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

COURSE CONTENT

STRENGTH OF MATERIALS								
III Semester: CE								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ACEE02	**Core**	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Concrete Technology								

I. COURSE OVERVIEW:

Strength of Materials is a fundamental branch of engineering that deals with the behavior of deformable solids under various loading conditions. Building upon the basic principles of mechanics learned in the Engineering Mechanics course, it serves as a pre-requisite for advanced subjects such as Structural Analysis and Structural Design. This course introduces the concepts of simple stresses, strains, and principal stresses in deformable solids, and develops the analytical skills to evaluate the axial, bending, and torsional response of structural members. Students will learn how to determine the strength, stiffness, and stability of components while ensuring safety and serviceability. Ultimately, this course equips engineers with the essential knowledge and problem-solving skills needed for the analysis and design of safe, reliable, and efficient structures.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The concepts of stresses and strains and response of structural elements subjected to gradual, sudden and impact loading.
II. Shear force and bending moment distributions in various types of beams under different loading conditions, and the behavior of determinate beams in response to various applied loads and load combination.
III. The relation between slopes, deflections and radius of curvature of elastic curve and variation of bending stresses in beams.
IV. The structural response of members subjected to combined stresses by using Mohr's circle of stresses and strains.

III. COURSE OUTCOMES:

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

CO 1 Summarize the concepts of stress, strain in conjunction with elastic properties of materials for understanding the behaviour of simple and composite bars subjected to external loads.
CO 2 Explain the relationship between bending moment, shear force and rate of loading for understanding response of the structural member under various loads.
CO 3 Determine slopes and deflections of determinate beams using various methods for understanding structural deformation under various loading conditions.
CO 4 Apply the conjugate beam method to compute slopes and deflections in beams for interpreting the physical difference between real beams and conjugate beams
CO 5 Apply the theory of simple bending to beams for computing the flexural strength and distribution of bending and shear stress across the section.
CO 6 Illustrate the concepts of principal stresses and principal strains with the help of Mohr's circle of stresses for solving two-dimensional stress problems.

IV. COURSE CONTENT:

MODULE - I: SIMPLE STRESSES AND STRAINS (09)
Concept of stress and strain, types of stresses and strains, Hooke's law, stress - strain diagram for mild steel, elasticity and plasticity, working stress, factor of safety, elastic moduli and the relationship between them; Bars of varying section, composite bars, temperature stresses. Strain energy – Resilience, Gradual, sudden, impact loadings and simple applications.

MODULE - II: SHEAR FORCE AND BENDING MOMENTS (09)
Introduction, Types of supports and beams, Sign convention for SF and BM, Shear Force and Bending Moment diagrams. BM and SF diagrams for cantilevers and simply supported beams with and without overhangs. Calculation of maximum BM and SF and the point of contraflexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of loads, uniformly varying load and couples.

MODULE - III: DEFLECTIONS OF BEAMS (10)
Deflection of beams: 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 point loads, U.D.L, Uniformly varying load and couple -Mohr's theorems – Moment area method – Application to simple cases.

Conjugate beam method: Introduction – 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 - IV: BENDING AND SHEAR STRESSES IN BEAMS (10)
Bending stress: Assumptions in the theory of simple bending, derivation of bending equation, Neutral axis, determination bending stresses, section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections, design of simple beam.
Shear stress: Derivation of formula – Shear stress distribution in rectangular, triangular, circular, I and T sections.

MODULE-V: PRINCIPAL STRESSES AND STRAINS (10)
Introduction, 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, introduction to analytical and graphical solutions.

V. TEXTBOOKS:

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.freeengineeringbooks.com/Civil/Strength-of-Material-Books.php
2. http://royalmechanicalbuzz.blogspot.in/2015/04/strength-of-materials-book-by-r-k-bansal.html
3. https://books.google.co.in/books?id=I8gg0Q4OQ4C-printsec=frontcover-dq=STRENGTH+OF+MATERIALShl=en-sa=Xed=0ahUKEwjpveCD44HgAhWBad4KHacUAg YQ6AEIMDAB-=onepageq=STRENGTH.

VIII. MATERIAL ONLINE:

1. Course outline description
2. Tutorial question bank
3. Tech-talk topics
4. Assignments
5. Definition and terminology
6. Open ended experiments
7. Model question paper – I
8. Model question paper – II
9. Lecture notes
10. E-learning readiness videos (ELRV)
11. Power point presentation