STRENGTH OF MATERIALS-I

III Semester: CE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACE001	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Relate mechanical properties of a material with its behavior under various loadtypes.
II. Apply the concepts of mechanics to find the stresses at a point in a material of a structuralmember.
III. Analyze a loaded structural member for deflections and failurestrength.
IV. Evaluate the stresses and strains in materials and deflections in beammembers.

COURSE LEARNING OUTCOMES (CLOs):

1. Calculate the stress and strain developed in any structural member due to applied external load.
2. Calculate the normal and tangential stresses on an inclined section a bar of under uni-axial, biaxial, pure shear and plain stress conditions.
3. Predict the strain energy and their applications like sudden load, uniform load and impact load.
4. Evaluate the principal stress and principal strain at a point of a stressed member and draw the Mohr's circle of stresses.
5. Understand failure of a material using various theories of failure, and their relative applications.
6. Differentiate the types of beam and the various loading and support condition upon them.
7. Apply the formulae for beams under different loading condition.
8. Draw shear force diagram and bending moment diagram for different type of beams
9. Derive the pure bending equation, and on its basis explain the existence of normal stresses.
10. Analyze the pure bending equation and on its basis.
11. Explain the existence of shear stresses in the different layers of the beam.
12. Evaluate the section modulus for various beam cross-sections.
13. Explain the importance of section modulus for various beam cross-sections
14. Derive the torsion equations and pure torsion.
15. Explain the design procedures of shafts and their theories of failure applications.
16. Understand the types of springs and explain their different conditions.
17. Analyze the close and open coiled helical springs under various conditions
18. Differentiate the types of column under the various end conditions.
19. Analyze the columns under the various formulas like Euler's formulae, Rankine'sand Gordon formula
20. Calculate the columns under the various formulas like empirical formulae, straight line formula and perry's formula.
21. Understand the laterally loaded struts under concentrated and uniformly distributed loads
22. Calculate the laterally loaded struts under various loading conditions.

UNIT-I	STRESSES AND STRAINS(SIMPLE AND PRINCIPAL)	Classes :09

Concept of stress and strain, elasticity and plasticity, Hooke's law, stress-strain diagram for mild steel, Poisson's ratio, volumetric strain, elastic module and the relationship between them bars of varying section, composite bars, temperature stresses; Strain energy, modulus of resilience, modulus of toughness; stresses on an inclined section of a bar under axial loading; compound stresses; Normal and tangential stresses on an inclined plane for biaxial stresses; Two perpendicular normal stresses

accompanied by a state of simple shear; Mohr's circle of stresses; Principal stresses and strains; Analytical and graphical solutions. Theories of Failure: Introduction, various theories of failure, maximum principal stress theory,maximum principal strain theory, strain energy and shear strain energy theory.

UNIT-II	SHEAR FORCE AND BENDING MOMENT	Classes :09

Definition of beam, types of beams, concept of shear force and bending moment, shear force and bending moment diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed load, uniformly varying loads and combination of these loads, point of Contraflexure, relation between Shear force, bending moment and rate of loading at a section of a beam

UNIT-III	FLEXURAL AND SHEAR STRESSES IN BEAMS	Classes :09

Flexural Stresses: Theory of simple bending, assumptions, derivation of bending equation: M/I = f/y = E/R - neutral axis: Determination of bending stresses; Section modulus of rectangular and circular sections (Solid and Hollow), IT angle and channel sections; Design of simple beamsections.
Shear Stresses: Derivation of formula - shear stress distribution across various beam sections like rectangular, circular, triangular, IT angle sections.

UNIT-IV	TORSION OF CIRCULAR SHAFTS	Classes:09

Theory of pure torsion: derivation of torsionequations,Assumptions made in the theoryofpure torsion, torsional moment of resistance, polar section modulus, power transmitted by shaft, combined bending and torsion and end thrust, design of shafts according to theories of failure. Introduction to springs, types of springs, deflection of close and open coiled helical springs under axial pull and axial couple, springs in series andparallel.

UNIT-V	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 and Gordon formula, long columns subjected to eccentric loading,secantformula,empiricalformulae,straightlineformulaandProf.Perry'sformula.Laterallyloaded struts, subjected to uniformly distributed and concentrated loads, maximum bending moment and stress due to transverse and lateral loading.

Text Books:

1. F. Beer, E. R. Johnston, J. DeWolf , "Mechanics of Materials", Tata McGraw-Hill Publishing Company Limited, New Delhi, Indian 1st Edition,2008.
2. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, "Mechanics of Materials", Laxmi Publications Private Limited, New Delhi, 4th Edition,2007.
3. R. K. Rajput, "Strength of Materials: Mechanics of Solids", S. Chand & Co Limited, New Delhi, 3rd Edition, 2007.
4. S. S. Rattan, "Strength of Materials", Tata McGraw-Hill Publishers, 4th Edition,2011.

Reference Books:

1. J. M. Gere, S.P. Timoshenko, "Mechanics of Materials", CL Engineering, USA, 5th Edition,2000.
2. E. G. Popov, "Engineering Mechanics of Solids", Pearson Education, India, 2nd Edition,2015.
3. S. S. Bhavikatti, "Strength of Materials", Vikas Publishing House Pvt. Ltd., New Delhi, 3rd Edition, 2013.
4. R. K. Bansal, "A Textbook of Strength of Materials", Laxmi Publications Private Limited., New Delhi, 4th Edition,2007.

5. D. S. PrakashRao, “Strength of Materials A Practical Approach Vol.1”, University PressIndia Private Limited, India, 1st Edition,2007.

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-mechanics-fall-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