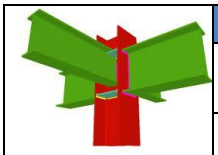
	Course Title: **DESIGN OF STEEL AND MASONARY STRUCTURES**		
	Credits (L:T:P) **4:0:0**	Total Contact Hours: **52**	Course Code: 15CE61T
	Type of Course: **Lecture, Mini projects**	**Credit :04**	Core/ Elective: **Core**
CIE -25 Marks			SEE-100 Marks

Pre-requisite: Knowledge of Strength of Materials, Material-Testing Lab, Materials of Construction.

Course Objectives

1. To provide basic knowledge in the areas of limit state method and the concept of design of structural steel elements.
2. To enable the students to identify, formulate, and solve engineering problems related to steel structural elements and masonry structures.
3. To give procedural knowledge to design a system, component or process as per needs and specifications of steel elements such as beams, tension members, compression members, bolted and welded connections subjected to various load combinations.
4. To imbibe the culture of professional and ethical responsibilities by following codal provisions in the analysis, design and detailing of steel elements.
5. Ability to engage in lifelong learning with the advancement in Steel and masonry structures.

Course Outcomes

At the end of the course the students should have the ability to:

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Use the basic knowledge of limit state method[#] to classify the various structural elements.	R/U	1,2,3,4,5,7	04
CO2	Develop the various types of structural connections considering different failure criteria and test their adequacy.	R/U/Ap/Ay	1,2,3,4,5,7	12
CO3	Design the flexural members considering the various failure patterns as per codal provisions.	R/U/Ap/Ay/C	1,2,4,5	07
CO4	Design the tension members considering the various failure patterns as per codal provisions.	R/U/Ap/Ay/C	1,2,4,5	09
CO5	Estimate the load carrying capacity of compression members and to propose suitable type of base.	R/U/Ap/An/C/E	1,2,4,5	12
CO6	Assess the various forces acting on the masonry structures and propose suitable cross sectional dimensions.	R/U/Ap/ Ay/ C/E	1,2,3,4,5, 6,7,8,9,10	08
CO7	Solve suggested or identified problems in design of steel and masonry structures individually or in teams and able to present it.	R/U/Ap/ Ay/ C/E	1,2,3,4,5, 6,7,8,9,10	*
			Total sessions	**52**

Legend- R; Remember U: Understand Ap: Application Ay: Analysis C:Creation E: Evaluation

 # IS 800-2007 must be used for analysis and design.

****Related to Student activity beyond classroom hours.***

Programme outcome Attainment Matrix

Course	Programme Outcome									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
	Basic knowledge	Discipline knowledge	Experiments and Practice	Engineering Tools	Engineer and society	Environment & Sustainability	Ethics	Individual and Team work	Communication	Life long learning
Design of steel and Masonry Structures	3	3	2	2	2	1	3	2	2	3

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

UNIT	CONTENTS	HOURS
1	Introduction	04
2	2.1 Bolted Connections	06
	2.2 Welded Connections	06
3	Flexural Members	07
4	Tension Members	09
5	5.1 Compression Members	06
	5.2 Column Bases	06
6	6.1 Analysis and Design of Masonry dams.	08
	6.2 Analysis and Design of Retaining walls.	
	TOTAL	**52**

Note:* IS 800-2007 must be used for analysis and design.

