INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**STEEL STRUCTURES DESIGN AND DRAWING**			
Course Code	A60130			
Regulation	R15-JNTUH			
Course Structure	**Lectures**	**Tutorials**	**Practical's**	**Credits**
	4	1	-	4
Course Coordinator	Mr. B. Suresh, Assistant Professor, Department of Civil Engineering			
Team Instructors	Mr. B. Suresh, Assistant Professor, Department of Civil Engineering Mr. G. Anil Kumar, Assistant Professor, Department of Civil Engineering			

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. PREREQUISITE(S):

Level	Credits	Periods / Week	Prerequisites
UG	4	5	Strength of Materials-I, Strength of Materials-II, and Structural Analysis

III. MARKS DISTRIBUTION:

Sessional Marks	University End Exam marks	Total marks
Midterm Test There shall be two midterm examinations. Each midterm examination consists of essay paper, objective paper and assignment. The essay paper is for 10 marks of 60 minutes duration and shall contain 4 questions. The student has to answer 2 questions, each carrying 5 marks.	**75**	**100**

Sessional Marks	University End Exam marks	Total marks
The objective paper is for 10 marks of 20 minutes duration. It consists of 10 multiple choice and 10 fill-in-the blank questions, the student has to answer all the questions and each carries half mark. First midterm examination shall be conducted for the first two and half units of syllabus and second midterm examination shall be conducted for the remaining portion. Five marks are earmarked for assignments. There shall be two assignments in every theory course. Assignments are usually issued at the time of commencement of the semester. These are of problem solving in nature with critical thinking. Marks shall be awarded considering the average of two midterm tests in each course.		

IV. EVALUATION SCHEME:

S. No	Component	Duration	Marks
1	I Mid Examination	80 minutes	20
2	I Assignment	-	5
3	II Mid Examination	80 minutes	20
4	II Assignment	-	5
5	External Examination	3 hours	75

V. COURSE OBJECTIVES:

The course is enable the students to:

I Analysis and design of steel members and connections.
II Understand the concept of buckling, shear, bending of members subjected to combined forces
III Understand the design of structural steel components (members and connections in two - dimensional (2D) truss and frame structures).
IV Ability to perform analysis and design of steel members and connections and design steel structural systems as per the latest IS code.
V Assess the effective use of the latest industry standard formulas, tables, design aids and computer software in the design of steel members.

VI. COURSE OUTCOMES:

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

1. Recognize the manufacturing process and the material properties of steel products.
2. Explain different design methodologies for the steel structures.
3. Identify the loads and loads combination acting on the members.
4. Understand the design philosophy of steel structures and the importance of limit state design method.
5. Design simple bolted and welded connections for tension and compression members and beams.
6. Analyze and design of tension members, compression members and beams.
7. Identify the effective length of compressive members.
8. Identify the different failure modes of bolted and welded connections and determine their design strengths.
9. Understand the concept of buckling, shear, bending of members subjected to combined forces.
10. Identify the yielding and rupture of critical sections
11. Analyze the concept on designing of beams and plate girders with solid webs.

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, 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.	H	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.	S	Assignments, Exams
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.	-	-
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	Assignments, Exams
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.	-	-
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.	-	-
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	-	-
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	-	-
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.	-	-
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.	-	-
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.	-	-

S= Supportive **H = Highly Related**

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Level	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.	H	Lectures, Assignments, Exams
PSO2.	**BROADNESS AND DIVERSITY:** Graduates will have a broad understanding of economical, 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.	S	Discussions
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.	-	-

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IX. SYLLABUS:

UNIT - I

Materials - Making of iron and steel - types of structural steel - mechanical properties of steel -concepts of plasticity - yield strength. Loads- and combinations loading wind loads on roof trusses, behavior of steel, local buckling. Concept of limit state design – Different limits states as per IS 800-2007- Design strengths - deflection limits – serviceability – Bolted connections – Welded connections – Design Strength – Efficiency of joint – Prying action types of welded joints – Design of Tension members – Design strength of members.

UNIT – II

Design of compress in members - buckling class, slenderness ratio / strength design - laced, - battened columns, column spice - column base, slab base.

UNIT - III

Design of Beams - Plastic moment - Bending and shear strength laterally / supported beams design - Built-up sections – large plates Web buckling Crippling and Deflection of beams, Design of Purlin.

