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

COURSE CONTENT

THEORY OF STRUCTURES								
IV Semester: CE								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ACED06	Core	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 60**		
Prerequisite: Strength of Materials								

I. COURSE OVERVIEW:

Theory of Structures, deals with deformable solids, requires basic knowledge and principles of mechanism from Strength of Materials course and acts as a pre-requisite to the advanced courses on Structural analysis and design. This course introduces study of indeterminate beams and focuses on the deflections of determinate beams and simple trusses by energy methods. It also introduces the study of columns and struts. Eventually, through this course content, engineers can analyze the response of various structural members under different loading conditions and design the same, satisfying the safety and serviceability conditions.

II. COURSE OBJECTIVES:

The students will try to learn:

I. Behavior of different type of beams for their movement and protection under different loading conditions
II. Concepts and applications of differential equations of various types of beams using different methods.
III. The methods of analysis of forces in various members of steel roof trusses for different spans.
IV. Fundamentals of shear force and bending moment diagrams for beams subjected to point load and uniformly distributed load.

III. COURSE OUTCOMES:

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

CO 1 Analyze propped cantilevers and fixed beams using method of consistent deformation for finding the shear forces and bending moments at various locations and draw shear force and bending moment diagrams
CO 2 Illustrate the concepts of clapeyron's theorem of three moments for solving problems on continuous beams including sinking of supports.
CO 3 Analyze the trusses using method of joints and sections for computing member forces
CO 4 Apply the concepts of energy methods for calculating deflections of simple beams and pin jointed frames.
CO 5 Apply the torsion equation to springs, solid and hollow circular shafts for computing torsional stiffness of springs and power transmitted by shafts.
CO 6 Develop the expressions for critical loads and stresses using Euler's and Rankine's methods for knowing behaviour of columns and struts with different end conditions.

IV. COURSE CONTENT:

MODULE - I: PROPPED CANTILEVERS AND FIXEDBEAMS (10)

Analysis of propped cantilever and fixed beams using the method of consistent deformation, including the beams with varying moments of inertia, subjected to uniformly distributed load, central point load, eccentric point load, number of point loads, uniformly varying load and combination of loads, shear force and bending moment diagrams for propped cantilever and fixed beams, effect of sinking of support, effect of rotation of a support.

MODULE - II: CONTINUOUS BEAMS (9)

Introduction, Continuous beams, Clapeyron's theorem of three moments, analysis of continuous beams with constant and variable moments of inertia with one or both ends fixed, continuous beams with overhang; effects of sinking of supports.

MODULE - III: ANALYSIS OF TRUSSES AND ENERGY METHODS (10)
ANALYSIS OF TRUSSES: Definition – Perfect, Deficient and Redundant frames – Methods of Analysis - Analysis of simple trusses by method of joints and method of sections.

ENERGY METHODS: Introduction-Strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear forces, Castigliano's first theorem, deflections of simple beams and pin jointed trusses.

MODULE - IV: TORSION OF CIRCULAR SHAFTS AND SPRINGS (10)
TORSION OF CIRCULAR SHAFTS: Theory of pure torsion, derivation of torsion equations: Assumptions made in the theory of pure torsion, torsional moment of resistance, polar section modulus, power transmitted by shafts, combined bending and torsion and end thrust, design of shafts according to theories of failure.
SPRINGS: Introduction, types of springs, deflection of close and open coiled helical springs under axial pull and axial couple, springs in series and parallel.

MODULE - V: COLUMNS AND STRUTS (9)
Columns and struts: introduction, types of columns, short, medium and long columns, axially loaded compression members, crushing load, Euler's theorem for long columns, assumptions, derivation of Euler's critical load formulae for various end conditions, equivalent length of a column, slenderness ratio, Euler's critical stress, limitations of Euler's theory, long columns subjected to eccentric loading, Secant formula Empirical formulae, rankine, gordon formula, straight line formula, Prof. Perry's formula.

V. TEXT BOOKS:

1. R. K. Bansal, *A Textbook of Strength of Materials*, Laxmi publications Pvt. Ltd., New Delhi, 2nd Edition, 2007.
2. F. Beer, E. R. Johnston, J. DeWolf, *Mechanics of Materials*, Tata McGraw-Hill Publishing Company Ltd., New Delhi, India, 1st Edition, 2008.
3. S. S. Bhavikatti, *Strength of Materials*, Vikas Publishing House Pvt. Ltd., New Delhi, 5th Edition, 2013.

VI. REFERENCE BOOKS:

1. B. C. Punmia, Ashok K Jain and Arun K Jain, *Mechanics of Materials*, Laxmi Publications Pvt. Ltd., New Delhi, 12th Edition, 2007.
2. R. Subramanian, *Strength of Materials*, Oxford University Press, 2nd Edition, 2010.
3. Hibbeler, R. C., *Mechanics of Materials*, East Rutherford, NJ: Pearson Prentice Hall, 6th Edition, 2004.

VII. ELECTRONICS RESOURCES:

1. http://www.nptelvideos.in/2012/11/strength-of-materials- prof.html
2. http://ocw.mit.edu/courses/civil-and-environmental-engineering/1-050-solid-mechanics-fall-2004/lecturenotes/.
3. https://www.youtube.com/watch?v=coRgpxG2pyY list=PLLbvVfERDon3oDfCYxkwRct1Q6YeOzi9g

VIII. MATERIAL ONLINE:

1. Course template
2. Tech-talk topics
3. Assignments
4. Definition and terminology
5. Tutorial question bank
6. Model question paper – I
7. Model question paper – II
8. Lecture notes
9. Early lecture readiness videos (ELRV)
10. Power point presentations