UNIT	CONTENTS	HOURS

1	**Introduction to Limit state design of steel structures** Advantages and disadvantages of Steel structures, structural steel sections, loads and load combinations, Limit state design- Design considerations, Failure criteria for steel, codal specifications and section classifications as per **IS 800-2007**.	**04**
2	**2.1 Bolted Connections** Introduction, advantages and disadvantages of bolted connections, Difference between unfinished bolts and High strength friction grip bolts (HSFG). Behaviour of bolted joints, failure of bolted joints, Simple problems on finding shear strength, bearing strength, tensile strength of bolts (bearing type only). Tensile strength of plate, Efficiency of the joint. Simple Lap Joint Design problems. Note: Excluding problems on HSFG Bolts and Long joints conditions.	**06**
	2.2 Welded Connections Introduction, advantages of welding, types of joints, weld symbols, specifications, effective area of weld, design strength of fillet weld, Simple problems on welded joints (fillet weld only).	**06**
3	**Flexural Members** Lateral buckling, Web buckling and crippling, Difference between laterally restrained and unrestrained beams, Determination of the moment capacity of laterally restrained beams. Design of laterally restrained simple beams using standard rolled steel sections only.	**07**
4	**Tension Members** Introduction, types of tension members, slenderness ratio, net area, behaviour of tension members, modes of failure, factors affecting the strength of tension member, design strength of tension member due to yielding of gross section, due to rupture of critical sections and block shear. Design of tension members.	**09**
5	**5.1 Compression Members** Columns –Classification, Boundary conditions, effective length, slenderness ratio. Design strength of Columns. Design of axially loaded Columns (Excluding Built up sections) Design of struts: Continues and Discontinues strut for given end conditions for axial load only.	**06**
	5.2Column Bases Introduction, Types of Column Bases, Slab base, Gusseted Base, Design of Slab base for axial Load.	**06**
6	**6.1 Analysis and Design of Masonry dams** Design of masonry dams with water face vertical , Distribution of pressure at foundation when the reservoir is full or empty.	**08**
	6.2 Analysis and Design of Retaining walls Theory of earth pressure – calculation of earth pressure by Rankin's method - with and without surcharge, Conditions of stability for no tension, middle third rule, Distribution of pressure at foundation, Design of masonry Retaining wall with earth face vertical.	
	TOTAL	**52**

Course Delivery: The course will be delivered through lectures, demonstration, Presentations and activities.

SUGGESTED ACTIVITIES

The topic should be related to the course in order to enhance his knowledge, practical skill & and lifelong learning, communication, modern tool usage.

1. Conduct a comparative study between a brittle and a ductile materials used in construction, Preparing a presentation report on the analysis of stress strain curve
2. Collect the map showing the Seismic zones of India and Basic wind speed throughout the country and analyse those maps.
3. Collect & Prepare a list of Indian Standard codes referred for structural steel design with the purpose of each code.
4. Prepare a chart showing various static and dynamic loads acting on the steel structures.
5. Visit a nearby construction site and identify the various types of connections used in steel structures and prepare a report. (steel Structures in railway stations, Bus terminals, Transmission towers)
6. Prepare a report and presentation on the topic "finite element analysis"
7. Prepare spread sheets for the following structural steel designs:
    a. Design of Beams
    b. Design of Columns
    c. Design of slab base
    d. Analysis and design of masonry dams
    e. Analysis and design of retaining wall
8. Prepare a report on the use of composite materials in construction and present it.
9. Collect the catalogues of various types of structural steel sections and prepare a presentation on that.
10. Prepare 2D & 3D models of various structural steel sections using CADD.
11. Prepare a report on the use of Concrete filled tubes in construction.
12. Prepare the structural detailing of designed sections as per SP 6-1 (1964): ISI Handbook for Structural Engineers -Part- 1
13. Prepare a model of Columns, Beam to beam connection, Beam to column connection slab base, masonry dams retaining wall
14. Prepare a presentation and project report on i) the different composite materials used in the construction. ii) Suspended Structures, iii) tubular structures.
15. Prepare report on Design and detailing of gantry girders
16. Prepare report on Design and detailing of Plate girders
17. Prepare report on Design and detailing of Column and beam Splices
18. Prepare report on Design and detailing of Lacings and battens
19. Prepare report on Design and detailing of Column to base connection

NOTE

1. Students should select any one of the above or other topics relevant to the subject approved by the concerned faculty, individually or in a group of 3 to 5. Students should mandatorily submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics. Weightage for 5 marks Internal Assessment shall be as follows: (Unsatisfactory 1, Developing 2, Satisfactory 3, Good 4, Exemplary5)

2. Reports should be made available along with bluebooks to IA verification officer

Example of model of rubrics / criteria for assessing student activity

Dimension	Students score (Group of five students)				
	STUDENT 1	STUDENT 2	STUDENT 3	STUDENT 4	STUDENT 5
Rubric Scale	Unsatisfactory 1, Developing 2, Satisfactory 3, Good 4, Exemplary5				
1.Literature	5				
2.Fulfill team's roles & duties	2				
3.Conclusion	3				
4.Convensions	4				
Total	13				
Average=(Total /4)	3.25=4				
Note: Concerned faculty (Course coordinator) must devise appropriate rubrics/criteria for assessing Student activity for 5 marks One activity to attain last CO (course outcome) may be given to a group of FIVE students					

Note: Dimension should be chosen related to activity and evaluated by the course faculty

