

ME185: Materials Science

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

Course Content:

Sr. No.	Topics	Teaching Hrs.
1	<p><u>Introduction to Materials Science:</u></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 correlation ships.</p>	04
2	<p><u>Atoms and Atomic Coordination:</u></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>	03
3	<p><u>Atomic Order in Solids:</u></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>	04
4	<p><u>Crystal Imperfection:</u></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>	03

5	<u>Plastic Deformation:</u>	05
	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.	
6	<u>Diffusion:</u>	03
	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.	
7	<u>Phase and Phase equilibrium:</u>	06
	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;	
8	<u>Conducting Materials:</u>	03
	Classification of Conductor, Insulator and semi conductors based on band theory, Controlling the Conductivity of metals, Insulators and Di-electric properties, Ferro-electricity, Piezo-electricity, super-conductivity.	
9	<u>Ceramic Materials:</u>	03
	Structure, Properties and Application of Glass, Clay and refractories and other advanced ceramic materials	
10	<u>Composite Materials:</u>	03
	Introduction, Materials Combination, Classification of composites, Matrix and Reinforcing phases, application of various composites in Engineering field, Hybrid composite, structural composite.	

11	<u>Nanomaterials:</u>	03
	Introduction to Nano-materials, classification of Nanomaterials with suitable examples, application of Nanomaterials	
12	<u>Miscellaneous Engineering Materials:</u>	03
	Introduction, characteristics and application of glass wool, solar cell, metallic glasses, optical fibres, Elastomers, Biomaterials, thin film shape memory alloys for MEMS, ultra light materials.	
13	<u>Corrosion in metallic Materials:</u>	04
	Concept of corrosion, types of corrosion,, introduction to electrochemical corrosion, standard emf series and galvanic series, corrosion rates, P-B ratio for oxidation and its significance to corrosion.	

Total Hrs.	47
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Reference Books:

1. Donald R. Askeland, Donald R, Phule, 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., 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.