MECHANICS OF SOLIDS

III Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AME004	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. To solve real field problems through evaluating the relationship between stress and strain.
II. To understand the shear force and bending moment diagrams of symmetrical beams.
III. To determine bending and shear stresses developed in beams of various sections
IV. To understand various theories of failure, mohr's circle of stresses, principle stresses and strains.
V. To understand and apply the concept of stress and strain to analyze and design structural members and machine parts under axial load, shear load, bending moment and torsion.

COURSE LEARNING OUTCOMES (CLOs):

1. Demonstrate the statically determinate and indeterminate problems. Use algebraic equations to determine the effect of stress and strain in the bars which are made up of various materials.
2. Understand extension and reduction of length of different bars. Explain the various stresses and strains and their relations, also comprehend the importance of elastic moduli.
3. Explore the shear force diagrams under various loads. Explain the importance of beams in the real field by understanding the types of loads.
4. Comprehend bending moment and its variation at various loads. Explain the bending moment diagram and its importance, understanding the supports and beams.
5. Determine the resistance and deformation in members which are subjected to axial, flexural and torsional loads.
6. Evaluate the principal stresses, strains and apply the concept of failure theories for design of shafts and other designed products.
7. Able to calculate the shear stresses developed in various sections of beams.
8. Capable of understand the loads which occur in crash analysis.
9. Understand the effect of gradual loads on the various materials.
10. Understand torsion equation
11. Able to calculate the flexural developed in various sections of beams of real field problems.
12. Find principle stresses and strains and to apply theories of failure in the design of various mechanical parts.
13. Determine stresses developed in a shaft and design of a shaft.
14. Derive the expression for Longitudinal stress
15. Derive the expression for volumetric strain
16. Find the volumetric strain of a thin spherical shell
17. Derive the expression for Hoop stress.
18. Understand the real field problems of various pressure vessels which are made up of different materials.
19. Able to design the thin vessels which are subjected to different stresses.
20. Explore the use of modern engineering tools, software and equipment to prepare for competitive exams, higher studies etc

UNIT I	SIMPLE STRESSES AND STRAINS	Classes: 09

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. Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

UNIT II	SHEAR FORCE AND BENDING MOMENT DIAGRAMS	Classes: 09

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., uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section

UNIT III	FLEXURAL STRESSES, SHEAR STRESSES	Classes: 09

Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y = E/R 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 sections.
Shear Stresses: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.Steering gears: Conditions for correct steering, Davis Steering gear, Ackerman's steering gear, Hooke's joint: Single and double Hooke's joint, velocity ratio, application, problems.

UNIT IV	PRINCIPAL STRESSES AND STRAINS, THEORIES OF FAILURE	Classes: 09

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 – 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 (Von Mises Theory)..

UNIT V	DESIGN OF CIRCULAR SHAFTS AND STRESSES IN PRESSURE VESSELS	Classes: 09

Theory of pure torsion – Derivation of Torsion equations : $T/J = q/r = N\theta/L$ – 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. Thin Cylinders: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses– hoop, longitudinal and Volumetric strains – changes in dia, and volume of thin cylinders– Thin spherical shells..

Text Books:

1. S. S Ratan, ―Strength of Materials‖, Tata McGraw-Hill, 2nd Edition, 2011.
2. W.A. Nash, ―Strength of Materials‖, Tata McGraw-Hill, 4th Edition, 2007.

Reference Books:

1. Jindal, ―Strength of Materials‖, Pearson Education, 1st Edition, 2012.
2. S. Ramamrutam, R. Narayan, ―Strength of Materials‖, Dhanpat Rai Publishing Company, 18th Edition, 2014.
3. R. K. Rajput, ―Strength of Materials‖, S.Chand & Co New Delhi, 4th Edition, 2007.

Web References:

1. http://www.uobabylon.edu.iq/uobColeges/ad_downloads/4_1293_515.pdf
2. http://ebooks.library.cornell.edu/k/kmoddl/toc_hartenberg1.html

E-Text Books:

1. https://drive.google.com/file/d/0B7raaoEF40D7eEJIR1VoODJodFE/edit.
2. http://royalmechanicalbuzz.blogspot.in/2015/04/solidmchanics-by-rs-khurmi-ebook-pdf.html.
3. https://docs.google.com/file/d/0B5dLUIZfysmqMXBhakRyODhublU/edit.