INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVILENGINEERING

COURSE DESCRIPTOR

Course Title	**ADVANCED STEEL DESIGN**				
Course Code	ACE004				
Programme	M.Tech				
Semester	II	STE			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	3	-	-
Chief Coordinator	Dr. J S R Prasad, Professor				
Course Faculty	Dr. Venu M, Professor				

I. COURSE OVERVIEW:

This course is recommended for postgraduate students in the structural engineering program who are interested in learning the design of steel structures. This course provides relevant material properties of different types of steelmaterial specifications and design considerations. It covers the behavior and design of structural steel components and helps to gain an educational and comprehensive experience in the design of simple steel structures. Italsodelivers students with a thorough understanding of the iterative nature of design and the fundamental principles on which the analyses are based. This course is mainly designed to introduce the behavior and design of tension members, compression members, laterally restrained and unrestrained beams, beam-columns and connections design.It deals with two types of connections namely welded and bolted connections.Students are expected to obtain basic knowledge about the design and failure mode of steel structural members after finishing this course.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AME002	II	Engineering Mechanics	4
UG	ACE002	III	Strength of Materials -I	4
			Load estimation skills and structural analysis capability, particularly shear and moment diagrams obtainedfrom static analysis underthe appropriate loads	

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Advanced Steel Design	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✘	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

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).

Table 1: Assessment pattern for CIA

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

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 by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Assignments/ Exams
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.	2	Assignments/ Exams
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.	2	Assignments
PO9	Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings	2	Assignments

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO1	**Engineering Knowledge**: Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	2	Lectures, Assignments
PSO2	**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.	-	-
PSO3	**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.	1	Assignments

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	learn the behavior and design of structural steel components (members and connections in two - dimensional (2D) truss and frame structures)
II	gain an educational and comprehensive experience in the design of simple steel structures
III	Obtain basic knowledge about the design and failure mode of steel structural members after finished this course.

IX. 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
ACE004.01	CLO 1	Get familiarity with the mechanical properties of steel	PO 1, PO 9	2
ACE004.02	CLO 2	Comprehension of the learned system of things	PO 1	2
ACE004.03	CLO 3	Apply or utilize the property of ductility of steel materials in structural design	PO 1	3
ACE004.04	CLO 4	Have thorough knowledge on different types of Indian standard Hot rolled sections	PO 2	2
ACE004.05	CLO 5	Appreciate the compactness and non-compactness of steel members	PO 1, PO 2	2
ACE004.06	CLO 6	know the prominence of slenderness ratio in structural behavior of members	PO 2	2
ACE004.07	CLO 7	Understand the effect of existence of residual stresses in Hot rolled sections	PO 3	2
ACE004.08	CLO 8	Get familiarity by different design processes for the design steel structures/ components	PO 1, PO 3	3
ACE004.09	CLO 9	Understand the Inelastic Bending Curvature property of steel	PO 3, PO 4	2
ACE004.10	CLO 10	Obtain the Plastic behavior of steel material	PO 3	2
ACE004.11	CLO 11	Thoroughly understand the Design criteria of steel structures	PO 1	1
ACE004.12	CLO 12	Evaluate the Stability, Strength, Drift of steel members in structures	PO 1	3
ACE004.13	CLO 13	study the buckling of beams and columns	PO 3, PO 4	1
ACE004.14	CLO 14	provide stability of columns by considering slenderness ratio and bracing of column about weak axis	PO 2, PO 4	3
ACE004.15	CLO 15	Get familiarity with allowable stress design, Plastic Design, Load and Resistance Factor Design	PO 3	1
ACE004.16	CLO 16	Thoroughly understand the Strength criteria of steel structures	PO 3, PO 4	2
ACE004.17	CLO 17	Thoroughly understand the Drift criteria of steel structures	PO 3, PO 4	2
ACE004.18	CLO 18	Design Welded, BoltedConnections Splices	PO 2, PO 3	2

3 = High; 2 = Medium; 1 = Low

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

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

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO1, PO2, PO3,PO9	SEE Exams	PO1, PO2, PO3, PO9	Assignments	PO1, PO2, PO3	Seminars	-
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XII. ASSESSMENT METHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback

