THEORY OF STRUCTURE II

Year-II **Semester-V**

Teaching Schedule Hours/Week					Examination Schedule						Total Marks
					Final				Internal Assessment		
					Theory		Practical		Theory Marks	Practical Marks	
Credit Hours	L	T	P	Total	Duration	Marks	Duration	Marks	40	25	125
3	3	3	2/2	7	3 Hrs.	60	-	-			

Note: **L:** Lecturer **T:** Tutorial **P:** Practical

Course Objective:

This course is designed to give students an understanding of structural analysis, with a focus on indeterminate structures. It is expected that by the conclusion of the course, students will be able to carry out analysis of indeterminate structures both manually and with the help of computer software.

Course Contents:

1. Statically Indeterminate Structures **(2 hours)**

1.1. Structural systems and conditions to be fulfilled
1.2. Satisfaction of conditions and solution of equations
1.3. Boundary conditions and partial restraints
1.4. Indeterminacy of structural system, its physical meaning and its types
1.5. Static indeterminacy and methods of determination for various types of structures(plane system)
1.6. Kinematic indeterminacy and methods of determination for various types of structures(plane system)

2. Theorem on Displacements **(3 hours)**

2.1. Law of reciprocal deflection (Maxwell's Theorem, Betti's Law)
2.2. Castigliano's Theorem and its applications in beam and truss

3. Force Method **(14 hours)**

3.1. Introduction to force method

3.2. Equilibrium conditions and compatibility equations

3.3. Flexibility matrix generation and calculation

3.4. Analysisof indeterminate beams including yielding of support(two to three span)

3.5. Analysis of indeterminate portal frames(not more than three unknowns)

3.6. Analysis of indeterminate plane trusses including temperature effects and lack of fit

3.7. Analysis of parabolic arches(two-hinged) including yield of support and temperature effect

3.8. Bending moment and shear force diagram for the above mentioned systems

4. Displacement Method **(18 hours)**

4.1. Introduction

4.2. Stiffness

4.3. Characteristics of stiffness matrix and its generation

4.4. Relationship between flexibility and stiffness matrices

4.5. Slope-deflection method

4.5.1. Derivation of slope-deflection equation

4.5.2. Analysis of indeterminate beams including support settlement and rotation of joints

4.5.3. Bending moment and shear force diagram for the above systems

4.6. Moment distribution method

4.6.1. Fixed end moment, Carry-over moment and unbalanced moment

4.6.2. Distribution factor

4.6.3. Analysis of indeterminate beam

4.6.4. Analysis of indeterminate portal frames without sway condition(one bay two storey/two bay one storey)

4.6.5. Analysis of indeterminate portal frames with sway condition(one bay one storey)

4.6.6. Bending moment and shear force diagram for the above systems

4.7. Stiffness matrix method

4.7.1. Analysis of beams and frames

4.7.2. Bending moment and shear force diagram for the above systems

4.7.3. Application to trusses

5. Influence Lines for Indeterminate beams **(3 hours)**

5.1. Influence lines for statically indeterminate beams

5.2. Muller-Breslau principle and its application for drawing ILD of continuous Beams

6. Plastic Theory of Structures **(5 hours)**

6.1. Definition and explanation
6.2. Plastic bending of beams
6.3. Plastic hinge and its length
6.4. Shape factor and load factor
6.5. Plastic analysis: determination of collapse load and plastic moment capacity

Laboratories:

Students should perform experiments in the lab to analyze the structure of a given system and verify their results using computer simulations. This process of combining experiments and simulations will allow students to gain a deeper understanding of the system and its underlying structure.

SN	Titles	Experimental	Computer Simulation
1	Obtain experimentally the horizontal thrust in a two-hinged arch	✓	✓
2	Verify the Maxwell's Theorem of reciprocal deflection with the help of a truss and beam.	✓	✓
3	Experimental analysis of a portal frame.	✓	✓
4	Experimental analysis of a continuous beam.	✓	✓

Mini Project:

Numerically analysis of any type existing structure for given loading condition.

References:

1. Bhavikatti, S. S. (2021). Structural Analysis-II. Vikas Publishing House.
2. Darkov A et al. (1969), Structural Mechanics, Mir Publishers, Moscow.
3. Ghali A.& Neville A. M. (1978) Structural Analysis: A Unified Classical and Matrix Approach, Chapman and Hall.
4. Hibbeler, R. C.(2019). Structural Analysis in SI Units. Pearson Prentice Hall.

5. KukrejaC. B.&SastryV. V. (1991). Experimental methods in structural mechanics, Standard Publishers Distributors, Delhi.
6. Norris, C. H., Wilbur, J. B. &Utku, S. (1977). Elementary structural analysis. McGraw-Hill Science.
7. PanditG. S. &GuptaS. P. (1981). Structural analysis, a matrix approach, Tata McGraw Hill Company Limited, New Delhi.
8. Ramamrutham S.&Narayan R. (1973).Theory of Structures, Dhanpat Rai Publishing company
9. WangC. K. (1989). Intermediate structural analysis, international student edition, McGraw Hill Company Limited.

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Mark Distribution *	Remarks
1	2	2	Th/N
2	3	6	Th/N
3	14	18	Th+N
4	18	20	Th+N
5	3	6	Th/N
6	5	8	Th/N
Total	**45**	**60**	

***Note: There may be minor deviation in marks distribution.**

 # Maximum number of choice question should be three (numerical) with internal 'OR'