum wind force on the roof truss. [8]
10. Design a spaced column 3.5m long of Sal timber to carry 120kN load. [10]

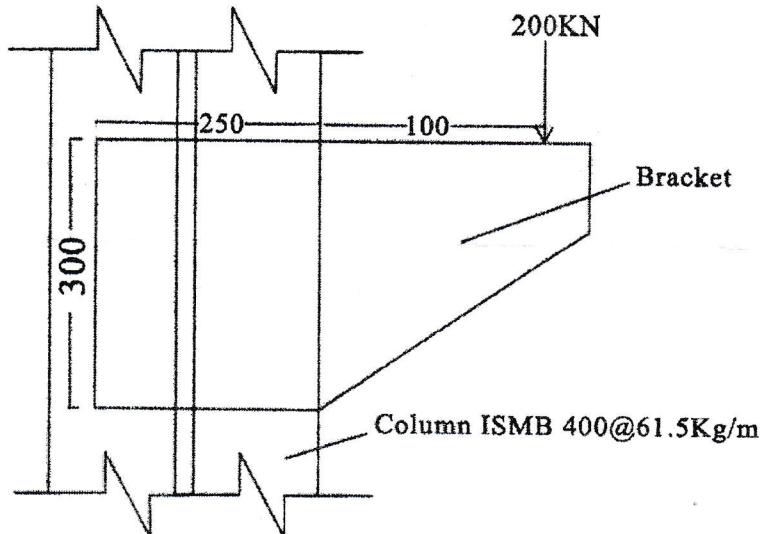
TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2077 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Design of Steel and Timber Structure (CE 651)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ IS 800-2007, IS 875-1987, IS 883-1994 and Structural Steel Books are allowed to use.
- ✓ Assume suitable data if necessary.

1. a) What is the safety and serviceability requirements of structures. [8]
- b) A bracket plate is welded to the flanges of a column section ISMB 400 @ 61.5kg/m as shown in figure below. If the width of weld is 250mm, depth 300mm and eccentricity from the face of column is 100mm. Determine the size of the weld to support a factorized load of 200KN. [12]



2. a) Calculate the moment carrying capacity of laterally unrestrained beam made of ISMB500 and length of member is equal to 6m. Assume necessary data suitably. [10]
- b) Design slab base for a column SC300 carrying factor axial lead of 1200KN if concrete grade used is M20. [10]
3. a) Design a suitable angle section to carry a factored tensile force of 250KN assuming a single row of M20 bolts. The yield strength and ultimate strength of the material is 250MPa and 410MPa respectively. The length of member is 3m. [10]
- b) Design a 5m long rectangular box columns built up by 5cm thick Sal wood planks to carry on axial load 400KN. [10]
4. a) Determine wind load on a roof truss for an industrial building with 40m span and 100m length. The roofing is galvanized iron sheeting. The basic wind speed is 47m/s and terrain is open industrial area and building is class A. The clear height of building at the eaves level is 10m. [10]
- b) Design a gusseted base for a column ISHB 350 @ 710 N/m with two plates 450mm×20mm carrying factored load 2000KN. The column is to be supported on Concrete pedestal with M20 grade concrete. [10]

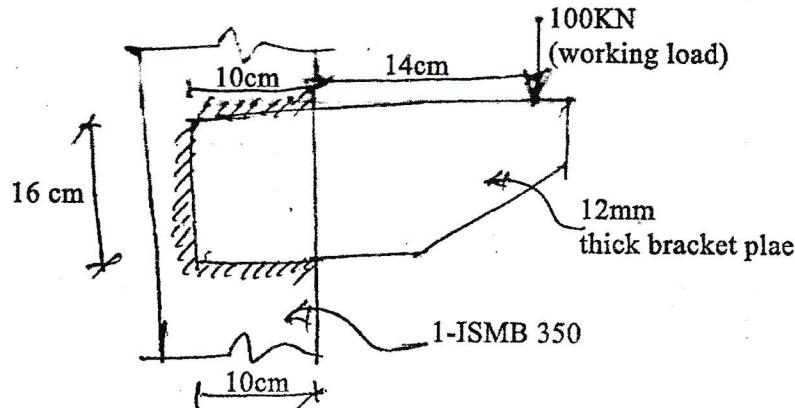
TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2076 Baisakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Design of Steel and Timber Structures (CE 651)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Show the results with sketches when and where required.
- ✓ IS 800:2007 (Code of Practice for General Construction in Steel), Steel section book, IS 875 and IS 883:1994 (Design of Structural Timber n Building) are allowed to use.
- ✓ Assume suitable data if necessary.

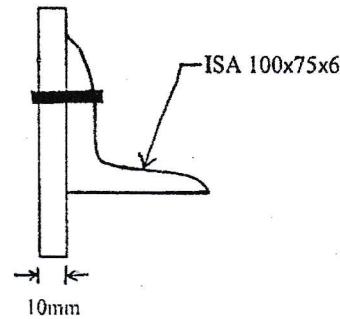
1. a) Design a built-up column to carry an axial load of 12 00kN and composed of two channels placed back to back. The effective length of the member is 6m. Design the column using battens system and Fe410 grade of steel. [12]
- b) Explain about the different components of welded plate girder with detail sketch. How can you select a section of welded plate girder. Give briefly design procedure. [4+4]
2. a) Write the difference between working stress method and limit state method with sketches. [6]
- b) Determine the size of fillet weld required to connect a bracket plate to the flange of a column as shown. [14]



3. a) An office hall measuring 16m x 6m consists of beams spaced at 3m c/c. RCC slab of 12cm is cast over the beam. The imposed load is 3kN/m². The beam is supported on 300mm wall. The comparison flange is supported throughout its length. Design intermediate beam and check for shear, deflection and lateral stability. [14]
- b) Find the wind pressure for design of a sloping roof of span 10m and pitch 1/4. The height of eaves is 9m above the ground. The building is situated in Kathmandu, where the basic wind speed is found to be 47 m/sec. and permeability is normal. [6]
4. a) A single unequal angle 100x75x6 is connected to a 10mm thick gusseted plate at the ends with six 16mm diameter bolts to transfer tension as shown in figure below.