Dimension	Rubric Scale				
	1 Unsatisfactory	2 Developing	3 Satisfactory	4 Good	5 Exemplary
1.Literature	Has not included relevant info	Has included few relevant info	Has included some relevant info	Has included many relevant info	Has included all relevant info needed
2. Fulfil team's roles & duties	Does not perform any duties assigned	Performs very little duties	Performs partial duties	Performs nearly all duties	Performs all duties of assigned team roles
3.Communication	Poor	Less Effective	Partially effective	Effective	Most Effective
4.Convensions	Frequent Error	More Error	Some Error	Rare Error	No Error

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)		Max Marks	Evidence collected	Course outcomes
Direct method Assessment	CIE	IA	Students	Three tests (Average of three tests)	TEST 1	20	Blue books	CO1,CO2
					TEST II			CO3,CO4
					TEST III			CO5,CO6
				Mini project		05	Reports	CO1 to CO7
	SEE	End Exam		End of the course		100	Answer scripts at BTE	CO1 to CO6
Indirect Assessment	Student Feedback on course		Students	Middle of the course			Feedback forms	CO1 to CO3, Delivery of course
	End of Course Survey			End of the course			Questionnaires	CO1 to CO7, Effectiveness of Delivery of instructions & Assessment Methods

*__CIE__ – Continuous Internal Evaluation *__SEE__ – Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Note to IA verifier: ***The following documents to be verified by CIE verifier at the end of semester***

1. Blue books (20 marks)
2. Student suggested activities report for 5 marks evaluated through appropriate rubrics.
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods

Weightage of Marks and blue print of marks for SEE

Unit	Major Topics	Hours Allotted	Questions to be set for SEE – Cognitive Levels						Marks weightage	weightage (%)	A *	B *
			R	U	Ap	Ay	C	E				
1	Introduction to Limit state design of steel structures	4	50%	50%	0%	0%	0%	0%	10	7	2	0
			5	**5**	**0**	**0**	**0**	**0**				
2	2.1 Bolted Connections 2.2 Welded Connections	12	15%	15%	28%	25%	7%	10%	35	24	1	2
			5	**5**	**10**	**10**	**2**	**3**				
3	Flexural Members	07	0%	25%	25%	25%	15 %	10%	20	14	1	1
			0	**5**	**5**	**5**	**3**	**2**				
4	Tension Members	09	0%	20%	20%	20%	20 %	20%	25	17	2	1
			0	**5**	**5**	**5**	**5**	**5**				
5	5.1Compression Members 5.2 Column Bases	12	0%	30%	30%	30%	5%	5%	35	24	1	2
			0	**10**	**10**	**10**	**2**	**3**				
6	6.1 Analysis and Design of Masonry dams 6.2 Analysis and Design of Retaining walls.	8	0%	25%	30%	30%	0%	15%	20	14	1	1
			0	**5**	**5**	**5**	**0**	**5**				
	Total	**52**	**10 %**	**30 %**	**28 %**	**20 %**	**4%**	**8%**	145	100	8	7
			10	**35**	**35**	**35**	**12**	**18**				

A*-SEE QUESTIONS TO BE SET FOR (05MARKS) in PART – A
B*- SEE QUESTIONS TO BE SET FOR (15MARKS) in PART – B

Questions for CIE and SEE will be designed to evaluate the various educational components

Sl. No	Bloom's taxonomy	% in Weightage
1	Remembering and Understanding	40%
2	Applying the knowledge acquired from the course	28%
3	Analysis	20%
4	Synthesis (Creating new knowledge)	4%
5	Evaluation	8%

Model Question Paper for CIE (Tests)

Test/Date and Time	Semester/year		Course/Course Code	Max Marks
Ex: I test/6 th week of sem 10-11 Am	**VI SEM**		Design of Steel and Masonry Structures	**20**
	Year: 2015-16		**Course code:15CE61T**	

