INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**ADVANCED STEEL DESIGN**			
Course Code	**BST006**			
Course Structure	**Lectures**	**Tutorials**	**Practicals**	**Credits**
	4	-	-	4
Course Coordinator	Mrs Praveena Rao			
Team of Instructors	Mrs Praveena Rao			

I. COURSE OVERVIEW

This course examines advanced designs of structural steel building, including consideration of torsion, lateral-torsional buckling, plastic design, plate girders, framing systems for seismic design, and principles of stability including the direct analysis method. Structural steel elements possess significant ductility and steel structures often have redundancy in the load path. As a result, there is an inherent ability to redistribute loads as localized inelasticity occurs. The use of linear elastic structural models and design methodologies limited by the design capacity of any one member do not accurately predict the behavior of steel structures at ultimate load. This course focuses on steel plasticity, plastic mechanism analysis, and the application of these concepts to design for strength and stability of steel structures. Students will gain an enhanced understanding of how steel behaves on a material level and how steel structures behave when subjected to loads large enough to cause collapse.

II. PREREQUISITE(S)

Level	Credits	Periods	Prerequisite
UG	3	3	DESIGN OF STEEL STRUCTURES

III. MARKS DISTRIBUTION

Subject	SEE Examination	CIA Examination	Total Marks
ADVANCED STEEL DESIGN	70 Marks	30 Marks	100 Marks

Semester End Examination 70 Marks All the Units (1, 2, 3, 4 and 5)	70 Marks (3 Hours)	5 questions to be answered. Each question carries 14 Marks

<table>
<tr><td rowspan="6">Average of two CIA Examinations</td><td colspan="4">Continuous Internal Assessment - 1</td></tr>
<tr><td rowspan="3">30 Marks
(2 Hours)</td><td rowspan="3">Units
I, II and
III (half)</td><td rowspan="2">Continuous Internal Examination (CIE)
(2 hours)</td><td>Part - A
5 questions to be answered out of 5 questions, each carries 1 mark.</td></tr>
<tr><td>Part - B
4 questions to be answered out of 5 questions, each carries 5 marks.</td></tr>
<tr><td>Quiz-I /Alternate Assessment Tool (AAT- I)</td><td>5 marks for assignment.</td></tr>
<tr><td colspan="4">Continuous Internal Assessment - 2</td></tr>
<tr><td rowspan="3">30 Marks
(2 Hours)</td><td rowspan="3">Units
III (half)
IV and V</td><td rowspan="2">Continuous Internal Examination (CIE)
(2 hours)</td><td>Part – A
5 questions to be answered out of 5 questions, each carries 1 mark.</td></tr>
<tr><td>Part - B
4 questions to be answered out of 5 questions, each carries 5 marks.</td></tr>
<tr><td>Quiz-II /Alternate Assessment Tool (AAT- II)</td><td>5 marks for assignment.</td></tr>
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IV. EVALUATION SCHEME

S. No	Component	Duration	Marks
1	CIE - I Examination	2 hour	25
2	Quiz - I / AAT - I	30 minutes	05
TOTAL			30
3	CIE - II Examination	2 hour	25
4	Quiz - II / AAT - II	30 minutes	05
TOTAL			30
CIA Examination marks to be considered as average of above two CIA's			
5	EXTERNAL Examination	3 hours	70
GRAND TOTAL			100

V. COURSE OBJECTIVES

The course should enable the students to:

I. Describe the basic principles bolted, welded and riveted connections.
II. Analyse beam-column connections and design the roof systems subjected to wind action.
III. Design beam, column, and frame bracing to provide structural stability.
IV. Understand and apply the design procedure of steel bridges, bunker and silos as per Indian standard codal provisions.

VI. COURSE OUTCOMES

After completing this course the student must demonstrate the knowledge and ability to:

I. Identify and compute the design loads on a typical steel building
II. Analyze and design beams and columns.
III. Analyze the strength and design beam-column connections.
IV. Analyze and design simple bolted and welded connections.
V. Design steel framing system and connections of an industrial building.
VI. Identify the different failure modes of steel tension and compression members and beams, and compute their design strengths.
VII. Select the most suitable section shape and size for tension and compression members and beams according to specific design criteria.
VIII. Design roof systems, purlins and bracings subjected to lateral wind loads.
IX. Design and analyse steel girder and truss bridges as per IS 800:2007.
X. Apply relevant IS Code provisions to ensure safety and serviceability of structural steel elements.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED

Program outcomes		Level	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	H	Assignments
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	H	Assignments
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	S	Assignments
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	S	Assignments
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	S	------
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	S	------
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	S	------

PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	N	------
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings	N	------
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions	N	------
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	N	-----
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	H	------

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED

Program Specific Outcomes		Level	Proficiency Assessed by
PSO1	**Professional skills:** Able to utilize the knowledge of aeronautical/aerospace engineering in innovative, dynamic and challenging environment for design and development of new products	S	Lectures and Assignments
PSO2	**Problem solving skills**: imparted through simulation language skills and general purpose CAE packages to solve practical, design and analysis problems of components to complete the challenge of airworthiness for flight vehicles	S	Assignments
PSO3	**Practical implementation and testing skills**: Providing different types of in house and training and industry practice to fabricate and test and develop the products with more innovative technologies.	S	Assignments

N - None **S - Supportive** **H – Highly related**

IX SYLLABUS

UNIT – I

SIMPLE CONNECTIONS –RIVETED, BOLTED PINNED AND WELDED CONNECTIONS

Riveted connection, bolted connections, load transfer mechanism, failure of bolted joints, specifications for bolted joints, bearing, type connections, tensile strength of plate, strength and efficiency of the joint, combined shear and tension, slip, critical connections, praying action, combined shear and tension for slip, critical connections. Design of groove welds, design of fillet welds, design of intermittent fillet welds, failure of welds

UNIT – II

ECCENTRIC AND MOMENT CONNECTIONS

Introduction, beams, column connections, connections subjected to eccentric shear, bolted framed connections, bolted seat connections, bolted bracketed connections. Bolted moment connections, welded framed connections, welded bracket connections, moment resistant connections.

UNIT – III

ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS

Dead loads, live loads and wind loads on roofs. Design wind speed and pressure, wind pressure on roofs; wind effect on cladding and louvers; design of angular roof truss, tubular truss, truss for a railway platform. Design of purlins for roofs, design of built up purlins, and design of knee braced trusses and stanchions. Design of bracings.

UNIT – IV

DESIGN OF STEEL TRUSS GIRDER BRIDGES

Types of truss bridges, component parts of a truss bridge, economic proportions of trusses, self-weight of truss girders, design of bridge compression members, tension members; wind load on truss girder bridges; wind effect on top lateral bracing; bottom lateral bracing; portal bracing; sway bracing.

UNIT – V

DESIGN OF STEEL BUNKERS AND SILOS

Introduction, jansen's theory, airy's theory, design of parameters, design criteria, analysis of bins, hopper bottom and design of bins.

Text Books:

1. Design of Steel Structures. P. Dayaratnam, S. Chand (2012).
2. Design Steel Structures Volume – II, Dr. Ramachandra & Vivendra Gehlot Scientitic Publishes Journals Department.
3. Limit State Design of Steel Structures S.K. Duggal Mc Graw Hill Education Private Ltd. New Delhi.

Reference Books:

1. Design of Steel Structures by Galyord & Gaylord, Tata Mc Graw Hill, Education (2012).
2. Indian Standard Code – IS:800 (2007).
3. Steel Design for Structural Engineers by B.O. Kuzamanovic and N. Willems, Prentice Hall (1997).
4. Analysis of Steel Structure by Arya & Azman

X. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Lecture No.	Course Learning Outcomes	Topics To Be Covered	Reference
1	Describe the different types of steel structure connections	Riveted connections	T2, T3,R3
2	Understand the bolted and riveted connections	Bolted connections	T3,R1
3	Understand the load transfer mechanism through the connections	Load transfer mechanism	T3,R1
4	Describe the failure of bolted joints	Failure of bolted joints	T2,T3
5	Study the specification of bolted connections as in IS 800	Specifications of bolted joints	T2, T3
6	Illustrate the types of bearings	Bearings, types of connections	T3,R3
7	Analyse the strength of plate	Tensile strength of plate	T3
8	Analyse the strength and efficiency of joints	Strength and efficiency of joints	T3
9	Design members for shear and tension	Combined shear and tension design of connections	T3,R3
10	Understand slip in connections	Slip and critical connections	T3,R3
11	Describe the prying action	Prying action	T3,R3
12	Analyse and design for shear and tension slip	Design for combined shear and tension for slip	T3,R3
13	Study the different cririical connections	Critical connections	T3,R3,R4
14	Design groove welds as per Is 800	Design of groove welds	T3,R3,R1
15	Design groove welds as per Is 800	Design of groove welds	T3,R3
16	Design fillet groove welds as per Is 800	Design of fillet welds	T1,T3,R3
17	Design fillet welds as per Is 800	Design of fillet welds	T1,T3,R3
18	Design intermittent fillet welds as per Is 800	Design of intermittent fillet welds	T3,R3
19	Design intermittent fillet welds as per Is 800	Design of intermittent fillet welds	T3,R3
20	Identify the failure modes of welded connections	Failure of welded connections	T3,R3
21	Describe the steel beams and columns	Introduction to beams, columns	T1,T3,R3
21	Design different types of beam-column connections	Beam-column connections	T3,R3
23	Design different types of beam-column connections	Beam-beam connections	T3,R3