Determine the design tensile strength of the angle assuming that the yield and the ultimate stress of steel used are 250 MPa and 410 MPa if the gusset plate is connected to the longer leg. Also design connection for its full capacity.

[10]



b) Design a square Deoder wood column of length 4m to be used in an open shed, to carry an axial load of 250kN.

[6]

c) Explain about types of timber and its defects. Explain the bolted joints in timber.

[2+2]

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INSTITUTE OF ENGINEERING
Examination Control Division
2076 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Design of Steel and Timber Structure (CE 651)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Four** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.
- ✓ **IS 800:2007, IS 808:1989, IS 883:1994 and IS 875:1987 (Part III) are allowed.**

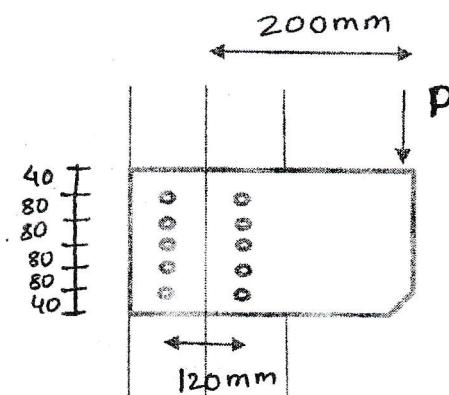
1. a) Discuss merits of Limit State Method of design over Working Stress Method of design in steel structure. [6]
- b) Design an eccentrically loaded bolted connection to connect bracket plate of thickness 12 mm with flange of column ISMB 300. Bracket plate is subjected to design load 220 kN at 90 mm from inner face of column. [14]
2. a) Explain about Buckling Behaviour of column. [6]
- b) Design a tensile member having length 2.5m, subjected to design axial load of 300 kN. Use double angle section provided at same side of gusset plate and M18 bolts to connect with gusset plate. [14]
3. a) Design a built up column using double channel section. Unsupported length of column is 6m, both end of column are restrained against lateral displacement but free in rotation. Column is subjected to design axial load of 1200 kN. Use battens. [10]
- b) Design a simply supported beam having unsupported span of 6m, support width 250 mm. Beam is subjected to imposed load (including self-weight) 20 kN/m and 100 kN from secondary beam at mid-span of beam. Ends and mid of beam is laterally restrained. [10]
4. a) What is the plate girder? Explain about preliminary design of plate girder. [8]
- b) Design a Sal timber rectangular column having length 4.0 m, subjected to axial compressive force 150 kN and bending moment 15 kNm. [12]
5. a) Find the wind pressure for design of root truss of span 20 m and slope 30°. The height of the truss root is 10m above the support. The building is in Kathmandu. [10]
- b) Design and detail a tension splice to connect 250mm×16mm flat with 250mm×8mm flat using two cover plate of thickness 6mm each to carry a tension of 400KN. Use M20 high strength bolts of the property class 8.8 if,
 - (i) No slip is permitted at the ultimate load
 - (ii) Slip is permitted at the ultimate load. Take $f_y = 250$ MPa and $f_u = 410$ MPA

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Design of Steel and Timber Structure (CE651)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.
- ✓ Use of IS: 800-2007, Steel Tables, IS: 883-1994 and IS: 875-1987, IS SP 6-1 are allowed.

1. a) In a truss angle ISA 100 100×8 is subjected to the factored tension of 200 kN. It is to be connected to a gusset using fillet welds at the toe and back. Find the length of weld required. Take Fe 410 steel. [10]
- b) Design a double angle section to carry a tension of 400 kN. The end connection to be made using M20 bolts at product grade C and property class 5.6. Assuming the angle sections are provided on the both sides of gusset plate. The steel used are E 250. [10]
2. a) Design a built up column 10 m long to carry a factored axial compressive load of 1000 kN. The column is restrained in position but not in direction at both ends. Design the column with connecting system as single lacing with bolted connection. Use two channel back to back. Assume steel of grade Fe 410, E250 C and bolts grade 4.6. [14]
- b) Explain about design process and Basis for design. [6]
3. a) Determine the safe load P that can be carried by the joint shown in figure below. Use M20 bolts of grade 4.6. The thickness of the flange of I-section is 9.1 mm and that of bracket plate 10 mm thick. [4]



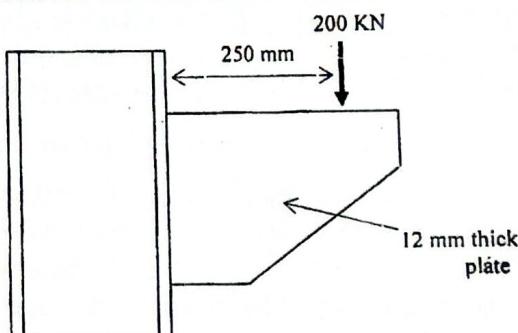
- b) Check the safety of a square column 200×200 mm in cross section. The effective length of the column is 2.5 m, the axial load and bending moment in the column are 30 kN and 1.5 kN-m respectively. The material is Debdar wood and the column is located outside the building. [8]
- c) The High Rise building at Kathmandu is to be constructed for a 50 years life; the size of the building is over 30 m. The height of the building is 50 m. determine the wind pressure at the site and force on the truss. Where basic wind speed of Kathmandu is 47 m/sec. [8]
4. a) A simply supported beam of span 6 m supports a reinforcement concrete slab. The compressive flange of the beam is restrained due to its connection with the slab. The beam is subjected to a dead load of 10 kN/m and imposed load of 30 kN. Design the beam. Assume the beam is sufficiently stiff against bearing. [14]
- b) Explain about structural timber and factors affecting the strength of timber. Write the design basis. [4+2]

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

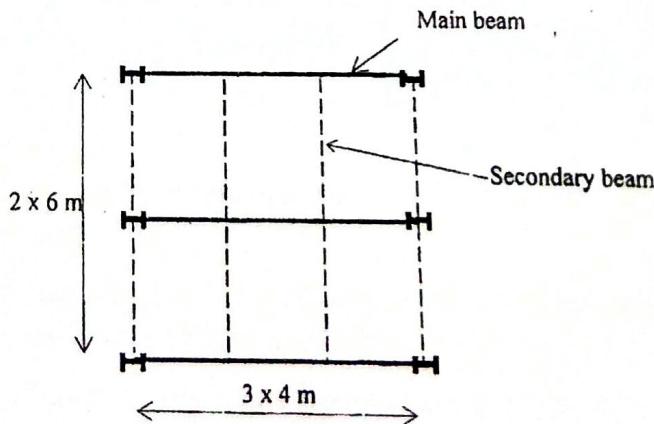
Subject: - Design of Steel and Timber Structure (CE651)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ IS 800 - 2007, IS 875 - 1987, IS 883 - 1994 and Structural Steel Section Books are allowed to use.
- ✓ Assume suitable data if necessary.