Name of Course coordinator :
Course outcome :CO1, CO2
Note: Answer all questions

	Question	M	CL	CO	PO
1	Calculate the strength of 20 mm diameter bolt of grade 4.6 if connected by a Lap joint. The main plates to be joined are 12 mm thick. OR A tie member in a truss is 200 x 10 mm in size it is welded to a 10 mm thick gusset plate by fillet weld. The overlap of the member is 300 mm and the weld size is 6 mm determine the design strength of the joint. If the welding is done on all the three sides.	**07**	Ay	**2**	**1,2, 3,5**
2	What are the advantages of steel as a structural material?	**04**	R	**1**	**1,2, 5**
3	List some of the bolts that are used in structural connections	**02**	U	**2**	**1,2, 3,5**
4	Design a lap joint between two plates of 20 mm and 12 mm thickness, so as to transmit a factored load of 70 kN using M16 bolts of grade 4.6 and grade 410 plates. OR An 150 x 100 x 10 mm angle section is to be connected to a 10 mm thick gusset plate at site. Design the fillet weld to carry a load equal to the strength of the member.	**07**	Ap	**2**	**1,2, 5**

Note: Internal choice may be given in each CO at the same cognitive level (CL).

TEXT BOOKS

1. M.L.Gambhir "Fundamentals of Structural Steel Design" Tata Mcgraw Hill, New Delhi
2. N. Subramanian, Design of Steel Structures Limit State Method, Oxford University Press, New Delhi
3. K.S. Duggal, "Limit State Design of Steel Structures", Tata Mcgraw Hill, New Delhi
4. S. S. Bhavikatti, Design of Steel Structures (By Limit State Method As Per IS: 800 2007)
5. L.S. Negi, Design of Steel Structures Second Edition, Mcgraw Hill Education.

Reference Books/Code Books

1. Gaylord and Gaylord, "Design of Steel Structures", Mcgraw Hill Publications, New York.
2. IS 800: 2007- General Construction in Steel- Code of Practice (Third Revision)
3. SP 6-1 (1964): ISI Handbook for Structural Engineers -Part- 1.

Web Links

1. http://nptel.ac.in/courses/105106112/
2. https://www.youtube.com/watch?v=EFBTSKPW5Ek
3.https://www.youtube.com/watch?v=4rRW8ampdc&list=PL5bDhnkL5C58uqazQ_zXxEGwtkSkU-3Bj&index=2
4. https://www.youtube.com/watch?v=C4Mm3mvN1P0
5. https://www.youtube.com/watch?v=g6sSbazsyLw

Model Question Paper

Diploma in Civil Engineering

6th semester

Course title: **DESIGN OF STEEL AND MASONRY STRUCTURES**

Time; 3Hrs. **Max. marks: 100**

Use of IS 800 -2007 is Permitted in the examination hall.
Missing data may be assumed suitably.

Part – A

Answer any five questions of the following. Each question carries five marks:

1. State the advantages and disadvantages of steel as a structural material?
2. State the advantages of using wide flanged beams over narrow ISMB beams.
3. Define i) effective length of weld, ii) throat thickness of the weld, iii) size of the weld.
4. Explain the failure criteria i) web buckling ii) web crippling
5. What are the different types of tension members?
6. Write short note on i) net sectional area ii) types of failures
7. Define i) effective length, ii) Slenderness ratio
8. Name the various conditions for the stability of the dam. Describe any one of them.

Part – B

Answer any five questions of the following. Each question carries fifteen marks:

1. Find the efficiency of the lap joint shown in figure. Given M20 bolts of grade 4.6 and Fe 410 plates.

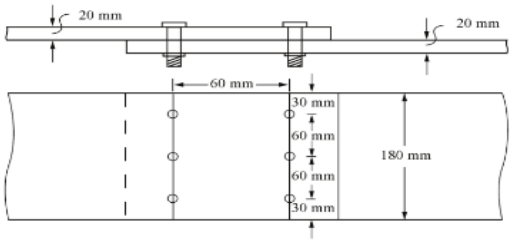


Figure 3.16

2. A tie member in a truss is 200 x 10 mm in size it is welded to a 10 mm thick gusset plate by fillet weld. The overlap of the member is 300 mm and the weld size is 6 mm determine the design strength of the joint. If the welding is done on all the three sides.

3. Design a Simply supported beam of span 5 m carrying a reinforced concrete floor capable of providing lateral restraint to the top compression flange. The beam is subjected to a dead load of 20 kN/m and imposed load of 30 kN/m. Assume Fe 410 grade steel.

4. Design a tension member using single angle section to carry a load of 100 kN. Use 16 mm diameter bolts, the length of the member is 2m. Ultimate stress= 410 N/mm^2, yield stress= 250 N/mm^2.

5. Design a column 3.5 m long in a building subjected to a factored load of 600 kN. Both the ends of the column are effectively restrained in direction and position. Use steel of grade Fe 410.