24	Analyse connections under eccentric shear	Connections subjected to eccentric shear	T3,R3
25	Design and analyse bolted frame connections	Design bolted frame connections	T3,R3
26	Design and analyse bolted seat connections	Design of bolted seat connections	T3,R3
27	Design and analyse bracketed seat connections	Design bolted bracketed connection	T3,R3
28	Analyse the bolted moment connections	Bolted moment connections	T3,R3,R4
29	Illustrate the welded framed connections	Welded framed connections	T3,R3,R4
30	Study welded bracketed connections	Welded bracketed connections	T3,R3
31	Design moment resisted connections	Moment resistance connections	T3,R3
32	Understand the different types of load	Dead load, live loads and wind loads	T3,R3,R1
33	Understand the mechanism of wind action on roof systems	Design wind speed and wind pressure on roofs	T3,R3
34	Design different types of roofs	Design of knee braced trusses and bracings	T3,R3,R2
35	Understand the effect of wind on cladding and louvers	Wind effect on cladding and louvers, design of roof trusses	T3,R3
36	Design roof trusses, railway truss and purlins	Railway truss, tubular truss, design of purlins	T3,R3
37	Study the types of truss bridges and its component parts	Types of truss bridges, component parts, economic proportions	T1,T3,R3
38	Describe the self - weight of truss girders and design compression and tension members of bridge	Self - weight of truss girder, design of bridge compression and tension members	T1,T3,R3
39	Understand the effects of wind load on top lateral bracings	Wind load and its effect on top lateral bracings	T3,R3
40	Understand the terms portal bracing and sway bracing	Bottom lateral bracing, portal bracing and sway bracing	T3,R3
41	Study the design parameters	Introduction to Jansen’s and Airy’s theory, design parameters	T3,R3
42	Illustrate the design considerations of silos, bunkers and bins	Design criteria for silos , bins and bunkers	T3,R3
43	Design bins as per the code recommendations	Design and analysis of bins and silos	T3,R3,R4
44	Design and analyse the hopper bottoms of silos	Design of hopper bottoms	T3,R3,R4
45	Design storage bunkers as per code recommendations	Design and analysis of bunkers	T3,R3

IX. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	H	S	H	H	S	S	S		H	S	H	S	H	H	H
II	H	H	H	S	S	H	H		S	S	S	S	S	H	S
III	H	H	H	H	S	H	H		S	S	S	S	H	H	H
IV	H	H	H	S	S	H	H		H	S	H	S	H	H	H

S = Supportive **H = Highly related**

X. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF TSHE PROGRAM OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	H	S	S	H	S	H	S		S	S	S	S	H	H	H
2	H	S	S	H	H	S	S		H	H	H	S	H	H	H
3	H	S	S	S	H	H	H		S	S	S	S	S	S	S
4	H	H	S	H	H	H	H		S	S	S	S	H	S	S
5	H	S	S	S	S	S	H		S	S	S	S	S	S	S
6	H	H	S	H	H	H	H		S	S	H	S	H	S	H
7	H	S	S	S	S	S	H		S	H	H	S	S	S	H
8	H	H	S	H	H	S	H		H	H	H	S	S	S	S
9	H	S	S	S	H	S	H		S	S	S	S	H	H	H
10	H	S	S	S	H	H	S		S	S	S	S	H	H	S

S = Supportive **H = Highly related**

Prepared by: Mrs Praveena Rao, Assistant Professor

HOD, CIVIL ENGINEERING