1. a) Design bolted connection for the bracket loaded as shown in figure. [12]



- b) Design a fillet welded channel section to act as a tension member subjected to an axial tensile load of 200 KN. [8]
2. Design a column section subjected to axial load of 1500 KN using rolled steel 'I' sections. Height of the column is 8 m. Both ends of column are fixed and exits sway condition. Also design lateral bracing of column using battening system. [20]
3. a) Write the design process and basis of design of steel structures. [10]
- b) A floor 12 m × 12 m in plan as shown in figure to be covered with a floor made up of secondary and main beams. The secondary beams of 5 KN/m are spaced at 3 m intervals. It supports reinforced concrete slab 125 mm thick and floor finish 0.5 KN/m². If live load on the floor is 3 KN/m², design main beam located at end of floor for bending. Compression flange of main beam is laterally restrained. [10]



4. a) Design a timber column of Sal species to carry the axial load of 50 KN. Unsupported length of column is 4 m. [10]
- b) Specify the types of timber columns according to their slenderness ratio. How the slenderness ratio is defined in solid, built-up and spaced column. [10]

Exam.		BE	Full Marks	80
Level	Programme	BCE	Pass Marks	32
Year / Part		III / II	Time	3 hrs.

Subject: - Design of steel and Timber Structure (CE651)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ IS 800-2007, IS 875-1987, IS 883-1994 and Structural steel Section Books are allowed to use.
- ✓ Assume suitable data if necessary.

1. Design a tension member of double angle section connected on the both sides of gusset plate. Member is subjected to an axial tension of 300 KN. [8]
2. Design a simply supported beam with an effective span of 6m for bending, shear and lateral stability. Beam carries a uniformly distributed load of 60 KN/m inclusive of self-weight. The beam is laterally supported. [14]
3. A timber beam of Sal of select grade carries an udl of 15 KN/m inclusive of its self-weight. The clear span of beam is 4m. Design the timber beam. Take bearing length of support = 230 mm. [12]
4. A bracket plate 12 mm thick transmits a load of 100 KN at an eccentricity of 25 cm to a column section SC 250 through 14-16 mm diameter. Product grade C and property class 4.6 bolts arranged in two vertical rows 10 cm apart. The pitch of the bolt is 8 cm and load lies in the plane of the bolts. Check the safety of the bolted joints. The grade of steel is Fe410. [10]
5. Design a built up column to carry an axial load of 1100 KN. The length of column is 8m and is effectively held in position at both ends but not restrained against rotation. Use single lacing system with bolted connection. Grade of steel E250, M10 Bolt, 4.6 grade. The built up column should consist of double channel back to back. [12]
6. Define the terms structural steel, factor of safety and partial safety factor. Explain briefly, how structural steel can resist loads even after local yielding. [3+3]
7. An ISHB 250 @ 536 N/m column carrying a factored axial load of 900KN. The column ends are machined. Design the splice connection. Use M16 bolts. [8]
8. Explain the method of calculation of wind load on roof truss. [4]
9. Design a solid wood column to resist a factored axial load of 75 KN and Factored moment of 12 KNm. The column is made of Sal wood and is 2m long. [6]

Regular			
Exam.	BE	Full Marks	80
Level	BCE	Pass Marks	32
Programme	III / II	Time	3 hrs.
Year / Part			

Subject: - Design of Steel and Timber Structure (CE651)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Use of IS 800-2007, IS 883-1994, IS 875 and steel tables are allowed.
- ✓ Assume suitable data if necessary.

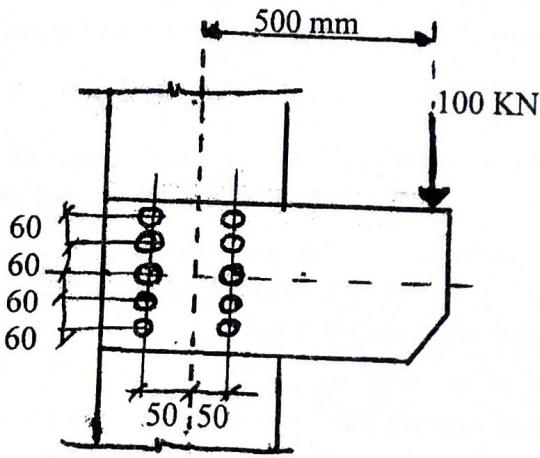
1. a) Describe different methods of design with their basic assumptions. [8]
 b) How the steel sections are classified according to their local bucking behaviors? [4]
- c) A single angle ISA 100×75×8 mm is connected to 12 mm thick gusset plate at the ends with six bolts of M20 in one row to transfer tension. Determine the design tensile strength of the angle if gusset is connected to the 100 mm leg. Take $f_y = 250 \text{ MPa}$, and $F_u = 410 \text{ MPa}$, pr.cl.4.6. [8]
2. a) Explain the method of wind load calculation in the sloped roof as per IS875. [5]
 b) A 7.5m long built-up and laced column has to carry a factored axial load of 1250KN. The column is restrained in position but not in direction at each end. Design the column with single lacing system. Connection shall consist of two channels placed back to back at a suitable spacing. [15]
3. a) Design a built up beam having laterally unsupported span of 4 m, support width 300 mm. Beam is subjected to design imposed load of 40 KN/m and 100 KN at mid span. Depth of beam is limited to 350 mm. [15]
 b) Describe use of stiffeners in plate girder with their types and their function. [5]
4. a) Design a single bolted double cover butt joint to connect boiler plates of thickness 12mm for maximum efficiency. Use M16 bolts of grade 4.6. Boiler plates are of Fe410. Find the efficiency of the joint. [10]
 b) Design a timber beam of sal wood having clear span 2.5 m, support width 300 mm and subjected to imposed load of 20 KN/m. [10]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Design of Steel and Timber Structure (CE651)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Use of IS 800-2007, IS 883-1994, IS 875 and steel tables are allowed.
- ✓ Assume suitable data if necessary.