6. Design a slab base for an ISHB 450 @92.5 Kg/m carrying an axial load of 1500 kN @ working conditions. Adopt Fe 410 grade steel and M25 concrete also design the bolted connections.

7. A Masonry dam of trapezoidal section having water on vertical face is 16 m high. The base of the dam is 8 m wide and top 3 m wide. Find
a) Resultant thrust on the base per meter length of the dam
b) Point, where the resultant thrust cuts the base and
c) Intensities of maximum and minimum pressure at the base.
Take weight of masonry as 24 kN/m^3 and water as 10 kN/m^3.

Model Question Bank:

1. Introduction

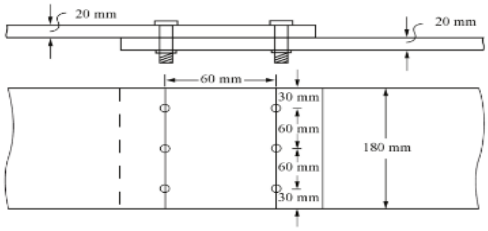
Cognitive Level: Remembering
1. State the advantages and disadvantages of steel as a structural material?
2. What are the types of structural steel?
3. What are the different types of loads acting on the steel structures?
4. What is meant by Limit state design?
5. State different limit states.
6. What is a partial safety factor?
7. Define design load.
8. Draw typical sections of structural steel sections.
9. Name some examples of steel structures.
10. Sketch the various structural shapes and name the components.

Cognitive Level: Understanding
1. Explain the different types of loads acting on the steel structures. 2. Mention the importance of load combinations in the design of steel structures. 3. State the advantages of using wide flanged beams over narrow ISMB beams. 4. Compare the limit state design method with ultimate load method and working stress method. 5. Discuss the importance of limit state of strength and limit state of serviceability in structural design. 6. Mention the important clauses used in the design of steel structural elements as per IS 800-2007

2.1 Bolted Connections

Cognitive Level: Remembering	
1	What are the advantages and disadvantages of bolted connections?
2	List some of the bolts that are used in structural connections.
3	What are the advantages of HSFG bolts?
4	Define the following i) Pitch ii) Gauge iii) Staggered pitch iv) Edge distance v) Lap
5	Define nominal diameter and gross diameter of bolt.
Cognitive Level: Understanding	
1	What are the types of failures occurring in bolted joints?
2	Write a note on minimum and maximum pitch.
3	What are the differences between unfinished and HSFG bolts.
4	What is the minimum pitch allowed in the code for bolted connections?
5	What is the minimum edge distance in the code for bolted connections?
6	What is the difference between the pitch and a staggered pitch?
7	Why minimum pitch values are specified in the code?
8	Define the efficiency of a joint. How to calculate the efficiency of a joint?
Cognitive Level: Application:	
1	Calculate the strength of 20 mm diameter bolt of grade 4.6 for the following cases. The main plates to be joined are 12 mm thick. a) Lap joint, b) Single cover butt joint: the cover plate being 8 mm thick, b) Single cover butt joint: the cover plate being 8 mm thick.
2	The plates of 6 mm thick tank are connected by a single bolted lap joint with 20 mm diameter bolts at 60 mm pitch, calculate the efficiency of the joint. Take fu of plate as 410 MPa and assume 4.6 grade of bolts.

Cognitive Level: Analysis	
1	The plates of a tank 8 mm thick are connected by a single bolted lap joint with 16 mm diameter bolts at 50 mm pitch calculate the efficiency of the joint. Take fu = 410 MPa. Assume 4.6 grade bolts.

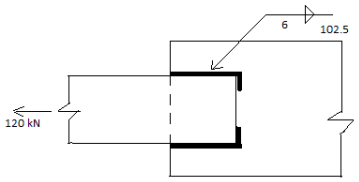
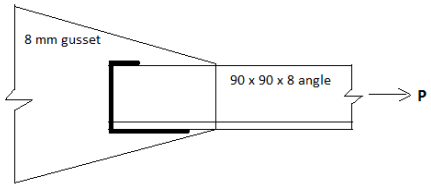
2	Find the efficiency of the lap joint shown in figure. Given M20 bolts of grade 4.6 and Fe 410 plates.  **Figure 3.16**

