MECHANICS OF MATERIALS

V Semester: CE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACEB12	CORE	2	1	-	3	30	70	100
Contact Classes: 30	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 45		

I. COURSE OVERVIEW:

Civil engineers are required to design structures like buildings, dams, bridges, etc. The time varying nonlinear applied loads on these structures, along with the self-weight, have to be safely transmitted to the ground. A structural engineer must be able to design a structure in such a way that none of its members fail during load transfer process. This foundational course in civil engineering is intended to introduce to concepts of stress and strain due to external loading on a structural member and their calculations. For this, the concept and calculation of slopes and deflections of beams using various methods are covered in depth. Deflections by energy methods and analysis of propped cantilevers, fixed and continuous beams under various load combinations. Through this course content engineers can design the structures for safety and serviceability.

II. OBJECTIVES:

The course should enable the students to:

I	The fundamental concepts of mechanics of deformable structures and theirbehavior.
II	Analysis of structural elements with the help of different mathematical, analyticaland energy methods for the purpose of design.
III	Analysis of structures independently in real world situations where the design ofstructures involved.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Recall** the concepts of buckling of columns and struts under axial loading for understanding the behavior of column.	Remember
CO 2	**Develop** the expressions for critical loads and stresses for columns and struts with different end conditions using Euler's and Rankin's methods.	Apply
CO 3	**Analyze** the beams and trusses for slopes and deflections subjected to various load combinations using analytical methods.	Analyze
CO 4	**Analyze** the beams and trusses for slopes and deflections subjected to various load combinations using energy methods.	Analyze
CO 5	**Analyze** propped cantilever and fixed beams to know the shear forces and bending moments at various locations in the beam for designing propped cantilever and fixed beams.	Analyze
CO 6	**Explain** the concepts of clapeyron's theorem of three moments for analyzing continuous beams including sinking of supports.	Understand

IV. SYLLABUS:

MODULE – I	COLUMNS AND STRUTS: BUCKLING	Classes: 09

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, Rankine's formula. Laterally loaded struts, subjected to uniformly distributed and concentrated loads, maximum bending moment and stress due to transverse and lateral loading.

MODULE – II	DEFLECTIONS OF BEAMS	Classes: 09

Bending into a circular arc, slope, deflection and radius of curvature, differential equation for the elastic line of a beam, double integration and Macaulay's methods, determination of slope and deflection for cantilever and simply supported beams subjected to various loads, Mohr's theorems, moment area method, application to simple cases including overhanging beams; Conjugate beam method, concept of conjugate

beam method, difference between a real beam and a conjugate beam, deflections of determinate beams with constant and different moments of inertia.

MODULE – III	DEFLECTIONS BY ENERGY METHODS	Classes: 09

Energy Methods: Work energy method, principal of virtual work, unit load method, Castigliano's theorem for displacements of cantilever beam with concentrated load and uniformly distributed load.

Deflections of simple beams like cantilever beams,simply supported beams with concentrated loads and uniformly distributed loads.Deflections of pin jointed trusses; Maxwell‘s theorem of reciprocal; Betti‘s Law.

MODULE – IV	INDETERMINATE BEAMS: PROPPED CANTILEVER AND FIXED BEAMS	Classes: 09

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, deflection of propped cantilever and fixed beams; Effect of rotation of a support.

MODULE – V	INDETERMINATE BEAMS: CONTINUOUS BEAMS	Classes: 09

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.

Text Books:

1. R. K. Bansal, “A Textbook of Strength of Materials”, Laxmi Publications (P) 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.

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. D. S. Prakash Rao, “Strength of Materials A Practical Approach Vol.1”, Universities Press (India) Pvt. Ltd., India, 3rd Edition, 2007.
4. J. M. Gere, S.P. Timoshenko, “Mechanics of Materials, SI units edition”, CL Engineering, USA, 5th Edition, 2000.

Web References:

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-mechanicsfall-2004/lecture-notes/
3. https://www.youtube.com/watch?v=coRgpxG2pyY&list=PLLbvVfERDon3oDfCYxkwRct1Q6YeOzi9g

E-Text Books:

1. http://www.freeengineeringbooks.com/Civil/Strength-of-Material-Books.php
2. http://royalmechanicalbuzz.blogspot.in/2015/04/strength-of-materials-book-by-r-k-bansal.html