MATERIALS AND MECHANICS OF SOLIDS

IV Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB11	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. The fundamental knowledge of crystallography and phase diagrams under various chemical compositions of ferrous and non ferrous metals.
II. The mathematical modeling of determinant structures under different loads from the basics of engineering mechanics.
III. The variations of normal and shear stresses, slope and deflections throughout the span and cross section of solids in relation to the applied loads.
IV. The affluence of real world engineering problems and examples towards gaining the experience for how mechanics of solids is applied in engineering practice.

COURSE OUTCOMES:

CO 1 **Discuss** the concepts of basic crystallography and imperfections of various crystals for improving the performance of materials.
CO 2 **Determine** the atomic packing factor of unit cells of various crystal structures to study the properties of materials.
CO 3 **Illustrate** the percentage of chemical composition of various materials in unary and binary phase diagrams with the knowledge of eutectic, peritectic, etectoid and hypoetectoid reactions.
CO 4 **Develop** the constitutive relations of materials to study the properties under normal and shear stresses.
CO 5 **Evaluate** the principal stresses on the inclined plane of a body which is subjected biaxial stresses using Mohr's circle method.
CO 6 **Apply** the equilibrium equations for constructing the shear force and bending moment diagrams for different types of loads on cantilever, simply supported and over hanging beams.
CO 7 **Estimate** bending stresses of various cross sections of beams under different boundary conditions to compute safe loads.
CO 8 **Apply** the knowledge of shear force and bending moment diagrams for drawing the flexural stress and shear stress distribution of beams.
CO 9 **Analyze** the deformation of a beams of cantilever, simply supported and over hanging by using bending equation.
CO 10 **Determine** the maximum and minimum slope and deflections of beams under point load and uniformly distributed loads by Maxwell's reciprocal theorem, double integration method and moment area method.

MODULE-I	FUNDAMENTALS OF MATERIAL SCIENCE	Classes: 09

Basic Crystallography Crystal structure BCC, FCC and HCP structure, unit cell, crystallographic planes and directions, miller indices. Crystal imperfections, point, line, planar and volume defects, grain size, ASTM grain size number. Frank Reed source of dislocation Elastic & plastic modes of deformation, slip & twinning, strain hardening, seasons cracking, Bauschinger"s effect, yield point phenomenon, cold/hot working, recovery, re-crystallization, and grain growth, strengthening of metals.

MODULE-II	**ALLOYS AND PHASE DIAGRAMS**	**Classes: 09**
Constitution of alloys and phase diagrams; constitution of alloys, solid solutions, substitutional and interstitial. phase diagrams, isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions. iron – iron carbide equilibrium diagram. classification of steel and cast-iron microstructure, properties and application.		
MODULE-III	**SIMPLE STRESSES AND STRAINS, PRINCIPAL STRESSES**	**Classes: 09**
Hooke‟s law, stress and strain- tension, compression and shear stresses elastic constants and their relations Volumetric, linear and shear strains, principal stresses and principal planes, Mohr‟s circle.		
MODULE-IV	**SHEAR FORCE AND BENDING MOMENT DIAGRAMS, FLEXURAL STRESSES, SHEAR STRESSES**	**Classes: 09**
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.		
MODULE-V	**SLOPE AND DEFLECTION**	**Classes: 09**
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.		

Text Books:

1. Sidney H Avner, “Introduction to Physical Metallurgy”, McGraw-Hill Education, 2nd Edition, 2008.
2. Donald R Askeland, Thomson, “Essentials of Material Science and Engineering”, Thomson Press, 1st
3. Edition, 2005.
4. R. S. Kurmi, Gupta, “Strength of Materials”, S Chand & Co, New Delhi, 6st Edition, 2020

Reference Books:

1. Jindal, “Strength of Materials”, Pearson Education, 1st Edition, 2012.
2. Vazirani, Ratwani, “Analysis of Structures”, Khanna Publishers, 19th Edition, 2014.
3. S. Ramamrutam, “Strength of Materials”, Dhanpat Rai Publishing Company, 18th Edition, 2014.
4. R K. Rajput, “Strength of Materials”, S.Chand & Co New Delhi, 4th Edition, 2007.