1. a) Why limit state method is better than working stress method. Explain in brief. [5]
- b) Design a built up column 10 m long to carry a factored axial compressive load of 1080 kN. The column is restrained in position but not in direction at both ends. Design the column with connecting system as battens with bolted connection. Use two channel back to back assume steel of grade Fe 410, E250A and bolts grade 4.6. [15]
2. a) Write design procedure of steel purlin in roof truss. [5]
- b) Design a simply supported I-section beam of span 6 m supports a RCC slab. The compression flange beam is restrained due to its connection with the slab. The beam is subjected to a dead load of 25 kN/m and an imposed load of 20 kN/m. Design the beam. Assume the beam is sufficiently stiff against bearing. [15]
3. a) A shaft transmits load of 100 kN at an eccentricity of 500 mm across a bracket plate bolted to a stanchion. Two rows of bolts 100 mm apart are provided with five bolts per row. The pitch of bolts in each row is 60 mm. Find the greatest force induced in bolt. [8]



- b) Explain the design concepts of plug and slot weld and its requirement for the connection of members. [5]
- c) Design a solid sal (Select grade) wood column to resist an axial load of 500 KN and moment of 50 KN-m. The length of column is 2 m. [7]
4. a) The High Rise building at Sundhara Kathmandu is to be constructed for a 50 years life, the size of the building is $40 \times 30\text{m}^2$. The height of the building is 50 m. Determine the wind pressure at the site and force on the truss. Where basic wind speed of Kathmandu is 47 m/sec. [10]
- b) Design a slab base for a column ISHB 350 @ 710.2 N/m subjected to an factored axial compressive load of 1000 kN. Concrete pedestal of grade M20. [6]
- c) What is effect of laterally restrained and unrestrained compression flange in bending moment carrying capacity of beam? [4]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Design of Steel and Timber Structure (CE651)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.
- ✓ IS 800-2007, IS 875-1987, IS 883-1994 and Structural Steel Section Book is allowed to use.

1. a) Explain about grade and classification of structural steel as per Indian Standard. [8]
- b) Design a single angle to carry a tension of 100 kN. The end connection is to be done using M20 bolts of product Grade C and property class 4.6. The yield and ultimate strength of the steel are 250 MPa and 410 MPa respectively. [12]
2. a) What are the basic assumptions of Working Stress Design method? [4]
- b) Design column to carry an axial load of 1200 kN. The column is effectively held in position but not restrained against rotation at both ends. Design the column using two channels placed toe to toe if center to center distance between connections is 6 m. Design the column using lacing and Fe 410 steel. [16]
3. a) The building is to be constructed in core city area for a 50 years life, the size of the building is over 30 m. The height of the building is 36 m and is classified as 1st category building. Determine the wind pressure at the site and force on the truss. [10]
- b) What do you mean by safety and serviceability requirements of steel structures? Explain it. [4]
- c) Design a slab base for a column ISHB 350@ 710.2 N/m subjected to an factored axial compressive load of 1000 kN. Concrete pedestal of grade M20. [6]
4. a) Design a simply supported I-section to support the slab of a hall 9m×24m with beams spaced at 3 m c/c. The thickness of the slab is 100 mm. Consider a floor finish load of 0.5 kN/m² and live load of 3 kN/m². The grade of the steel is E250. Assume that an adequate lateral support is provided to the compression flange. [12]
- b) Design a built up salwood column fabricated with 50 mm thick and 250 mm width planks to carry an axial load of 925 kN. The effective length of the column is 3.5 m. Take E = 12700 N/mm², f_{cp} = 10.6 N/mm² constant U = 0.6 and q = 1. [8]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Design of Steel and Timber Structure (CE651)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Use of IS: 800-2007, Steel Tables, IS: 883-1994 and IS: 875-1987 are allowed.
- ✓ Assume suitable data if necessary.

1. a) Design a suitable bolted bracket connections of a 12 mm thick bracket plate to the flange of a ISHB 300 @ 577 N/m to carry a vertical factored load of 600 KN at an eccentricity of 300 mm from face of column. Consider the eccentric load not lying in the plane of bolted joints. Use M24 of grade 4.6. [12]
- b) Find the ultimate design strength of angle 100×100×10 mm in tension which is connected to a gusset 12 mm thick through 100 mm leg using M20 bolts of product Grade C and property class 4.6 in single line. Assume that the bolt threads are outside the shear plane. The yield and ultimate strength of the steel are 250 MPa and 410 MPa respectively. [8]
2. a) Design a built up column 10 m long to carry a factored axial compressive load of 1000 kN. The column is restrained in position but not in direction at both ends. Design the column with connecting system as lacing with bolted or welded connection. Use two channel back to back. Assume steel of grade Fe 410, E250 C and bolts grade 4.6. [12]
- b) Design a slab base for a column ISMB 350 @ 52.4 kg/m to carry a service load of 850 KN. Assume Fe410 grade steel and M25 concrete. [8]
3. a) Design a simply supported beam of span 3.5 m subjected to a factored bending moment of 470 KN-m and factored shear of 180 KN. The beam is laterally unsupported. Steel grade of Fe 410. Check for web bucking, web crippling and maximum deflection is required. [14]
- b) Design a built up salwood column fabricated with 50 mm thick and 250 mm width planks to carry an axial load of 925 kN. The effective length of the column is 3.5 m. Take $E = 12700 \text{ N/mm}^2$, $f_{cp} = 10.6 \text{ N/mm}^2$ constant $U = 0.6$ and $q = 1$. [6]
4. a) The bottom chord of a truss is subjected to an axial pull of 400 KN. The length of joint available is only 300 mm. Design the tension member using a single equal angle section with requirements of LUG ANGLE if necessary. Use M20 bolts of 4.6 grade and steel as Fe410. [12]
- b) The building is to be constructed in core city area for a 50 years life. The size of the building is over 30 m. The height of the building is 36 m and is classified as 1st category building. Determine the wind pressure at the site and force on the truss. [8]

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INSTITUTE OF ENGINEERING
Examination Control Division
2071 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Design of Steel and Timber Structure (CE651)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Use of IS: 800-2007, IS: 875 (II) IS: 1730-1989 and IS: 809-1989 (Steel tables); IS: 883-1995, (Timber) are allowed.
- ✓ Assume suitable data if necessary.

