



Birla Institute of Technology & Science, Pilani
Hyderabad Campus

ACADEMIC – GRADUATE STUDIES AND RESEARCH DIVISION
FIRST SEMESTER 2022-2023
Course Handout Part II

Date: 29/08/2022

In addition to part -I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : **CE G612**
Course Title : **Advance Steel Structures**
Instructor-in-charge : **Prof. Arkamitra Kar**

Course Description : Steel properties; high strength steels, structural behaviour, analysis and design; loads and environmental effects; load and resistant factor design (LRFD); column and beams; connections; member under combined loads; bracing requirements; composite members; plastic analysis and design; tall steel buildings, detailing in steel structures.

Scope and Objective of the Course:

Scope: This course deals with the analysis and designs of steel structures covering advanced topics on beam, beam-column, plate girder, composite beams and columns, moment-resistant framed connections, and industrial structures including consideration of high strength steel, loads and environmental effects, torsion, lateral-torsional buckling, plastic design, design for fatigue, and fire resistant design. Moreover, discussion on tall steel buildings and detailing in steel structures along with design of bracings has been made. Design is based on Load Resistance Factor Design Approach and/ or Limit State Design Approach.

Learning Objectives: After the successful completion of this course, the students should be able to:

1. analyze the plastic capacity of framed structures and design them by considering the local plate buckling effects.
2. design steel members for flexural-torsional, and lateral torsional buckling
3. design of plate girders and gantry girders through design example
4. design of beam, beam-column, and frame bracings along with connections to provide structural stability
5. design of industrial building systems and special structures such as Chimney may also be considered in the form of special projects.

Student Learning Outcomes (SLOs) assessed in this course – **(a), (c), (f), and (k).**

Text Books:



1. N. Subramanian, "Design of Steel Structures", Oxford University Press, December 2015.
2. Teaching Resource for Structural Steel Design, Volume 1, 2 & 3. Institute for Steel Development & Growth, ISPAT Niketan, 52/1A Ballygunge Circular Road, Kolkata 700019.

Reference Books:

1. C. G. Salmon and John E. Johnson, "Steel Structures: Design and Behavior," Fourth Edition, Prentice Hall, NJ, USA
2. M. L. Gambhir, "Fundamentals of Structural Steel Design," McGraw Hill Education Ltd., New Delhi, 2013.
3. S. K. Duggal, "Limit State Design of Steel Structures," McGraw Hill Education (India) Ltd., New Delhi, 2014.
4. P. Dayaratnam "Design of Steel Structures", Wheeler Pub. 1992.
5. E H Gaylord and C N Gaylord "Design of steel structures" McGraw Hill
6. P. Dayaratnam, "Handbook on design and detailing of structures", Wheeler Publishing 1994.
7. IS 800:2007 "Code of practice for General construction in steel "B.I.S.?"
8. IS 875 :1987 "Code of practice for design Loads"
9. Design of Steel Structures- S Ramamrutham & R. Narayanan, Dhanpat Rai, Publishing co., (P) Ltd, New Delhi, 110002, 2000.
10. B.C. Punmia, "Design of Steel Structures Volume I and II", Laxmi Publications (P) Ltd., New Delhi, 1998 (Eight edition).
11. R. Englekirk, "Steel Structures: Controlling Behavior through Design," Replika Press Pvt. Ltd. Kundli, India, 1994.
12. K. M. Ghosh, "Analysis and Design Practice of Steel Structures," PHI, New Delhi, 2010.
13. B. S. Smith and A. Coull, "Tall Building Structures: Analysis and design," Wiley India Pvt Ltd. New Delhi, 2011.
14. S. N. Manohar, "Tall Chimneys: Design and Construction," Tata McGraw Hill Publishing Company Ltd., New Delhi, 1985.
15. E. H. Gaylord, C. N. Gaylord, and J. E. Stallmeyer, "Design of Steel Structures, 3rd Edition, Tata McGraw-Hill Education Pvt. Ltd., New Delhi, 2011

