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**
ACED01	**Core**	3	1	-	4	40	60	100
Contact Classes: 48	**Tutorial Classes: 16**	**Practical Classes: Nil**				**Total Classes: 64**		
Prerequisite: Engineering Mechanics								

I. COURSE OVERVIEW:

Strength of Materials, deals with deformable solids, requires basic knowledge of principles of mechanics from Engineering Mechanics course and acts as a pre-requisite to the advanced courses on Structural Analysis and Design. This course introduces study of simple stresses, strains and principal stresses on deformable solids. It focuses on the analysis of members subjected to axial, bending, and torsional loads. In a nutshell, the course aims at developing the skill to solve engineering problems on strength of materials. 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. Basic concepts and principles in the theory of elasticity including strain/displacement and Hooke‘s law relationships; and perform calculations, relative to the strength and stability of structures and mechanical components.
II. Characteristics and magnitude of combined stresses in individual members and complete structures; analyze solid mechanics problems using classical methods and energy methods.
III. The various situations involving structural members subjected to combined stresses by application of Mohr‘s circle of stress; locate the shear center of thin wall beams.
IV. Deflection at any point on a beam subjected to a combination of loads.

III. COURSE OUTCOMES:

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

CO 1 Summarize the concepts of stress, strain and strain energy in conjunction with elastic properties of materials for understanding the behaviour of simple and composite bars subjected to uniaxial and biaxial stresses.
CO 2 Explain the relationship between bending moment, shear force and rate of loading for understanding response of the member under external loads
CO 3 Apply the theory of simple bending to beams for computing the flexural strength and distribution of bending and shear stress across the section.
CO 4 Develop the differential equation for elastic curve for finding slopes and deflections of determinate beams.
CO 5 Illustrate the concepts of principal stresses and principal strains with the help of Mohr’s circle of stresses for solving two-dimensional stress problems.
CO 6 Apply the concepts various theories of failure for finding the cause of failure and to take care of it in the design.

IV. COURSE CONTENT:

MODULE - I: SIMPLE STRESSES AND STRAINS (12)

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 (12)
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: BENDING AND SHEAR STRESSES IN BEAMS (12)
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 - IV: DEFLECTIONS OF BEAMS (12)
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 - V: PRINCIPAL STRESSES AND STRAINS AND THEORIES OF FAILURES (12)
PRINCIPAL STRESSES AND STRAINS: 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.
THEORIES OF FAILURES: Various theories of failures like Maximum principal stress theory, maximum principal strain theory, maximum shear stress theory, maximum strain energy theory and maximum shear strain energy theory.

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.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=X-ved=0ahUKEwjpveCD44HgAhWBad4KHacUAgYQ6AEIMDAB-=onepageq=STRENGTH

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