

**INSTITUTE OF AERONAUTICAL ENGINEERING** 

(Autonomous) Dundigal, Hyderabad -500 043

# **CIVIL ENGINEERING**

# **COURSE DESCRIPTOR**

Course Title	DESIGNOF STEEL STRUCTURES AND DRAWING						
Course Code	ACE012	ACE012					
Programme	B.Tech						
Semester	VI						
Course Type	Core						
Regulation	IARE - R16						
	Theory Practical				al		
Course Structure	Lectures	Tutorials	Credits	Laboratory	Credits		
	3	1	4	-	-		
Chief Coordinator	Dr. Venu M, Professor						
Course Faculty	Dr. Venu M. Dr. U Vams	, Professor i Mohan, Profess	or				

#### I. COURSE OVERVIEW:

This course addresses mechanical properties of steel, concepts of elasticity and plasticity, concept of limit state design-Limit Sates like serviceability, and stability check. It also creates awareness and share knowledge on the design provisions as per current codes (IS 800-2007) leading to wider use in the future. This course provides a broader understanding of the behavior of steel structures as systems, in opposition to individual elements only. This course also focuses on the design of ductile steel structures. Although emphasis is placed on design concepts and strategies pertinent to steel structures, the methods presented can be applied to other materials with certain modifications. This course will help in up-gradation of knowledge / information / skills of academicians, researchers and design engineers to create environment for efficient / economic design of steel structures.

#### II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	ACE008	V	Structural Analysis	4

#### **III. MARKSDISTRIBUTION:**

Subject	SEE Examination	CIA Examination	Total Marks
Design of Steel Structures and Drawing	70 Marks	30 Marks	100

### IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

×	Chalk & Talk	~	Quiz	~	Assignments	×	MOOCs
~	LCD / PPT	×	Seminars	×	Mini Project	×	Videos
×	Open Ended Experi	ments					

### V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

**Semester End Examination (SEE):** The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into fiveunits and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

#### **Continuous Internal Assessment (CIA):**

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz / Alternative Assessment Tool (AAT).

Component	Theory		Total Marka
Type of Assessment	CIE Exam	Quiz / AAT	T OTAT MATKS
CIA Marks	25	05	30

Table 1: Assessment pattern for CIA

#### **Continuous Internal Examination (CIE):**

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

#### Quiz / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

#### VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

	Program Outcomes (POs)	Strength	Proficiency assessed
PO 1	<b>Engineering knowledge</b> : Apply the knowledge of mathematics science engineeringfundamentals and an	2	Presentation on real-world problems
	engineering specialization to the solution of complex engineering problems.		
PO 2	<b>Problem analysis</b> : Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	1	Assignments
PO 3	<b>Design/development of solutions:</b> 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.	1	Guest Lectures

**3** = High; **2** = Medium; **1** = Low

## VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

	Program Specific Outcomes (PSOs)	Strength	Proficiency assessed
PSO 1	Engineering knowledge: Graduates shall demonstrate	1	Presentation on
	sound knowledge in analysis, design, laboratory		real-world problems
	investigations and construction aspects of civil		
	engineering infrastructure, along with good foundation		
	in mathematics, basic sciences and technical		
	communication		
PSO 2	Broadness and diversity: Graduates will have a broad	-	-
	understanding of economic, environmental, societal,		
	health and safety factors involved in infrastructural		
	development, and shall demonstrate ability to function		
	within multidisciplinary teams with competence in		
	modern tool usage.		
PSO 3	Self-learning and service: Graduates will be	-	-
	motivated for continuous self-learning in engineering		
	practice and/or pursue research in advanced areas of		
	civil engineering in order to offer engineering services		
	to the society, ethically and responsibly.		

**3** = **High**; **2** = **Medium**; **1** = Low

# **VIII. COURSE OBJECTIVES :**

The cour	se should enable the students to:
Ι	Discuss the concepts of structural steel design conforming to the IS 800 design code.
II	Identify various types of structural steel and its properties also define concepts of Limit State Design.
III	Analyse structures using plastic method of analysis and evaluate collapse load and plastic moment capacity.
IV	Design compression members, beams, connections and girders.

# IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Know the materials, making of iron and steel, types of structural	CLO 1	Know the materials, making of iron and steel.
	steel, mechanical properties of steel, concepts of plasticity yield	CLO 2	Know the types of structural steel, mechanical properties of steel.
	strength, loads and combinations loading wind loads on roof trusses,	CLO 3	Know the concepts of plasticity yield strength.
	behavior of steel, local buckling. Concept of limit state design –	CLO 4	Understand loads and combinations loading wind loads on roof trusses.
	different limit states as per IS 800:2007. Design strengths	CLO 5	Understand behavior of steel, local buckling.
	deflection limits, serviceability, bolted connections, welded	CLO 6	Concept of limit state design – different limit states as per IS 800:2007.

COs	Course Outcome	CLOs	Course Learning Outcome
	connections, efficiency of joint, prying action types of welded	CLO 7	Concept of design strengths deflection limits, serviceability.
	joints, design of tension members, design strength of members.	CLO 8	Evaluate the bolted connections.
		CLO 9	Evaluate welded connections, efficiency of joint.
		CLO 10	Analyze the prying action types of welded joints.
		CLO 11	Understand the design of tension members and design strength of members.
CO 2	Know the design of compression members, buckling class,	CLO 12	Understand the design of compression members, buckling class, slenderness ratio.
	slenderness ratio, strength design, laced battened columns, column	CLO 13	Understand the strength design, laced battened columns.
	splice, column base, slab base.	CLO 14	Understand the design of column splice, column base, and slab base.
CO 3	Know the design of beams, plastic moment, and bending and shear	CLO 15	Understand the design of beams, plastic moment.
	strength laterally supported beams. Design, built up sections, large	CLO 16	Analyse the bending and shear strength laterally supported beams.
	plates web buckling, crippling and deflection of beams, design of	CLO 17	Understand the design, built up sections, large plates web buckling.
	purlin.	CLO 18	Analyse the crippling and deflection of beams, design of purlin.
CO 4	Know the design of eccentric connections with brackets, beam	CLO 19	Understand the design of eccentric connections with brackets.
	end connections, web angle, unstiffened and stiffened seated	CLO 20	Analyse the beam end connections, web angle, unstiffened and stiffened seated
	types) and design of truss joints.		connections, and design of truss joints.
CO 5	Know the design of welded plate girders, optimum depth, design of main section, design of end	CLO 21	Understand the design of welded plate girders, optimum depth, and design of main section.
	bearing stiffness and intermediate stiffness. Connection between web	CLO 22	Understand the design of end bearing stiffness and intermediate stiffness.
	and flange and design of flange splice and web splices.	CLO 23	Analyze the Connection between web and flange and design of flange splice and web splices.

# X. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE012.01	CLO 1	Know the materials, making of iron and steel.	PO 1	2
ACE012.02	CLO 2	Know the types of structural steel, mechanical properties of steel.	PO 1	2
ACE012.03	CLO 3	Know the concepts of plasticity yield strength.	PO 2	1
ACE012.04	CLO 4	Understand loads and combinations loading wind loads on roof trusses.	PO 1	2
ACE012.05	CLO 5	Understand behavior of steel, local buckling.	PO 2, PO 3	1
ACE012.06	CLO 6	Concept of limit state design – different limit states as per IS 800:2007.	PO 3	2
ACE012.07	CLO 7	Concept of design strengths deflection limits, serviceability.	PO 1	2