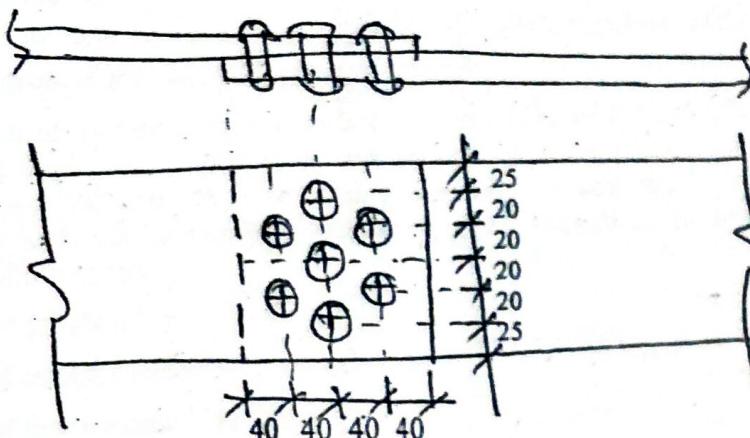
1. a) In truss ISA $90 \times 90 \times 12$ mm is subjected to the factored tension load of 100 kN. It is to be connected to a gusset using fillet welds at the toe and back. Find the length of welds required so that the centre of gravity of the welds lies in plane of the centre of gravity of angle. Fe410 [10]
- b) Find the ultimate load carrying capacity of 2 ISA $100 \times 100 \times 8$ mm in tension which is connected to both sides of gusset plate 12 mm thick using M16 bolts of property class 5.6 in single line. One shear is in shaft and another is in thread. The yield and ultimate strength of the steel are 250 MPa and 410 MPa respectively. [10]
2. a) A hall measuring $15 \text{ m} \times 6 \text{ m}$ consists of beams spaced at 3 m c/c. R.C.C. slab of 110 mm is cast over the beam. The imposed load is 4 kN/m^2 . The beam is supported on 250 mm wall. Design intermediate beam and check for shear, deflection and lateral stability. [15]
- b) Write about factor of safety and partial safety factors used in steel structures. [5]
3. a) Design a built-up column of the effective length of 5 m to carry an axial load of 900 kN using two channels and single lacing. Design the connections using bolt. The grade of the steel is Fe410. [14]
- b) Explain about elements of plate girders, web and flange splices of plates. [6]
4. a) A timber column 225×225 in cross section having an unsupported length of 3 m. Assuming the column to be of sal wood of selected grade, find the safe axial load. [8]
- b) Find the design wind pressure on a sloping roof of span 10 m and pitch $\frac{1}{4}$. The height of the eves is 6 m above ground. The building is situated in Madras and its permeability is normal. [6]
- c) Design a slab base for a column SC220 to transfer an axial load of 1000 kN. Take Fe410 grade steel and M30 for concrete. [6]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

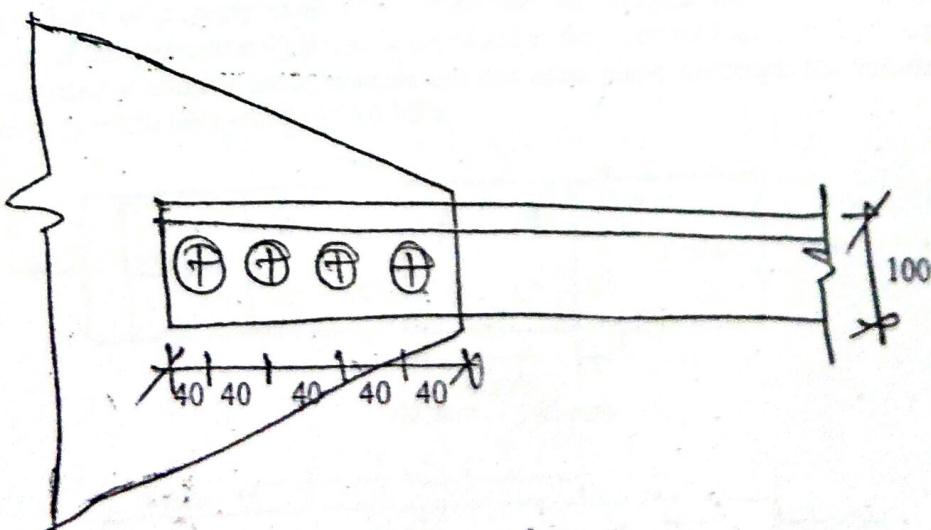
Subject: - Design of Steel and Timber Structures (CE651)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Use of IS:800-2007, IS1730-1989 and IS809:1989 (Steel tables); IS883-1995 (timber) are allowed
- ✓ Assume suitable data if necessary.

