Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Institute of Technology
Semester-6 (B. Tech.)

Subject: Design of Industrial Structures – BETCV16333
Type of Course: Professional Elective
Prerequisite: Knowledge of Design of Structures

Rationale: Knowledge of designing and detailing of steel structures is very important for civil engineers in order to make structures safe and serviceable during its life span. Limit State design philosophy is currently used worldwide for design of steel structures and its various components. Also, precise and correct detailing of structural drawing is necessary in order to get the correct behavior of structures and leads to smooth construction of structures. This course will provide detailed knowledge of design and detailing of steel structures as per Indian standards.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					
CI	T	P	C	Theory Marks		Practical Marks		CA	Total Marks
				ESE	MSE	V	P	ALA	
3	0	2	4	60	30	10	20	30	150

Legends: CI-Classroom Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V -- Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

Note: IS 800:2007: General Construction in Steel, SP 6 (1): handbook for Structural Engineers Structural Steel sections, IS: 875 (Part I to V) - Code of practice for structural safety of Buildings Loading standards, IS: 1893 - Criteria for earthquake resistant design of structures

Course Content:

Sr. No.	Course Content	Hrs.	% Weightage
1	**Introduction of load on Steel Connection** Loads & Load combinations: Appraisal of loading standards such as I.S, I.R.C., Effect of wind and earthquake on structure Connections: Stiffened and unstiffened, moment & shear resisting structural connections, design and detailing of various connections - roof truss to column, column to beam, beam to beam and truss to bed block.	05	10
2	**Design of Plate Girder** Modes of failure: Elastic buckling, bending in the plane of web, Local buckling, buckling in the plane of web, Vertical buckling of the compression flange, Shear buckling Design of bolted, welded plate girder by Tension field Method & Simple Post Critical Method including design of vertical & horizontal stiffeners, Splices, Curtailment. Detailing of various elements of Plate girder.	10	25
3	**Design of foot-over bridge** Structural system, Through and deck type bridges, design concept and components, Design, Design of foot-over bridge and its supporting system, including members subjected to tension and compression, Detailing, Structural detailing of truss members, supports, joints, and connections for foot-over bridge construction.	10	25
4	**Plastic Design** Introduction to plastic method of analysis, concept of plastic hinges and collapse load, Design of continuous beams and portal frames, plastic design approach, Evaluation of ultimate load capacity and formation of plastic mechanisms.	10	15
5	**Design of Gantry Girder** Introduction, Function and importance of gantry girders in industrial structures, Loading, Static and moving loads, impact factor, and lateral loads, Design, Selection and design of gantry girder section, connections, and supporting system, Detailing, Drawing and detailing of various elements of the gantry girder.	10	25

Continuous Assessment:

Sr. No.	Active Learning Activities	Marks
1	**Field Visits on Industrial Structures** Faculty will organize industrial visits to nearby industrial structures. Students (in a group) will observe structural systems, connections, and load transfer mechanisms, and interact with engineers to understand real-world design and construction challenges. Each student will prepare a detailed report and submit it on the GMIU Web Portal.	10

2	**Plastic Design Exercises** Students will perform plastic analysis of continuous beams using hand calculations. They will identify plastic hinge locations, determine bending moments and load redistribution, and compile results, calculations, and diagrams into a report. The completed report must be uploaded to the GMIU Web Portal.	10
3	**Case Study Analysis of Industrial Structures** Faculty will assign case studies of real industrial structures such as plate girder bridges, foot-over bridges, portal frames, gantry girders. Students will be divided into groups, each analyzing one structure for its purpose, structural system, load considerations, design methodology, and construction challenges. Findings will be presented through PowerPoint presentations and submitted to the GMIU Web Portal.	10
	TOTAL	**30**

Suggested Specification table with Marks (Theory): 60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage %	15%	25%	30%	30%	-	-

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course, the students should be able to:	
CO1	Understand various types of loads, load combinations, and design of different steel structural connections as per IS and IRC standards.
CO2	Analyze and design plate girders considering different modes of failure and detailing of stiffeners and splices.
CO3	Design and detail foot-over bridges with appropriate structural systems and load-carrying members.
CO4	Apply plastic analysis methods to determine ultimate load capacity of continuous beams and portal frames.
CO5	Design and detail gantry girders considering moving loads, impact effects, and industrial structure requirements.

List of Practical

Sr. No.	Descriptions	Unit No.	Hrs.
01	Solve an example to determine dead, live, wind, and earthquake loads for a given structure using IS/IRC codes.	01	04

02	Solve problems applying various load combinations for different structural systems.	01	04
03	Draw and detail stiffened and unstiffened connections for roof trusses to columns with design notes.	02	02
04	Prepare sketches of moment- and shear-resisting connections and provide detailing as per IS codes.	02	04
05	Solve a design problem for a plate girder subjected to bending and shear; include web/flange stiffeners and splice details.	03	02
06	Solve a simple numerical example for plate girder design using the Tension Field Method or Simple Post-Critical Method.	03	02
07	Draw and detail structural element for a given foot-over bridge type.	03	02
08	Solve an example of a gantry girder subjected to static and moving loads, including section design and detailing.	04	02
09	Perform plastic analysis of a continuous beam, determine plastic hinge locations, and calculate bending moments.	04	04
10	Solve a numerical example of a single-bay portal frame using plastic design concepts; sketch hinge locations and moment diagram.	05	04
TOTAL			**30**

Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory.

The internal evaluation will be done on the basis of Active Learning Assignment.

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in the laboratory.

Reference Books:

[1] Design of Steel Structures, N. Subramaniam, Oxford University Press

[2] Design of Steel Structures: By Limit State Method as Per IS: 800-2007, S. S. Bhavikatti, I K International Publishing House Pvt. Ltd

[3] "Design of Steel Structures", P. Dayaratnam, S. Chand Group

[4] Limit State Design of Steel Structures, Duggal S.K., Tata McGraw Hill Education

[5] Limit State Design of Steel Structures, B.C. Punmia, A.K. Jain & A.K. Jain, Laxmi Publications Pvt. Ltd.