CLO	CLO's	At the end of the course, the student will have	PO's	Strength of
Code		the ability to:	Mapped	Mapping
ACE012.08	CLO 8	Evaluate the bolted connections.	PO 2,	1
			PO 3	
ACE012.09	CLO 9	Evaluate welded connections, efficiency of joint.	PO 2,	2
			PO 3	
ACE012.10	CLO 10	Analyze the prying action types of welded joints.	PO 1,	1
			PO 2	
ACE012.11	CLO 11	Understand the design of tension members and	PO 2,	1
		design strength of members.	PO 3	
ACE012.12	CLO 12	Understand the design of compression members,	PO 1	2
		buckling class, slenderness ratio.		
ACE012.13	CLO 13	Understand the strength design, laced battened	PO 3	1
		columns.		
ACE012.14	CLO 14	Understand the design of column splice, column	PO 1,	2
		base, and slab base.	PO 3	
ACE012.15	CLO 15	Understand the design of beams, plastic moment.	PO 1	2
ACE012.16	CLO 16	Analyse the bending and shear strength laterally	PO 1,	1
		supported beams.	PO 3	
ACE012.17	CLO 17	Understand the design, built up sections, large	ections, large PO 1 1	
		plates web buckling.		
ACE012.18	CLO 18	Analyse the crippling and deflection of beams,	PO 2,	1
		design of purlin.	PO 3	
ACE012.19	CLO 19	Understand the design of eccentric connections	PO 1	1
		with brackets.		
ACE012.20	CLO 20	Analyse the beam end connections, web angle,	PO 1,	1
		unstiffened and stiffened seated connections, and	PO 3	1
		design of truss joints.		
ACE012.21	CLO 21	Understand the design of welded plate girders,	PO 1,	1
		optimum depth, and design of main section.	PO 3	
ACE012.22	CLO 22	Understand the design of end bearing stiffness and	PO 1,	1
		intermediate stiffness.	PO 3	
ACE012.23	CLO 23	Analyze the Connection between web and flange	PO 2	1
		and design of flange splice and web splices.		
1				

**3= High; 2 = Medium; 1 = Low** 

# XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

<b>Course Outcomes</b>	Program Outcomes (POs)							
(COs)	PO 1	PO 2	PO 3	PSO1				
CO 1	2	1	1	1				
CO 2	2		1	2				
CO 3	1	1	1	1				
CO 4	1		1	1				
CO 5	2	1	1	1				

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#### XII. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning	Program Outcomes (POs)									Program Specific Outcomes (PSOs)					
Outcomes (CLOs)	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	2												2		
CLO 2	2												1		
CLO 3		1											2		
CLO 4	2												2		
CLO 5		1	2										1		
CLO 6			2												
CLO 7	2												1		
CLO 8		2	1										2		
CLO 9		2	2												
CLO 10	1	2											2		
CLO 11		2	1										1		
CLO 12	2												2		
CLO 13			1												
CLO 14	2		2										2		
CLO 15	2														
CLO 16	2		1										1		
CLO 17	1												2		
CLO 18		1	2										1		
CLO 19	1												2		
CLO 20	2		1										1		
CLO 21	2		1										2		
CLO 22	2		1										2		
CLO 23		1											1		

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# XIII. ASSESSMENT METHODOLOGIES-DIRECT

CIE Exams	PO1, PO2, PO3,PSO1	SEE Exams	PO1, PO2, PO3,PSO1	Assignments	PO1, PO2, PO3,PSO1	Seminars	-
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

# XIV. ASSESSMENT METHODOLOGIES-INDIRECT

~	Early Semester Feedback	~	End Semester OBE Feedback
×	Assessment of Mini Projects by Experts		

# XV. SYLLABUS

UNIT-I	INTRODUCTION ON MECHANICAL BEHAVIOUR OF STEEL							
Materials, mal plasticity yield local buckling deflection lim action types of	king of iron and steel, types of structural steel, mechanical properties of steel, concepts of d strength, loads and combinations loading wind loads on roof trusses, behavior of steel, . Concept of limit state design – different limit states as per IS 800:2007. Design strengths its, serviceability, bolted connections, welded connections, efficiency of joint, prying welded joints, design of tension members, design strength of members.							
UNIT-II	COMPRESSION MEMBERS							
Design of concernments of concernments of concernments of the concernment of the concernm	mpression members, buckling class, slenderness ratio, strength design, laced battened mn splice, column base, slab base.							
UNIT-III	BEAMS							
Design of bea built up sectio	ms, plastic moment, and bending and shear strength laterally supported beams. Design of ns, large plates web buckling, crippling and deflection of beams, design of purlin.							
UNIT-IV	ECCENTRIC CONNECTIONS							
Design of eco stiffened seate	Design of eccentric connections with brackets, beam end connections, web angle, unstiffened and stiffened seated connections (bolted and welded types), design of truss joints.							
UNIT-V	WELDED PLATE GIRDERS							
Design of welded plate girders, optimum depth, design of main section, design of end bearing stiffness and intermediate stiffness. Connection between web and flange and design of flange splice and web splices.								
Text Books:								
1. S. K. Dugga 2. N. Subrama	l, "Limit state design of steel structures", Tata McGraw-Hill, 3 <sup>rd</sup> Edition, 2019. nian, "Design of steel structures", Oxford University Press, 2 <sup>nd</sup> Edition,2018.							
<b>Reference Bo</b>	oks:							
<ol> <li>K. S. Sai Ram, "Design of steel structures", Pearson Education, 2010.</li> <li>Edwin H. Gaylord, Jr. Charles N. Gaylord and James Stallmeyer, "Design of steel structures", Tata McGraw-Hill Education private Limited, 3rd Edition, 2010.</li> <li>Ramachandra, "Design of steel structures Volumes 1 and 2", Standard Publications, 2009.</li> <li>S.S. Bhavikatti, "Design of steel structures", IK International Publication House, New Delhi, 2010.</li> </ol>								
Web Referen	ces:							
1. http://www.nptel.ac.in/downloads/105106112/         2. http://iitmweb.iitm.ac.in/phase2/courses/105103094/12         3. http://freevideolectures.com/Course/2679/Design-Of-Steel-Structures								
E-Text Books	:							
1. http://www.freeengineeringbooks.com/Civil/Steel-Structure-Design-Books.php 2. https://books.google.co.in/books/about/Comprehensive_Design_of_Steel_Structures.html?id=pXekq3F								