UNIT – IV

Design of eccentric connections with brackets, beam end connections – Web angle – Un stiffened and stiffened seated connections (bolted and Welded types) Design of truss joints

UNIT - V

Design of welded plate Girders, optimum depth, design of main section - Design of end bearing stiffness bearing and intermediate stiffness. Connection between web and flange and Design of flange splice and web splices.

Text Books:

1. N. Subramanian, “Design of steel structures”, Oxford University Press-2009.
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, Newdelhi, 2007.
5. IS 808: Dimensions for Hot Rolled Steel Beam, Column, Channel and Angle Sections, Bureau of Indian Standards, Manak bhavan, New Delhi, 1989.

X. COURSE PLAN:

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

Lecture No.	Topics to be covered	Learning Objective	Reference
1-3	Making iron and steel, types of structural steel, mechanical properties of steel, concepts of plasticity, yield strength	Introduction to Materials	T2:1.1 -1.8
4-5	Limit state, design strength, deflection limits, serviceability and stability check.	Concepts of limit state design	T2:2.1-2.10
6-7	General Design Requirements**,** Limit State Design**.**	Introduction to IS 800- 2007 Code for Steel Structures	R4:3.1-3.10
8-9	Design Considerations for Bolted connections.	Design of Connections	T2:10.2
10-12	Design Considerations for Riveted connections As per IS -800-2007	Riveted connections	T2:10.1
13-15	Concepts related to Design strength and problems related to design strength	Design strength, and efficiency of joint	T2: 10.4-10.5
16-18	Types of welded joints, specifications and design requirements	Welded connections	T2: 11.1-11.8
19-20	Design of eccentric connection, framed, stiffened and seat connection	Design of Welds	T2: 11.10 -11.11
21-22	Introduction, Design considerations,	Tension Members	T2: 3.1-3.9
23-24	Design Tension member	Design strength, Design procedure, splice lug-angle.	T2: 3.10-3.12
25-27	Design of Tension member	Problem related to tension members	T2 : 3.10
28	Compression members	Introduction , possible failure Modes , Behaviour of compression member	T2: 5.1-5.3
29-31	Design of compression members	Design Considerations buckling class, slenderness ratio, strength design, laced, battened columns,	T2: 5.4-5.9

32-33	Problems on Compression members	Problems on slenderness ratio , Design of compression members	T2: 5.11-5.13
34	Design of beams	Types of Beams, lateral stability of beams, effective length, buckling of beams.	T2: 6.1-6.4
35	Design of beams	General Design considerations, Design Strength of Laterally supported beams, Design of beams.	T1: 6.5-6.12
36-38	Design of beams	Problems related to design of beams	T1: 6.12
39-41	End Bearings	Design of end bearings, Problems related to it.	T2: 12.6
42-43	Design of joints	Design of Joints for trusses	T2: 11.3-11.4
44-46	Plate Girders	Introduction to plate girders, economical depth, design of main section.	T2: 7.1-7.3
47-49	Plate Girders	Connections between web flange, design of stiffness bearing, intermediate stiffeners, design of web splice and flange splice.	T2: 7.4-7.8
50-51	Design of Plate Girders	Design of Plate girder using IS 800:2007 Problems related.	T2: 7.6.
52-54	Gantry Girders	Introduction to gantry girders, maximum load, Selection of gantry Girder.	T2: 8.1-8.4
55-56	Design of Gantry girders	Problems related To Design of Gantry girder	T2: 8.5
57-59	Design of Gantry girders	Problems related To Design of Gantry girder	T2: 8.8
60	Roof Trusses	Introduction to roof trusses , Bracings ,Types of Roof Trusses	R3: 12.1-12.2
61	Design of roof trusses	Design considerations, Nomenclature of member of trusses	R3:12.3
62	Loads on Trusses	Types of loads, load Combinations	R3:12.8-12.9
63-65	Problems related to roof trusses	Simple Problems related to load Combinations	R3: Ex 12.1-12.3
66-67	Design of roof trusses	Analysis of trusses, design of members, Design of joints, End bearings	R3: 12.11-12.15
68-69	Design of roof trusses	Design of Roof trusses	R3:Ex 12.4
69-70	Purlin design Design of Purlins	Introduction to Purlin , Design considerations Problems on design of Purlin	T2: 6.11

XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFICOUTCOMES:

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

S–Supportive **H – Highly Related**

XII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFICOUTCOMES:

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

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