STRENGTH OF MATERIALS

III Semester: CE

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACEC02	Core	3	1	0	4	30	70	100
Contact Classes:45	Tutorial Classes:15	Practical Classes: Nil				Total Classes: 60		

Prerequisite: Engineering Mechanics

I. COURSEOVERVIEW

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. COURSEOBJECTIVES

The Students will try to learn:

I The concepts and principles of stress and strain, and behavior of structural elements subjected to gradual, sudden and impact loading.

II The behavior of determinate beams in response to various applied loads and loadcombinations.

III The energy transmission through solid and hollow circular shafts and various applications of close coiled helical springs.

IV The behavior of structural members subjected to combined stresses by usingMohr's circle of stresses and strains.

III. COURSE OUTCOMES:

After successful completion 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 uniaxialand biaxial stresses.	Understand
CO 2	**Explain** the relationship between bending moment, shear force andrate of loading for understanding response of the member under external loads	Understand
CO 3	**Apply** the theory of simple bending to beams for computing the flexural strength and distribution of bending and shear stress acrossthe section.	Apply
CO 4	**Apply** the torsion equation to springs, solid and hollow circularshafts for computing torsional stiffness of springs and power transmitted by shafts.	Apply
CO 5	**Illustrate** the concepts of principal stresses and principal strainswith the help of Mohr's circle of stresses for solving Two dimensional stress problems.	Understand
CO 6	**Apply** the concepts various theories of failure for finding the cause of failure and to take care of it in the design.	Apply

IV. COURSE SYLLABUS

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 module and the relationship between them; Bars of varying section, composite bars, temperature stresses. Strain energy – Resilience, Gradual, sudden, impact loadings, 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 contra-flexure 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:TORSION OF CIRCULAR SHAFTS AND SPRINGS (12)

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: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, 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. 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/lecturenotes/.
3. https://www.youtube.com/watch?v=coRgpxG2pyY&list=PLLbvVfERDon3oDfCYxkwRct1Q6YeOzi9g

VIII. E-TEXTBOOKS

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+MATERIALS&hl=en&sa=X&ved=0ahUKEwjpveCD44HgAhWBad4KHacUAgYQ6AEIMDAB#v=onepage&q=STRENGTH%20OF%20MATERIALS&f=false.