1. a) Two plates of 16 mm thick are jointed by M16 bolts of property class 8.6 in a triple staggered lap joint as shown. Show how the joint will fail and calculate efficiency of the joint. Assume Fe410 grade of plate. [10]



- b) Longer leg of a ISA 100 x 75 x 8 is connected to a gusset plate of thickness 10 mm by M16 bolts of property class 8.8 as shown. If Fe410 grade steel is used, determine the design tensile strength of the angle. [10]



2. a) Design a simply supported I section to support a moment of 700 kNm. The beam is laterally supported and grade of steel is Fe410. [14]
- b) What do you mean by structural steel? Explain classification of structural steel sections. [6]
3. a) Design a bridge compression member using two channels placed back to back to carry a factorial load of 1200 kN, if effective length of column is 8.5 m. Also design the single racing system using tie bar. [5+7]
- b) Explain about design steps of column bases. [8]
4. a) A high rise building is to be constructed in Kathmandu at city area for a 50 year life, the size of building is over 30 m. The height of building is 36 m and it is classified as 1st category building. Determine the wind pressure at the site and force on truss members. [10]
- b) Design a 5 m long rectangular box column built by 60 mm thick deodar planks to carry ax axial load of 350 kN. [10]

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INSTITUTE OF ENGINEERING
Examination Control Division
2070 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Design of Steel & Timber Structure (CE651)

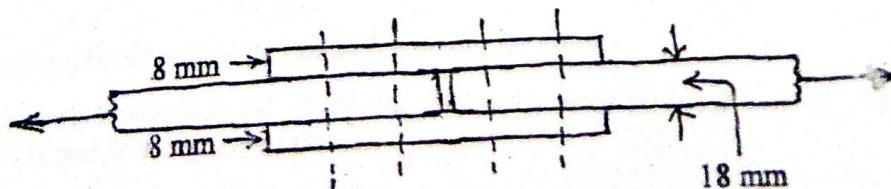
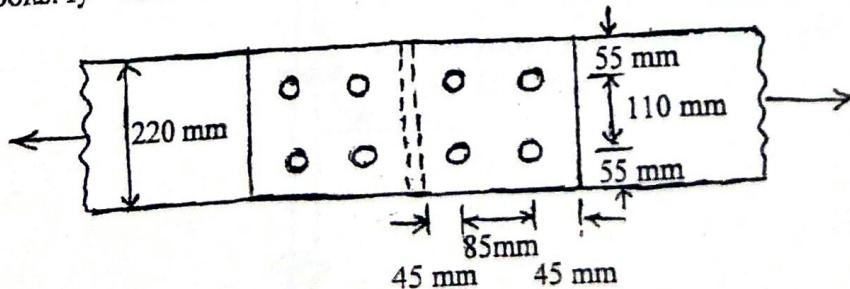
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ All questions carry equal marks.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Show the results with sketches when and where required.
- ✓ IS 800 : 2007 (Code of Practice for general construction in steel), Steel section book, IS 875 and IS 883 : 1994 (Design of Structural Timber in Building) are allowed to use.
- ✓ Assume suitable data if necessary.

1. a) A bridge compression member is built using two channels ISLC 400 @ 45.8 kg/m placed toe to toe. The effective length of the member is 8.0 m. The width over the backs of two channels is 40 cm. The channels are properly connected by lacings. [12]
 - i) Calculate the safe load for the member.
 - ii) Design the lacing systems using M16 properly class 4.6 grade bolts.
- b) Design the base plate for the column ISHB 450 to carry a factored load of 1400 kN. Take E250 grade of steel and M20 grade of concrete. [8]
2. a) A office hall of clear dimension 18 m × 6 m is provided with 12 cm thick RC slab over rolled steel beams 3 m c/c. A wearing coat of 2 cm thick lime concrete is provided over RC concrete slab. The compression flange would be supported throughout its length by providing grooves in slabs. Design an intermediate beam with the following data. [14]

Live load = 5.5 kN/m²

Unit wt. of cement concrete = 25 kN/m³

Unit wt. of lime concrete = 18 kN/m³
- b) Find the design wind pressure on a sloping roof of span 10 m and pitch 1/4. The height of the eaves is 5 m above ground. The building is situated in Delhi and its permeability is normal. [6]
3. a) Two 18 mm thick steel flats are spliced by two 8 mm thick plates with four M18 high strength bolts of property class 10.9. Determine the ultimate design load carrying capacity of the connection (i) if slip is permitted at the ultimate load and (ii) if slip is not permitted at ultimate load. Assume that one shear plane intercepts the threads of the bolts. $f_y = 250 \text{ MPa}$ and $f_u = 410 \text{ MPa}$. [14]



- b) Explain why limit state design method has become more popular than the working stress design method. [6]
4. a) Design a suitable angle section to carry a tensile force of 250 kN (Factored). The end connection is to be done by using (i) fillet welds (ii) bolts. The yield and ultimate strengths of the steel are 250 MPa and 410 MPa, respectively. [12]
- b) Differentiate between the terms "factor of safety" and "partial safety factor" in the structural steel design. Design a circular salwood column to be used in an open shed, to carry an axial load of 200 kN. The column is 3.5 m high. [8]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Design of Steel and Timber Structure (CE651)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Show the results with sketches when and where required.
- ✓ IS 800 : 2007 (Code of practice for general construction in steel), Steel section book, IS 875 and IS 883 : 1994 (Design of structural Timber in Building) are allowed to use.
- ✓ Assume suitable data if necessary.

1. a) Design a single angle (unequal angle) to carry a working tensile load of 150 KN, If the end connection is done using fillet welds. The yield and ultimate strength of the steel are 250 MPa and 410 MPa respectively. [10]

b) Design a single equal angle to carry a compression of 50 KN. The centre to centre distance between the end connections is 2.0 M. Assume that at least two bolts are used for the end connections. [10]

2. a) A building is situated in Birgunj, where the basic wind speed is found to be 60 m/sec. Find the wind pressure for the design of sloping roof of the building having following data: [6]

