Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Institute of Technology
Semester-5 (B. Tech.)

Subject: Advanced Structural Analysis – BETCV15317
Type of Course: Professional Elective Courses
Prerequisite: Knowledge of Structural Mechanics

Rationale: The study of Advanced Structural Analysis is essential for expanding upon fundamental principles and developing a comprehensive understanding of indeterminate structures, influence lines, and approximate methods. To provide students with the ability to analyze complex beams, frames, and trusses under various loading scenarios, to determine critical load paths, and to foster proficiency in utilizing advanced analytical techniques for practical structural design.

Teaching and Examination Scheme:

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

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

Course Content:

Sr. No.	Course Content	Hrs.	% Weightage
1	**Analysis of Plane Truss:** Plane Truss - assumptions used in the analysis of Truss. Perfect, imperfect and redundant truss, analysis of Truss by method of joints and method of sections.	10	20
2	**Principle Stress and Mohr Circle:** Principle stresses: Two dimensional system, stress at a point on a plane, principal stresses and principal planes. Mohr's circle of stress	09	20

3	**Influence Line Diagrams:** Structure subjected to Moving loads Influence line diagrams ILD for statically determinate beams- I.L.D of support reaction, shear force and moment bending moment for beams subjected to u.d.l and several point loads, criteria for maximum effects, ILD for statically determinate trusses, forces in members for u.d.l and point loads ILD for statically indeterminate beams: Muller-Breslau's principle, steps for obtaining I.L for reaction and internal forces in propped cantilever and continuous beams, qualitative I.L diagram for rigid jointed structures having higher degree of statically indeterminacy.	12	30
4	**Energy Methods:** Energy Principles, Approximate methods Energy Principles: Castigliano's theorems, Application of castigliano's 1st and 2nd theorem to statically determinate and indeterminate framed structure – beams, plane truss & plane frames. Approximate methods: Forces in the framed structure subjected to Vertical and lateral loads.	14	30

Continuous Assessment:

Sr. No.	Active Learning Activities	Marks
1	**"Truss Design Challenge" Model** Faculty will assign student groups to design and build a model of Truss using specified materials (e.g., candy sticks, glue, cardboard etc). The model should demonstrate the principles of truss behavior depending upon the design. Students will upload photos of their model, along with a report on GMIU Web portal	10
2	**"Case Studies of Structural Failures/Successes"** Students will prepare a Report on a real-world case study involving structural failure (e.g., bridge collapse, building damage) or a successful innovative structural design. Students will present them to the class and upload their Report on GMIU web portal.	10
3	**"Influence Lines in Action" Presentations:** Students will prepare a presentation explaining: what influence lines are and how they are used, how to draw influence lines for support reactions, shear force, and bending moment in simple beams. Students will present them to the class and upload their presentations on 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 %	20%	30%	30%	20%	-	-

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	Analyze the stresses developed in truss subjected to axial load
CO2	Determine principal stresses and strains for two dimensional system using analytical and graphical methods
CO3	Determine internal forces and reactions in determinate and indeterminate structures subjected to moving loads.
CO4	Apply energy principles in determining response of statically determinate & indeterminate structures.

List of Practical

Sr. No.	Descriptions	Unit No	Hrs
01	Solve Zero-Force Members on analysis of truss using method of joints.	01	02
02	Solve Unknown Forces on analysis of truss using method of joints.	01	02
03	Solve Problem on analysis of truss by Equilibrium Equations.	01	04
04	Solve Zero-Force Members on analysis of truss using method of sections.	01	02
05	Solve Unknown Forces on analysis of truss using method of sections	01	02
06	Solve problems and plot Mohr circle	02	04
07	Plot Influence line diagrams for Point load & Point Moment condition	03	02
08	Plot Influence line diagrams for Uniformly distributed loading condition	03	04
09	Plot Influence line diagrams for Uniformly varying loading condition	03	04
10	Solve practice problems on energy methods	04	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] "Structural Analysis" by R.C. Hibbeler
[2] "Theory of Structures" by S.P. Timoshenko and D.H. Young
[3] "Advanced Structural Analysis" by Ashok K. Jain
[4] "Structural Analysis-II" by S.S. Bhavikatti