Cognitive Level: Application, Analysis & Evaluation	
1	Design a lap joint between two plates of 20 mm and 12 mm thickness, so as to transmit a factored load of 70 kN using M16 bolts of grade 4.6 and grade 410 plates.
2	Design a lap joint between two plates of size of 60 x 10 mm thick and 60 x 8 mm thick so as to transmit a factored load of 60 kN using a single row of M16 bolts of grade 4.6 and 410 grade plates.
3	Design a lap joint to connect two plates of 100 x 8 mm using M16 bolts and Fe-410 grade plate.
4	Two flats Fe 410 grade, each 210 mm x 8 mm are to be jointed using 16 mm diameter,4.6 grade bolts to form a lap joint, so as to transmit a load of 200 kN. Design the joint and determine the suitable pitch for the bolts.

2.2 Welded Connections

Cognitive Level: Remembering	
1	Define weld.
2	What are the advantages and disadvantages of welded joints?
3	List the various types of welded joints.
4	Define i) effective length of weld, ii) throat thickness of the weld, iii) size of the weld.
Cognitive Level: Understanding	
1	What are assumptions usually made in the analysis of welded joints.
2	What is effective area of a fillet weld?
3	What is the minimum overlap length of the plates in a lap joint?
4	What is the minimum size of the weld.

Cognitive Level: Application & Analysis	
1	A tie member in a truss is 200 x 10 mm in size it is welded to a 10 mm thick gusset plate by fillet weld. The overlap of the member is 300 mm and the weld size is 6 mm determine the design strength of the joint. If the welding is done on all the three sides.
2	A tie member in a truss ISMC 200 @ 218.763 N/m is welded to a 10 mm thick gusset plate by fillet weld. The overlap of the member is 250 mm and the weld size is 6 mm determine the design strength of the joint. If the welding is done on the two sides along the direction of load.

Cognitive Level: Application, Analysis & Evaluation	
1	Determine the size and length of the fillet weld for the lap joint to transmit a factored load of 120 kN as shown in figure, assuming site welds, Fe 410 steel, assume the width of the plate as 75 mm. 
2	An 150 x 100 x 10 mm angle section is to be connected to a 10 mm thick gusset plate at site. Design the fillet weld to carry a load equal to the strength of the member, Use IS 800-2007.
3	Design a fillet weld to join the tension member consisting of 2 ISA 100 x 75 x 8 mm to a 12 mm thick gusset plate. The factored tensile load is 410 kN.
4	A tie member of a truss consisting of an angle section ISA 100 x100x 10 mm of Fe 410 grade is welded to an 8 mm gusset plate. Design a weld to transmit a load equal to the full strength of the member.
5	Determine the effective throat dimension of a 10 mm fillet weld.
6	A tie member of a truss consisting of an angle section ISA 65 x 65 x 6 mm of Fe 410 grade is welded to an 8 mm gusset plate. Design a weld to transmit a load of 170 kN.
7	Design a joint of an angle section ISA 90 x 90 x 8 mm of Fe 410 grade when welded to a 8mm gusset plate on all the three sides as shown in the figure. 
8	A tie member of a roof truss consists of 2 ISA 100 x 75 x 8 mm the angles are connected to either side of a 10 mm gusset plates and the member is subjected to a working pull of 300 kN. Design the welded connection.
9	A tie member 75 mm X 8mm is to transmit a load of 90 kN. Design the fillet weld and calculate the necessary overlap.

3. Flexural Members

Cognitive Level: Remembering	
1	Mention the different types of sections used for beams.
2	Draw a neat sketch of ISMB 400 and mention its properties.
Cognitive Level: Understanding	
1	Mention the different types of failure in beams.
2	Differentiate between laterally restrained and laterally unrestrained beams.
3	Explain the failure criteria i) web buckling ii) web crippling

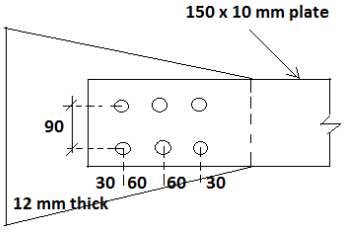
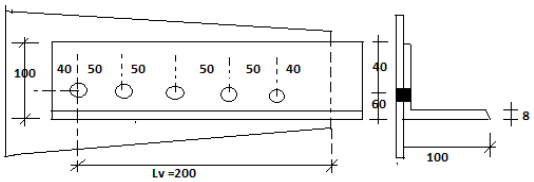
Cognitive Level: Application & Analysis	
1	Calculate the moment carrying capacity of a laterally restrained simply supported beam with ISMB 400 section for a length of 3 meters
2	Calculate the load carrying capacity of laterally restrained simply supported beam with ISMB 500 section for a length of 4 meters.