Course Plan:

Lecture No.	Learning Objective	Topics Covered	Chapter in TB	SLO
1-5	Study the different loads and load combinations for the design of steel structures. Study the overview of different methods of design for steel structures.	Types of loads, types of steel for various structural elements. Types of connections for structural framing, factor of safety, partial safety factors, load factors, steel vs. concrete, standard specifications, introduction to limit states and working stress design.	TB, Ch.1 & 2	(a), (f)
6-10	Study the plastic analysis methods	Determination of Plastic-collapse load, Conditions of Plastic Analysis, Methods of	TB, Ch.4,	(a), (c)



	Study the local buckling of plates and its effect on overall strength of members	Plastic Analysis, Plastic Local Buckling of Plates, Cross-section classification, Behavior and Ultimate Strength of Plates, Design of Rigid Frames	RB#1, Ch.15	
11-15	Design and detail the steel beams	Design Criteria, permissible stresses in beams, lateral stability of beams with unrestrained compression flanges, effective length of compression flanges and lateral bracings, secondary design considerations.	TB (Ch.6)	(a), (c), (k)
16-20	Design and detail plate girders	Design of web, flanges, curtailment of flanges, connecting rivets, stiffeners, web and flange splices, economic depth of plate girders and complete design of plate girder with and without tension field approach and detailing showing locations and geometry of intermediate and bearing stiffeners. .	TB (Ch.7)	(a),(c), (k)
21-24	Design and detail gantry girders	Loading considerations, selection of gantry girders, crane girders, and complete design procedure of gantry girder through example	TB (Ch. 8)	(a),(c), (k)
25 - 30	Design and detail beam-columns	General Behavior of Beam- Columns, Design of Beam-Columns through examples, Design of Eccentrically loaded Base Plate	TB (Ch.9)	(a), (c), (k)
31 - 35	Design and detail bolted and welded connections	Moment Resisting Frame Connections, Beam-to-Beam Connections, Beam and Column Connections, Continuous Beam-to-Column Connections	TB, (Ch.10 & 11)	(a), (c), (k)
36 -39	Design an Industrial Building Systems	Selection of Roofing and Wall Materials, Selection of Bay Width, Structural Framing, Design of Purlins, Girts, Eave Strut, Plane Trusses, End Bearings, and Bracing of Trusses and Frames. Check for Stability of Frames under Primary Bending Moments, Bracing Requirements, Overall stability check when plastic hinges form.	TB (Ch.12 & 14), RB#1,	(a), (c), (k)
40 – 43	Design a Composite Steel-Concrete Columns and Beams	Composite Action, Advantages and Disadvantages of Composite Construction, Computation of Elastic Section Properties, Design Procedure using Load and Resistance Factor Design	TB (Ch.16), RB#1	(a), (c), (k)

⁺ It is mandatory for each student to have the original IS-800:2007 code book and Steel Table

***Student Learning Outcomes (SLOs):**

SLOs are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.



- (a) an ability to apply knowledge of mathematics, science and engineering
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data
- (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- (d) an ability to function on multidisciplinary teams
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (i) a recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Evaluation Scheme:

Component	Weightage (%)	Duration	Evaluation Date & Time	Nature of Component
Mid Test	25	90 min	01/11 9.00 - 10.30AM	Open book
Assignments (4 No.)	15		Continuous	Open book
Design Lab (10 No.)	15		1 per week	Open book
Projects (1 No.)	10			Open book
Comprehensive Exam	35	180 min	20/12 AN	Open book

Chamber Consultation Hour: By prior appointment only

Notices: Notice concerning to the course will be displayed through Google classroom.

Make-up Policy: Makeup will be given only to the genuine cases (medical reasons) with prior permission.

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

INSTRUCTOR-IN-CHARGE
CE G612

