# 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 | | |

## I. COURSE OVERVIEW:

Materials and mechanics of solids is a domain of materials science and engineering that studies the physical and chemical behaviour of metallic elements, their inter-metallic compounds, and their mixtures, which are called alloys. 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. OBJECTIVES:

**The course should enable the students to:**

I. Understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.
II. Calculate the elastic deformation occurring in various simple geometries for different types of loading.

## III. COURSE OUTCOMES (COs):

| COs | Course Outcome |
|---|---|
| CO 1 | Describe the differenttypes of crystal structures. |
| CO 2 | Discuss the phase transformations andequilibrium diagram. |
| CO 3 | Ability to apply the principles of elasticity, plasticity, stresses, strains and their relationships under various types of loads and to analyze the composite bars. |
| CO 4 | Able to draw shear forceand bending moment diagrams for various loads. |
| CO 5 | Determination of slope anddeflection of various types of beams. |

## IV. SYLLABUS:

| MODULE-I | FUNDAMENTALS OF MATERIAL SCIENCE | Classes: 09 |
|---|---|---|

Basic Crystallography- Crystal structure – BCC, FCC and HCP structure – unit cell –crystally graphic 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 & 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. | | |

**V. 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 Edition, 2005.
3. R. S. Kurmi, Gupta, "Strength of Materials", S Chand & Co, New Delhi, 1st Edition, 2013.
4. Egor P. Popov, "Solid Mechanics" Pearson, 2nd Edition, 2002.
5. Ryder. G.H, "Strength of Materials", Macmillan Long Man Publications, 3rd Edition, 2002.
6. W.A. Nash, "Strength of Materials", Tata McGraw-Hill, 4th Edition, 2007.
7. S. S Ratan, "Strength of Materials", Tata McGraw-Hill, 2nd Edition, 2011.


**VI. References**


1. Jindal, "Strength of Materials", Pearson Education, 1st Edition, 2012.
2. Vazirani, Ratwani, "Analysis of Structures", Khanna Publishers, 19th Edition, 2014.
3. H.J.Shah, S.B.Junnarkar, "Mechanics of Structures", Charotar Publishing House Pvt. Ltd, 31st Edition, 2014.
4. S. Ramamrutam, R. Narayan, "Strength of Materials", Dhanpat Rai Publishing Company, 18th Edition, 2014.
5. . K. Rajput, "Strength of Materials", S.Chand & Co New Delhi, 4th Edition, 2007.


**VII. Web References:**

1. https://www.youtube.com/watch?v=whB7IX3NQpg&list=PL49866E92803B242C
2. https://www.youtube.com/watch?v=vidZ1p82oCg
3. http://web.mit.edu/emech/dontindex-build/

**VIII. E-Text Book:**

1. http://royalmechanicalbuzz.blogspot.in/2015/04/strength-of-materials-book-by-r-k-bansal.html