Cognitive Level: Application, Analysis & Evaluation	
1	Design a Simply supported beam of span 5 m carrying a reinforced concrete floor capable of providing lateral restraint to the top compression flange. The beam is subjected to a dead load of 20 kN/m and imposed load of 30 kN/m. Assume Fe 410 grade steel.
2	Design a Simply supported beam of span 6 m carrying a reinforced concrete floor capable of providing lateral restraint to the top compression flange. The beam is subjected to a dead load of 25 kN/m and live load of 40 kN/m. Assume Fe 410 grade steel.

4 .Tension Members

Cognitive Level: Remembering	
1	What are the different types of tension members?
2	Define tension member.
Cognitive Level: Understanding	
1	Write short note on i) slenderness ratio, ii) net sectional area iii) types of failures
2	What is meant by tensile stress? How it is calculated?

Cognitive Level: Application & Analysis	
1	An ISA 100 x 75 x 10 mm is connected by its longer leg with a gusset plate 12 mm thick with two 2-16 mm diameter bolts of grade 4.6. Determine the total net area and effective net area of the section.
2	A double angle tension member 75 x 50 x 8 mm is subjected to a service load of 300 kN it is connected to gusset plate with one line of 16 mm diameter bolts to longer legs. Determine the strength of the tension member. Assume that effective net area is equal to 0.80 times the net area.

Cognitive Level: Analysis & Evaluation	
1	Determine the tensile strength of the plate 150 mm x 10 mm connected to 12 mm thick gusset plate using M16 bolts, as shown in figure use property class 4.6 bolts. 
2	A single angle 120 x 120 x 8 mm connected to a gusset plate at the ends with 20 mm diameter bolts with the connection length of 200 mm to transfer tension determine the tensile capacity of the joint. 
3	Determine tensile strength of a channel ISJC 175 is connected to a gusset plate using 6 bolts of 16 mm diameter arranged in two rows with pitch 50 mm and edge distance 35 mm.

Cognitive Level: Application, Analysis & Evaluation	
1	Design a tension member to carry a factored tensile load of 400 kN, connected by shorter legs back to back. Length of the member is 3.0 m.
2	A T section 3.8 m long is to be provided to support a tensile load of 300 kN design the section.
3	Design a tension member using single angle section to carry a load of 100 kN. Use 16 mm diameter bolts, the length of the member is 2m. Ultimate stress= 410 N/mm2, yield stress= 250 N/mm2.

5.1 Compression Members

Cognitive Level: Remembering	
1	Define i) effective length, ii) Slenderness ratio iii) radius of gyration
2	Mention the different types of columns depending on their behaviour.
Cognitive Level: Understanding	
1	What is meant by strut?
2	Differentiate between the column and a strut.
3	Differentiate between short column and long column
4	Mention the end conditions of columns with their effective lengths as per IS standards

Cognitive Level: Application & Analysis	
1	Calculate the value of the least radius of gyration for a compound column consisting of ISHB 250 @ 536.6 N/m with one cover plate 300 x 20 mm on each flange.
2	Calculate the design compressive load for a column ISHB 350 @ 710.2 N/m, 3.5 m high. The column is restrained in direction and position at both the ends. Use steel of grade Fe 410.
3	A single angle discontinuous member ISA 120 x 120 x 10 mm with single bolted connection is 2.5 m long. Calculate the safe load carrying capacity of the section. If it is connected by one bolt at each end.
4	An ISA 100 x 100 x 6 mm (fy = 250 N/mm2) is used as a strut in a truss. The length of the strut between the intersections at each end is 3.0 m. Calculate the strength of the strut if a) it is connected by two bolts at each end b) it is connected by one bolt at each end c) it is welded at each end.
5	Calculate the strength of a discontinuous strut of length 3.2 m. The strut consists of two unequal angles 100 x 75 x 8 mm (fy = 250 N/mm2) with long legs connected and placed: a) on the opposite side of a gusset plate b) on the same side of a gusset plate

Cognitive Level: Application, Analysis & Evaluation	
1	Design a column 3.5 m long in a building subjected to a factored load of 600 kN. Both the ends of the column are effectively restrained in direction and position. Use steel of grade Fe 410.
2	Design a single angle discontinuous strut to carry a factored axial compressive load of 65 kN. The length of strut is 3.0 m between intersections. It is connected to 12 mm thick gusset plate by 20 mm diameter 4.6 grade bolts. Use steel of grade Fe 410.
3	Design a double angle discontinuous strut to carry a factored load of 175 kN. The length of the strut is 3.0 m between intersections. The two angles are placed back to back, consider the following cases:

5.2 Column Bases

Cognitive Level: Remembering	
1	Mention the types of column bases, and situations where they are used.