Angle of slope of roof, $\alpha = 28^\circ$

Building height ratio, $h/w = 0.75$

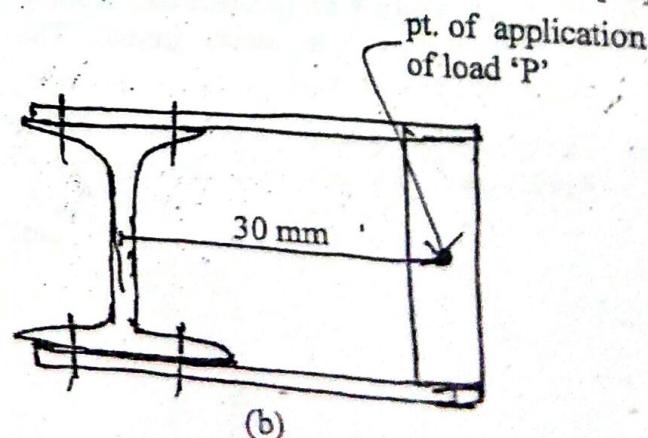
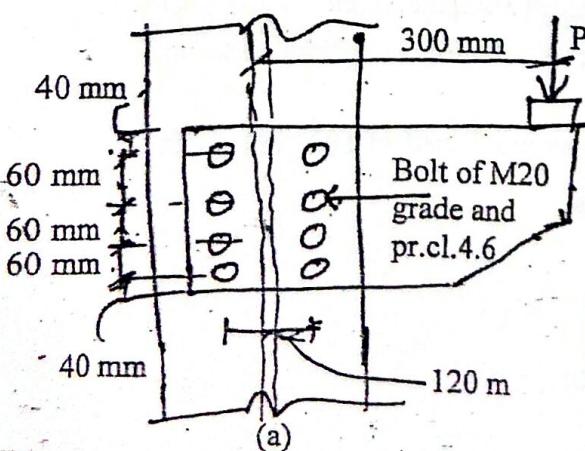
$$K_1 \times K_2 \times K_3 = 0.70$$

b) A simply supported steel beam of 6 m effective span carries a total uniformly distributed load of 46 KN/m (inclusive of self-weight). Design the beam (Fe 410 steel) if the compression flange is restrained throughout the span against lateral bending. Apply all the necessary checks. [14]

3. a) Explain the advantages and disadvantages of steel structures compared to timber structures. [4]

b) Explain in salient features of the working stress method and limit state method for structural steel design. [4]

c) If two bracket plates are connected to the flanges of the column SC 250 as shown in figure below find the design load 'P' that can be applied at an eccentricity of 300 mm. [12]



4. a) Design a deodar column 4 m long to carry an axial load of 300 kN. [10]

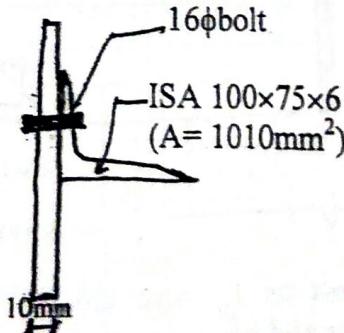
b) Design the foundation base for an ISHB 350 column to carry factored load of 120 KN. Assume steel and M20 concrete. [10]

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: -Design of Steel and Timber Structural (CE651)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Four questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.
- ✓ Use of IS:800-2007, Steel tables: IS 883-1994; IS 875:1987 (timber) are allowed.

1. a) Design a double cover butt joint to transmit a working load of 300KN to connect two flats 100mm wide and 20mm thick using M16 high strength bolts of property class 10.9 if slip is permitted at design load. The cover plates are 12mm thick. Assume that one shear plane intercepts the threads of the bolts. [10]
- b) The center to center distance between the end connections of a discontinuous strut consisting of two L75 75x8 is 3.0m. Calculate the design load carrying capacity in compression if angles are connected to the same side of a gusset by more than one bolt in each angle. The grade of the steel is E250. [10]
2. a) Find the design wind pressure on a sloping roof of span 10 meter and pitch $\frac{1}{4}$. The height of eaves is 5 meter above ground. The building is situated in Delhi and it's permeability is normal. Assume $K_1 = 1$; $K_2 = 0.8$; $K_3 = 1$. [6]
- (b) Design a built-up column of the effective length of 6m to carry an axial load of 1000KN using two channels and laces. Design the connections using welds. The grade of the steel is E250C. [14]
3. a) A beam of effective span 6.0m carries a uniformly distributed load of 30KN/m with a concentrated load of 16KN at mid span. The depth of the beam is limited to 300mm. Design the beam with additional plates to the flanges. Assume that the beam is laterally supported throughout. The grade of steel is E250. M16 bolts of property class 4.6 and product grade C may be used for connection. Checks for shear, deflection and lateral stability are necessary. [16]
- b) Discuss briefly the different types of limit states in steel design. [4]
4. a) Design the base plate for a ISHB 350 column to carry factored load of 1200KN. Take E250 grade of steel and M20 grade of concrete. [10]
- (b) A single unequal angle 100x75x6 is connected to a 10mm thick gusset plate at the ends with six 16mm diameter bolts to transfer tension as shown in figure below. Determine the design tensile strength of the angle assuming that the yield and the ultimate stress of steel used are 250MPa and 410MPa if the gusset is connected to the 100mm leg. Also design connection for its full capacity. [10]



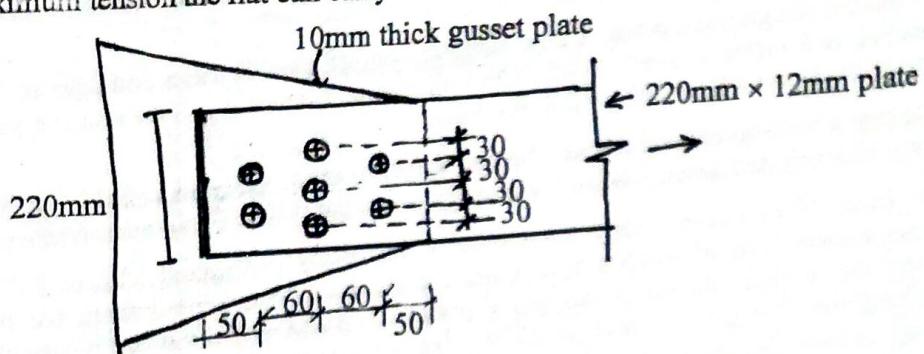
5. (a) Describe design methods and design basis for timber structure. [4]
- (b) Design a 4m long square column of deodar planks to carry an axial load of 350KN. Take outside location and select grade of timber. [12]
- (c) Explain simple timber beam and flitched beam with neat sketches. [4]

Exam.	Regular / Back
BE	80
BCE	32
III / II	3 hrs.

