

PCME4203 Introduction to Physical Metallurgy and Engineering Materials

MODULE-I

(16 Lectures)

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.

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.

MODULE-II

(16 Lectures)

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.

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, their microstructures and typical uses. Specification of steel.

T.T.T. diagram: concept of heat treatment of steels i.e. annealing, normalizing, hardening and tempering; microstructural effects brought about by these processes and their influences on mechanical properties; factor affecting hardenability.

MODULE-III

(12 Lectures)

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. Glass fiber reinforced plastics, Carbon fibre reinforced plastics, fibre reinforced plastics, Laminated plastic sheets. Tefnol, Properties of composites, Metal matrix composites, manufacturing procedure for fiber reinforced composite.

Introduction to Nano-materials

Text Books:

1. Engineering Physical Metallurgy and Heat Treatment by Y.Lakhtin, Mir Publisher, Moscow.
2. Introduction to Physical Metallurgy by Avner, Tata McGraw Hill
3. Materials Science and Engineering by W.D.Callister, Wiley and Sons Inc.

Reference Books

1. Elements of Material Science and Engineering, L.H.Van Vlack, Addison Wesley
2. Physical Metallurgy: Principles and Practice by Ragahvan, PHI
3. The Science and Engineering of Materials by Donald R. Askeland and Pradeep P Phule, Thomson Learning (India Edition)
4. Materials Science and Engineering by V.Raghavan, Prentice Hall of India Pvt.Ltd.
5. Essentials of Material Science and Engineering by Donald R. Askeland and Pradeep P Phule, Thomson Learning
6. Processes and Material of manufacture by Lindberg, PHI.
7. Elements of Materials Science & Engineering by Van Vlack, Pearson
8. Mechanical Metallurgy by Dieter, Tata MacGraw Hill
9. Materials Science and Metallurgy By Daniel Yesudian, Scitech
10. Material Science and Metallurgy by C.K.Dutta, Dhanpat Rai
11. Materials Science and Metallurgy by R.B.Choudhary, Khanna Publishers
12. Principles of Engineering Metallurgy by L.Krishna Reddy, New Age International
13. Material Science and Processes by S.K.Hazra Chowdhury, Indian Book distributing Co.
14. Engineering Materials, Properties and Selection by Kenneth G. Budinski and Michael K. Budinski, Prentice Hall of India
15. Materials Science by M.S. Vijaya , G.Rangarajan, TMH
16. Materials Science by V. Rajendra, A. Marikani, , TMH