Cognitive Level: Understanding	
1	Differentiate between a slab base and a gusseted base.
2	State the purpose of providing anchor bolts in the column foundations.
3	What are the load transfer mechanisms considered in the design of slab base.

Cognitive Level: Application, Analysis & Evaluation	
1	Design a slab base for an ISHB 450 @92.5 Kg/m carrying an axial load of 1000 kN @ working conditions. Adopt Fe 410 grade steel and M25 concrete also design the welded connections.
2	Design a slab base for an ISHB 450 @92.5 Kg/m carrying an axial load of 1500 kN @ working conditions. Adopt Fe 410 grade steel and M25 concrete also design the bolted connections.
3	Design a slab base for a column ISHB 350 @ 710.2 N/m subjected to a factored compressive load of 1500 KN for the following conditions:

6.1 Masonry Dams

Cognitive Level: Remembering	
1	Mention the types of forces acting on the masonry dam.
2	Name the various types of dams commonly used in these days.
Cognitive Level: Understanding	
1	Name the various conditions for the stability of the dam. Describe any two of them.
2	Explain the middle third rule in a dam section.
3	What is the role of centre of gravity in the stability of the dam section?

Cognitive Level: Application, Analysis & Evaluation	
1	A Masonry dam of trapezoidal section having water on vertical face is 16 m high. The base of the dam is 8 m wide and top 3 m wide. Find a) Resultant thrust on the base per meter length of the dam b) Point, where the resultant thrust cuts the base and c) Intensities of maximum and minimum pressure at the base. Take weight of masonry as 24 kN/m^3 and water as 10 kN/m^3.
2	A masonry trapezoidal dam is 4 m high and 1 m wide at its top and 3 m wide at its bottom retains water on its vertical face. Determine the maximum and minimum stresses at the base i) when the reservoir is full ii) when the reservoir is empty. Take weight of water as 10 kN/m^3 and that of masonry as 24 kN/m^3.
3	A masonry dam, trapezoidal in section, 2 m wide at the top is 7 m in height. The face of the dam exposed to water is vertical and water level is likely to come up to the top. If the densities of concrete and water are 24 kN/m^3 and 10 kN/m^3 respectively, determine the minimum bottom width necessary so that no tension is induced at the base; also calculate the Maximum pressure intensity at the base.

6.2 Masonry Retaining Walls

Cognitive Level: Remembering	
1	Mention the types of forces acting on the retaining wall.
2	What is a retaining wall? Discuss its uses.
Cognitive Level: Understanding	
1	What are the assumptions made in Rankine's theory for calculating the earth pressure behind retaining walls?
2	Define i) Angle of repose ii) Surcharge due to back fill and surcharge due to live load
3	Differentiate between Active and Passive Earth Pressure.

Cognitive Level: Application, Analysis & Evaluation	
1	A masonry retaining wall, trapezoidal in section with vertical face exposed to earth is 1 m wide at top, 3 m wide at bottom and 6 m high. The surface of the earth is horizontal and level with the top of the wall. Determine the maximum and minimum pressure intensities at the base. Check the stability of the wall if the coefficient of friction is 0.60. Given the density of masonry 24 kN/m3 and that of earth is 16 kN/m3. The angle of repose of earth is 30°.Draw the normal stress intensity diagram below the section of the retaining wall.
2	A masonry retaining wall, trapezoidal in section with vertical face exposed to earth is 1 m wide at top, 4 m wide at bottom and 8 m high. The surface of the earth is horizontal and level with the top of the wall. Determine the maximum and minimum pressure intensities at the base. Check the stability of the wall if the coefficient of friction is 0.60. Given the density of masonry 24 kN/m^3 and that of earth is 16 kN/m^3. The angle of repose of earth is 30°.Draw the normal stress intensity diagram below the section of the retaining wall.