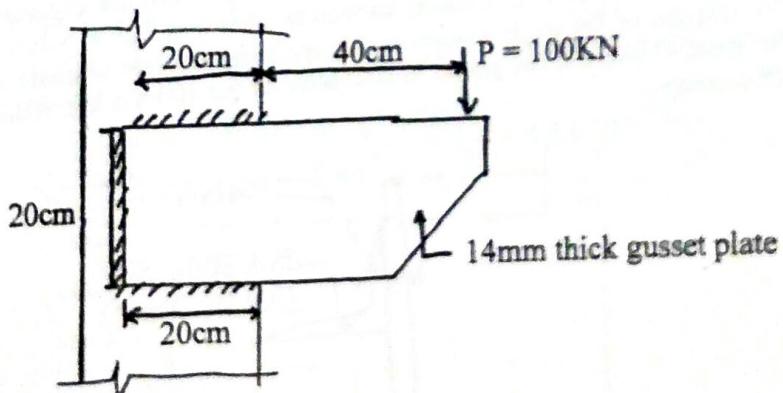
Subject: - Design of Timber and Steel Structures

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Four** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ IS 800, IS 875, IS 883 and structural steel selection book is allowed to use.
- ✓ Assume suitable data if necessary.

1. a) A flat plate ($220\text{mm} \times 12\text{mm}$) is loaded in tension and connected with 10mm thick gusset plate as shown. If the rivets are 20mm dia power driven shop rivets, calculate the maximum tension the flat can carry. [14]



- b) Describe the horizontal load resisting system in steel structure building. [6]
2. a) For the electric connection as shown, determine whether the joint is safe or not. Size of the fillet weld is 8mm and load P is equal to 100KN . Assume that permissible shear stress in the weld is 108 MPa . [14]



- b) For a steel of yield stress as f_y , what are the permissible stresses in tension compression, bending, shear and bearing according to IS 800? [6]
3. a) Design a column to carry an axial load of 800KN using two channels laced together. The length of the column is 6m and is effectively held in position at both ends but not restrained against rotation. [14]
- b) Describe the process to find thickness of slab base foundation. Show the sketch. [6]

Exam.	Back
Level	Full Marks
Programme	Pass Marks
Year / Part	Time

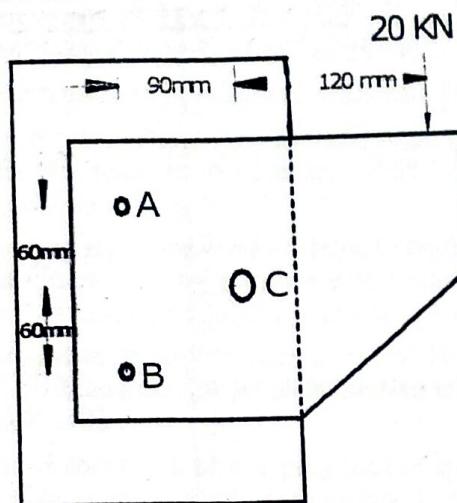
80
 32
 III / II
 3 hrs.

Subject: - Design of Timber and Steel Structures

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Four questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Use of IS:800-1984, IS 1730-1989 and IS 809:1989 or Steel section book, IS883-1995 and IS 875 are allowed.
- ✓ Assume suitable data if necessary.

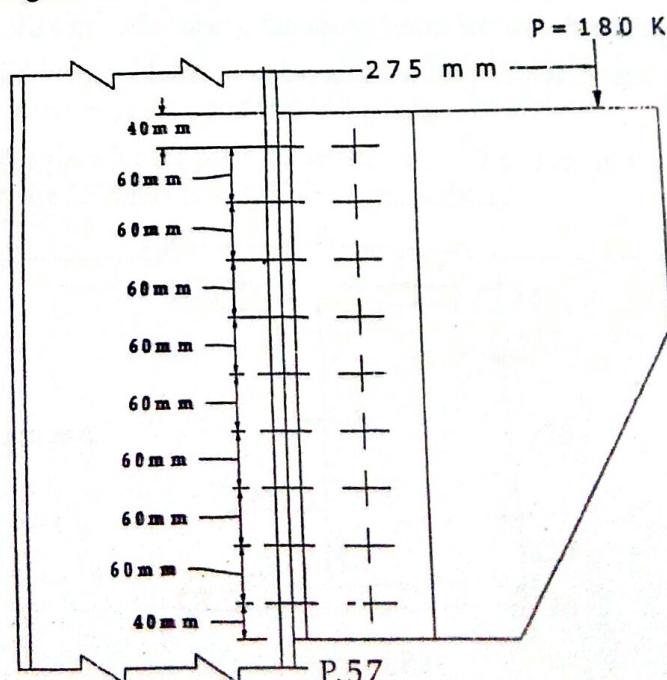
1. a) Explain the types of failures on riveted joints. [6]

b) Calculate the shear stress in the rivet B and C for the connection shown in figure below. Rivets A and B have 16mm diameter while C has a diameter of 20mm. [14]



2. a) Show the idealized stress-strain diagram for mild steel and high tensile steel used in the design of steel structures. [6]

b) Design the connection between the bracket angles 2-IAS 110x 110 x 8 mm and column using (i) power driven (hot) shop rivets (ii) Power driven (cold) shop rivets, as shown in figure below. [14]



4. a) Design a beam of 6m span carrying UDL of 20KN/m including self wt. The beam is laterally restrained by a concrete slab and is simply supported at the ends on wall of 350mm width. Check for shear, deflection, web crippling and buckling. [14]
- b) Derive a relation for economical depth of a girder. [6]
5. a) Design a purlin using suitable section for a roof-truss. Span of roof = 10m, spacing of truss is 4m and pitch is $1/4$. Assume vertical load of 500N/m (including self wt) and wind load 2 KN/m. [10]
- b) If a sal-wood column of 25cm \times 25cm has a length of 4m, determine whether the column can carry 200KN axial load and 20KNm bending moment. Assume suitable data if necessary. [10]
