

**ME207: MATERIALS SCIENCE**  
**CREDITS = 5 (L=3, T=0, P=2)**

**Course Objective:**

To understand the behavior of materials through structure- property-performance relationships.

**Teaching and Assessment Scheme:**

Teaching Scheme			Credits	Assessment Scheme				Total Marks
L	T	P		Theory		Practical		
			ESE	CE	ESE	CE		
3	0	2	5	70	30	30	20	150

**Course Contents:**

Unit No.	Topics	Teaching Hours
1	<p><b><u>Introduction to Materials Science:</u></b></p> <p>Significance of Materials Science, Classification of Engineering Materials, Advanced materials, Engineering needs of modern materials, Levels of internal structure like macro, micro, crystal and atomic and their correlated properties, Methods/Tools to reveal the different levels of structure, Review of Service and Processing Properties of materials, Criterion for selection of materials for engineering applications through Structure-Properties-Performance correlations.</p>	04
2	<p><b><u>Atomic and Crystal level:</u></b></p> <p>Atomic Co-ordination and its relevance, Force V/s inter atomic distance and Energy V/s inter atomic distance plots, Properties related with atomic structure.</p> <p>Short range and long range order, Amorphous Materials, Unit Cell, Crystal structure, Bravais lattice, atomic packing, coordination number, crystal structures of metallic elements, crystal directions and planes, Miller indices, interplaner spacing, Methods to determine crystal structure, Polymorphism or Allotropy, Properties related to Crystal Structure.</p> <p>Difference between Perfect and Imperfect crystals, Importance of imperfections, Types of imperfections-point, line and surface, Effect of imperfections on materials properties.</p>	14

Unit No.	Topics	Teaching Hours
3	<p>Deformation by slip, Mechanism of slip, Schmid's law, Slip in different lattice structures, Deformation by twinning, Strain hardening, Effect of strain hardening on properties, Recovery, Recrystallization and Grain Growth and their effect on properties of ductile metals.</p> <p><b><u>Micro structure level:</u></b></p>	10
4	<p>Applications of diffusion, stability of Atoms and Ions, Mechanism of Diffusion, Activation Energy of Diffusion, Fick's first law, Factors affecting Diffusion, Fick's second Law, Diffusion and Materials Processing.</p> <p>Constitution of Alloys, Unary and Binary equilibrium phase diagrams, Gibb's free energy for thermodynamic stability of phases, Gibb's phase rule, solid solutions and compounds, Hume-Rothery rules; cooling curves, lever rule, Different reactions like eutectic, eutectoid, peritectic and peritectoid; Non-equilibrium cooling.</p> <p><b><u>Other Materials:</u></b></p> <p>Structure, properties and Applications of Thermoplastics and Thermosetting polymers.</p> <p>Structure, Properties and Application of Glass, Clay and refractories and other advanced ceramic materials.</p> <p>Introduction, Materials Combination, Classification of composites, Matrix and Reinforcing phases, application of various composites in Engineering field, Hybrid composite, structural composite.</p> <p>Introduction to Nanomaterials, classification of Nanomaterials with suitable examples, application of Nanomaterials.</p>	10
5	<p><b><u>Corrosion of metals:</u></b></p> <p>Concept of corrosion, types of corrosion,, introduction to electrochemical corrosion, standard e. m.f. series and galvanic series, corrosion rates, P-B ratio for oxidation and its significance to corrosion.</p>	04
<b>TOTAL</b>		<b>42</b>

**List of References:**

1. Donald R. Askeland, Donald R. Phule and Pradeep P, “*The Science and Engineering of Materials*”, Cengage Learning.
2. Avner, Sidney H, “*Introduction to Physical Metallurgy*”, 2nd Edition, Tata-McGraw Hill.
3. William D. Callister Jr. and David G. Rethwisch, “*Materials Science and Engineering- An Introduction*”, 8th Edition John Wiley & Sons.
4. Smith, W. F., “*Principles of Materials Science and Engineering*”, McGraw Hill.
5. George F. Vander Voort (editor), “*ASM Handbook Vol. 9: Metallography and Microstructure*”, ASM International 2004.
6. Lawrence H Van Vlack, “*Elements of Materials Science and Engineering*”, 7th edition, Addison-Wesley Publishing Company.
7. V Raghavan, “*Materials Science and Engineering*”, 5th Edition, PHI Learning.

**Course Outcomes (COs):**

At the end of this course students will be able to ...

1. Select engineering materials on the basis of structure-property-performance relationship.
2. Correlate behavior of materials at atomic and crystal level.
3. Correlate behavior of materials at microstructure level.
4. Interpret structure, property and applications of polymer, ceramic, composite and nano materials.
5. Analyze the influence of corrosion in the light of processing and performance characteristics of materials.