✘	Assessment of Mini Projects by Experts

XIII. SYLLABUS

Unit-I	**PROPERTIES OF STEEL**
Mechanical Properties, Hysteresis, Ductility, Hot Rolled Sections: compactness and non-compactness, slenderness, residual stresses	
Unit-II	**DESIGN OF STEEL STRUCTURES**
Inelastic Bending Curvature, Plastic Moments, Design Criteria Stability, Strength, Drift. Stability of Beams: Local Buckling of Compression Flange &Web, Lateral Torsional Buckling	
Unit-III	**STABILITY OF COLUMNS AND METHOD OF DESIGNS**
Slenderness Ratio, Local Buckling of Flanges and Web, Bracing of Column about Weak Axis Allowable Stress Design, Plastic Design, Load and Resistance Factor Design	
Unit-IV	**STRENGTH CRITERIA**
Beams -Flexure, Shear, Torsion, Columns - Moment Magnification Factor, Effective Length, PM Interaction, Biaxial Bending, Joint Panel Zones	
Unit-V	**DRIFT CRITERIA AND CONNECTIONS**
Drift Criteria: P Effect, Deformation Based Design Connections: Welded, Bolted, Location Beam Column, Column Foundation, Splices	
Text Books:	
1. N. Subramanian, "Design of steel structures", Oxford University Press-2009. 2. 2. S. K. Duggal, "Limit state design of steel structures",Tata McGraw Hill, New Delhi, 2010.	
Reference Books:	
1. K.S. Sai Ram, "Design of steel structures", Pearson Education, 2010. 2. Ram Chandra, "Design of steel structures Vol. 1 and 2, Standard Publications, 1991. 3. S.S. Bhavikatti "Design of steel structures", I.K. International Publications, New Delhi, 2010. 4. IS 800, Indian Standard "Code of Practice for General Construction in Steel", Bureau of Indian Standards, Manak bhavan, New Delhi, 2007. 5. IS 808: Dimensions for Hot Rolled Steel Beam, Column, Channel and Angle Sections, Bureau of Indian Standards, Manak Bhavan, New Delhi, 1989.	
Online Available Material:	
1. NPTEL: https://nptel.ac.in/courses/105106112/19	

XIV. COURSE PLAN:

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

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	Introduction -brief recap of Mechanics of Solids, Strength of Materials, RC design- Overview of syllabus	CLO 1	Course Pre-requisites
3-4	Concepts of structural steel design and Mechanical properties of structural steel and discussion of types of loads and load combination.	CLO 1	T2:2.1-2.10
5-6	Corrosion, fire protection and fatigue failure of steel structures	CLO 1	NPTEL
7-8	Summary on metallurgy of steel	CLO 2	R4
9-10	Type of Steel Structures - Properties of Indian Standard rolled steel sections- limit state method of design - partial safety factor - general codal requirements	CLO 4	R4, R5
11-12	Introduction to Limit State Design	CLO 3	T2:2.1-2.10
13-14	Analysis procedures and design philosophy	CLO 8	R1:12.1, 12.2

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
15-16	Other design requirements	CLO 11	T1: 4.6-4.7 R1:12.3
17-19	Introduction on beams	CLO 13	T2: 6.1-6.4
20-22	Limit state design of beams	CLO 9, CLO10	T1: 6.5-6.12
23-24	Behaviour of steel beams	CLO 13	T1: 6.12
25-26	Summary on beams	CLO 2	NPTEL
27-30	Introduction on compression members	CLO 13	T2: 5.1-5.3
31-32	Elastic buckling of an ideal column or structs with pinned end	CLO 13	T2: 5.4-5.9
33-34	Strength curve for all ideal strut	CLO 12	T2: 5.4-5.9
35-38	Strength of compression members in practice	CLO 12	T2: 5.11-5.13
39-40	The concepts of effective lengths	CLO 6	T2: 5.11-5.13
41-42	Torsional and torsional-flexural buckling of columns	CLO 9	T2: 5.11-5.13
43-44	Design strength of Columns	CLO 13	T2: 5.11-5.13
45	Types of column sections	CLO 4	R5
46-47	Steps in the design of axially loaded columns	CLO 12	T2: 5.11-5.13
48-49	Summary on compression members	CLO 2	NPTEL
50	Introduction on beam columns	CLO16, CLO 17	T2: 5.1-5.3
51-52	Concept of limit state design of beam columns	CLO16, CLO 17	T2: 5.4-5.9
53-54	Design of members subjected to combined forces	CLO16, CLO 17	T2: 5.11-5.13
55-56	Summary on beam columns	CLO 2	NPTEL
57-58	Introduction on Connections	CLO 18	T2:10.2
59-60	Bolted connections	CLO 18	T2:10.2
61-62	Welding and welded connections	CLO 18	T2: 11.1-11.8
63-64	Analysis of bolt groups	CLO 18	T2: 11.9 -11.10
65-66	Analysis of weld group	CLO 18	T2: 11.10 -11.11
67-68	Beam and column splices	CLO 18	T2: 10.4-10.5
69-70	Summary on connections	CLO 2	NPTEL

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

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Performance based design of steel members	Seminars/Guest Lectures/NPTEL	PO 3, PO 9	PSO1, PSO 3
2	Earthquake Resistant Design of Steel structures	Seminars/Guest Lectures/NPTEL	PO 3, PO 9	PSO 1, PSO 3

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