Introduction to Material Science			
Hours/Week L-T-P :	3-0-0	Credits:	3
Course Type :	Professional Core	Course Code:	MS2105

Course Objectives:

1. Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
2. To provide a detailed interpretation of equilibrium phase diagrams

Course Outcomes:

At the end of the course, students will be able to

CO1: Identify crystal structures for various materials and understand the defects in such structures

CO2: Understand how to tailor material properties of ferrous and non-ferrous alloys

CO3: Apply quantify mechanical integrity and failure in materials

CO4: Analyze different phases and heat treatment methods or the properties of Fe-C alloys

UNIT-1 9 Hours

Classification of Engineering Materials, Engineering properties of materials. Characteristic property of metals, bonding in solids, primary bonds like ionic, covalent and metallic bond, crystal systems, common crystal structure of metals, representations of planes and directions in crystals, atomic packing in crystals, calculation of packing density, voids in common crystal structures and imperfections crystals.

UNIT-2 9 Hours

Concept of plastic deformation of metals, critical resolve shear stress, dislocation theory, deformation by slip and twin, plastic deformation in polycrystalline metals, yield point phenomenon and related effects, concept of cold working preferred orientation. Annealing; recovery; recrystallization and grain growth; hot working.

Concept of alloy formation, types of alloys, solid solutions, factors governing solids solubility viz. size factor, valency factor, crystal structure factor and chemical affinity factor; order/disorder transformation.

UNIT-3 *9 Hours*

Binary phase diagrams (a) Isomorphism system, (b) Eutectic system, (c) Peritectic system, (d) Eutectoid system and (e) Peritectoid system. Allotropic transformation. Lever rule and its application, Interpretation of solidification behaviors and microstructure of different alloys belonging to those systems, Effect of non-equilibrium cooling, coring and homogenization. Iron cementite and iron graphite phase diagrams, microstructure and properties of different alloys (alloy steels; stainless steel, tool steel, HSS, high strength low alloy steel) types of cast iron, theirmicrostructures and typical uses. Specification of steel. T.T.T. diagram: concept of heat treatment ofsteels i.e. annealing, normalizing, hardening and tempering; microstructural effects brought about bythese processes and their influences on mechanical properties; factor affecting hardenability.

UNIT-4 *9 Hours*

Optical properties of Materials: Scattering, Refraction, Theory of Refraction and absorption, Atomic Theory of optical properties. Lasers, Optical fibres- Principle, structure, application of optical fibres.

Plastic-: Thermosetting and thermoplastics.

Ceramics: Types, structure, Mechanical properties, application

Composite Materials: Agglomerated Materials: Cermets, Reinforced Materials: Reinforced Concrete. Fibre reinforced plastics, Properties of composites, Metal matrix composites, manufacturing procedure for fiber reinforced composite.

Text Books:

1. Introduction to Physical Metallurgy by Avner, Tata McGrawHill
2. Materials Science and Engineering by W.D. Callister, Wiley and Sons Inc.
3. Physical Metallurgy: Principles and Practice by Ragahvan, PHI

Reference Books:

1. Engineering Physical Metallurgy and Heat Treatment by Y. Lakhtin, Mir Publisher, Moscow.
2. Elements of Material Science and Engineering, L.H.Van Vlack, Addison Wesley
3. Materials Science and Engineering by V. Raghavan, Prentice Hall of India Pvt. Ltd. Pearson
4. Mechanical Metallurgy by Dieter, Tata Mac GrawHill
5. Composite Material science and Engineering by K. K. Chawla, Springer
6. Material Science and Metallurgy, by U. C. Jindal, Pearson

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	1	1	-	-	-	3	1	3	3	3
CO2	3	2	3	2	1	-	2	-	-	-	3	1	3	3	1
CO3	3	3	3	2	1	-	3	-	-	-	3	1	3	3	2
CO4	2	2	3	2	1	-	3	-	-	-	-	1	3	3	3