INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

ADVANCED STRUCTURAL ANALYSIS								
I Semester: STE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BSTE01	**Core**	3	-	-	3	40	60	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: NIL								

I. COURSE OVERVIEW:

This course focuses on advanced methods of analyzing structural members and systems, extending beyond classical approaches. Students will explore unsymmetrical bending, curved beam behavior, beams on elastic foundations, and stability problems in columns. The course also emphasizes modern computational techniques such as stiffness and flexibility formulations, matrix methods, and the direct stiffness method for analyzing trusses, beams, and frames. It equips students with theoretical understanding and analytical tools essential for tackling complex structural engineering problems in practice and research.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The analysis of curved beams and beams supported on elastic foundations under different loading conditions.
II. The theories of column buckling with various end conditions, local effects, and inelastic behavior.
III. The fundamentals of stiffness and flexibility approaches in matrix methods of structural analysis.
IV. The formulation of stiffness matrices, load vectors, and coordinate transformations for structural members.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO 1 Explain the concept of shear center and analyze stresses and deflections in beams subjected to unsymmetrical bending.
CO 2 Examine circumferential and radial stresses in curved beams and analyze the response of beams resting on elastic foundations.
CO 3 Analyze the buckling behavior of columns under elastic, inelastic, and local instability conditions.
CO 4 Formulate stiffness and flexibility matrices for different structural elements and transform them between local and global coordinates.
CO 5 Assemble global stiffness matrices and solve for structural responses using matrix methods of analysis.
CO 6 Apply the direct stiffness method for analyzing trusses, beams, and frames in practical structural systems.

IV. COURSE CONTENT:

MODULE –I: UNSYMMETRICAL BENDING (9)
Definition of Shear Center in Bending - Symmetrical and Nonsymmetrical Bending - Bending Stresses in Beams Subjected to Nonsymmetrical Bending - Deflections of Straight Beams Subjected to Nonsymmetrical Bending.

MODULE -II: ADVANCED ANALYSIS OF BEAMS (9)
Curved Beams: Circumferential Stresses in a Curved Beam - Radial Stresses in Curved Beams - Correction of Circumferential Stresses in Curved Beams Having I, T or Similar Cross Sections - Deflections of Curved Beams Beams on Elastic Foundations - Infinite Beam Subjected to a Concentrated Load: Boundary Conditions - Infinite Beam Subjected to a Distributed Load Segment.

MODULE -III: COLUMN BUCKLING (9)
Concept of Column Buckling - Deflection Response of Columns to Compressive Loads

Euler Buckling of Columns with General End Constraints - Local Buckling of Columns - Inelastic Buckling of Columns

MODULE -IV: INTRODUCTION TO MATRIX METHODS OF ANALYSIS (9)
Static indeterminacy and kinematic indeterminacy - degree of freedom - coordinate system - structure idealization stiffness and flexibility matrices - suitability element stiffness equations - elements flexibility equations - mixed force – displacement equations-Transformation of coordinates - element stiffness matrix - and load vector - local and global coordinates - Assembly of stiffness matrix from element stiffness matrix – Analysis of trusses, beams and frames by stiffness matrix methods.

MODULE -V: DIRECT STIFFNESS METHOD (9)
General procedure - banded matrix - semi bandwidth - assembly by direct stiffness matrix method -Application of direct stiffness method to trusses, simple and continuous beams and frames.

V. TEXTBOOKS:

1. C.S. Reddy, "*Basic Structural Analysis*", Tata McGraw-Hill, 3rd Edition, 2010.
2. R. Vaidyanathan & P. Perumal, "*Comprehensive Structural Analysis – Vol. I & II*", Laxmi Publications, 2005.
3. A. Ghose, "*Matrix Methods of Structural Analysis*", Prentice Hall of India, 1996.
4. W. Weaver & J.M. Gere, "*Matrix Analysis of Framed Structures*", CBS Publishers, 3rd Edition, 1990.

VI. REFERENCE BOOKS:

1. R.C. Hibbeler, "*Structural Analysis*", Pearson, 10th Edition, 2017.
2. Aslam Kassimali, "*Matrix Analysis of Structures*", Cengage Learning, 2nd Edition, 2011.
3. Devdas Menon, "*Advanced Structural Analysis*", Narosa Publishing, 2009.
4. M.L. Gambhir, "*Fundamentals of Structural Mechanics and Analysis*", PHI Learning, 2011.
5. B.C. Punmia, Ashok Kumar Jain & Arun Kumar Jain, "*Structural Analysis*", Laxmi Publications, 16th Edition, 2017.

VII. ELECTRONICS RESOURCES:

1. https://nptel.ac.in/courses/105101085
2. https://nptel.ac.in/courses/105101086
3. https://nptel.ac.in/courses/105106050

VIII. MATERIAL ONLINE:

1. Course Outline Description
2. Tutorial Question Bank
3. Assignments
4. Model Question Paper – I
5. Model Question Paper - II
6. Lecture Notes
7. Early Lecture Readiness Videos
8. Power point presentation