SOLID MECHANICS

III Semester: ME								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AMEC05	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Basic principles of Engineering Mechanics								

I. COURSEOVERVIEW:

This course is designed to provide students an understanding of deformation of solid bodies under external loading, shear force, bending moment diagrams of beams and Euler's column theory. The basis of virtually all mechanical design lies in how the material reacts to outside forces. Mechanics is the core of engineering analysis and is one of the oldest of the physical sciences. An in-depth understanding of material properties as well as how certain materials react to outside stimulus is paramount to an engineering education.

II. COURSEOBJECTIVES:

The students will try to learn:

I The variations of normal and shear stresses, slope and deflections throughout thespan and cross section of solids in relation to the applied loads.

II The concepts of stress analysis, theories of failure, relationship between mechanical and metallurgical properties to design and analyse commonly used machine components.

III The theory of pure torsion, bending to draw, analyze shear stress distribution diagrams in circular shafts and bending moment distribution diagrams in various cross sections of beams for different loading types.

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III. COURSE OUTCOMES:

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

CO 1	**Relate** the concepts of stress and strain at a point as well as the stress-strain relationships for linear, elastic, homogeneous and isotropicmaterials.	Remember
CO 2	**Summarize** the equilibrium equations for constructing the sheer force and bending moment diagrams for different types of loads on cantilever,simply supported and over hanging beams.	Understand
CO 3	**Identify** the principal stresses, maximum shearing stresses and angles acting on any arbitrary plane within a structural element using Mohr'scircle method.	Apply
CO 4	**Apply** the knowledge of theories of failure, shear force and bending moment relations for analyzing the flexural stress, shear stress distributions and failure of beam sections.	Apply
CO 5	**Utilize** Maxwell's reciprocal theorem, double integration method and moment area method to determine the maximum and minimum slopeand deflections of beams.	Apply
CO 6	**Make use of** the concept of torsion and buckling of thin shells, spheres, etc. to determine the stresses at various points of geometry.	Apply

IV. SYLLABUS:

MODULE-I: SIMPLE STRESSES & STRAINS(12)

Elasticity and plasticity, types of stresses & strains, Hooke's law, stress & strain diagram for mild steel, working stress, factor of safety, lateral strain, Poisson's ratio & volumetric strain, elastic moduli & the relationship between them, bars of varying section, composite bars, temperature stresses.

MODULE –II: SHEAR FORCE AND BENDING MOMENT DIAGRAMS(12)

Definition of beam, types of beams, concept of shear force and bending moment, S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, U.D.L., U.V.L. and combination of these loads – point of contra flexure, relation between S.F., B.M, and rate of loading at a section of a beam.

MODULE –III: PRINCIPAL STRESSES(12)

Principle stresses and strains-computation of principal stresses and strains on inclined planes: Uni-axial problems, Bi axial problems, Mohr's circle: Uni axial problems, Bi axial problems.

THEORY OF FAILURES- Minimum principle stress, strain, shear stress and strain energy theories.

MODULE –IV: FLEXURAL STRESSES, DEFLECTION OF BEAMS(12)

Beams and types transverse loading on beams shear force and bend moment diagrams types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads. moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell"s reciprocal theorems.

MODULE –V: TORSION, SPRING, STRESSES IN THIN SHELLS AND COLUMNS (12)

Theory of pure torsion, derivation of torsion equations T/J = q/r = Gθ/L, assumptions made in the theory of pure torsion, torsional moment of resistance, polar section modulus, introduction to springs: deflection of springs, thin cylinders, thin seamless cylindrical shells, derivation of formula for longitudinal and circumferential stresses, hoop stress, longitudinal and volumetric strains, changes in diameter, and volume of thin cylinders, thin spherical shells, and efficiency of a joint, Euler's column theory.

V. TEXTBOOKS

1. R.Subramaniam, "The Strength of Materials", Oxford publishers, 4th Edition, 2018.
2. Dr. Sadhu Singh, "The Strength of Materials", Khanna Publishers, 12th Edition, 2019.
3. S. Ramamrutam, "Strength of Materials", Dhanpat Rai Publishing Company, 18th Edition, 2014.

VI. REFERENCEBOOKS:

1. Robert J Asaro, Vlado Lubarda, "Mechanics of Solids and Materials", Cambridge University Press, 4th Edition, 2006.
2. Vazirani, Ratwani, "Analysis of Structures", Khanna Publishers, 19th Edition, 2014.

VII. WEBREFERENCES:

1. http://www.efunda.com/sm _home/sm.cfm
2. http://www.ocw.mit.edu/resourcs/#sm
3. http://www.som.com