## XVI. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

		a	
Lecture	Topics to be covered	Course	Reference
No		Learning	
		Outcomes	
		(CLOs)	
1	Know the materials, making of iron and steel.	CLO 1	T1:1.1 -1.8
2-3	Know the types of structural steel, mechanical properties of steel.	CLO 2	T1:2.1-2.10
4-7	Know the concepts of plasticity yield strength.	CLO 3	R4:3.1-3.10
8-10	Understand loads and combinations loading wind loads on roof trusses.	CLO 4	T1:10.2
12-14	Understand behavior of steel, local buckling.	CLO 5	T1:10.1
15-18	Concept of limit state design – different limit states as per IS 800:2007.	CLO 6	T1: 10.4-10.5
19	Concept of design strengths deflection limits, serviceability.	CLO 7	T1: 11.1-11.8
20-22	Evaluate the bolted connections.	CLO 8	T1: 11.10 -
23-24	Evaluate welded connections, efficiency of joint.	CLO 9	T1: 3.1-3.9
25-26	Analyze the prying action types of welded joints.	CLO 10	T1: 3.10-3.12
27-28	Understand the design of tension members and design strength of members.	CLO 11	T1:3.10
29-31	Understand the design of compression members, buckling class, slenderness ratio.	CLO 12	T1: 5.1-5.3
32-34	Understand the strength design, laced battened columns.	CLO 13	T1: 5.4-5.9
35-36	Understand the design of column splice, column base, and slab base.	CLO 14	T1: 5.11-5.13
37-39	Understand the design of beams, plastic moment.	CLO 15	T1: 6.1-6.4
40-41	Analyse the bending and shear strength laterally supported beams.	CLO 16	T1: 6.5-6.12
42-44	Understand the design, built up sections, large plates web buckling.	CLO 17	T1: 6.12
45-48	Analyse the crippling and deflection of beams, design of purlin.	CLO 18	T1: 12.6
49-50	Understand the design of eccentric connections with brackets.	CLO 19	T1: 11.3-11.4
51-53	Analyse the beam end connections, web angle, unstiffened and stiffened seated connections, and design of truss joints.	CLO 20	T1: 7.1-7.3
54-56	Understand the design of welded plate girders, optimum depth, and design of main section.	CLO 21	T1: 7.4-7.8
57-60	Understand the design of end bearing stiffness and intermediate stiffness.	CLO 22	T1: 7.6.
61-64	Analyze the Connection between web and flange and design of flange splice and web splices.	CLO 23	R3: 12.11- 12.15

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	The internal behavior of the material with the externally applied loading including thermal loads.	Seminars/Guest Lectures/NPTEL	PO 2	PSO 1
2	Analysis of steel structure especially for building moments and shear force and decision making of analysis.	Seminars/Guest Lectures/NPTEL	PO 2, PO3	PSO 1
3	Torsional effects in the structure and failure criteria of the compression members.	Seminars/ Assignments	PO 2, PO 3	PSO 1

# XVII. GAPS IN THE SYLLABUS-TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

**Prepared by:** Dr. Venu M, Professor

HOD, CE