II YEAR I SEM

15AME08-MATERIAL SCIENCE AND METALLURGY

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Course Objectives

Student can be able to:

- Know the fundamental science and engineering principles relevant to materials.
- Understand the relationship between nano/microstructure, characterization, properties and processing and design of materials.
- Have the experimental and computational skills for a professional career or graduate study in materials.
- Possess a knowledge of the significance of research, the value of continued learning and environmental/social issues surrounding materials.
- Be able to communicate effectively, to work in teams and to assume positions as leaders.

UNIT – I

Structure of Metals : Bonds in Solids – Metallic bond - crystallization of metals, grain and grain boundaries, effect of grain boundaries on the properties of metal / alloys – determination of grain size.

Constitution of Alloys : Necessity of alloying, types of solid solutions, Hume Rotherys rules, intermediate alloy phases, and electron compounds.

UNIT -II

Equilibrium of Diagrams : Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of important binary phase diagrams of Cu-Ni-, Al-Cu, Bi-Cd, Cu-An, Cu-Sn and Fe-Fe_3C.

UNIT –III

Cast Irons and Steels : Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheriodal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.

Non-ferrous Metals and Alloys :

Structure and properties of copper and its alloys, Aluminium and its alloys, Titanium and its alloys.

UNIT –IV

Heat treatment of Alloys:

Effect of alloying elements on Iron – Iron carbon system, Annealing, normalizing, Hardening, TTT diagrams, tempering , Hardenability, surface - hardening methods, Age hardening treatment, Cryogenic treatment of alloys.

UNIT – V

Ceramic materials:

Crystalline ceramics, glasses, cermets, abrasive materials, nonmaterial's-definition, properties and application of the above.

Composite Materials: Classification of composites, various methods of component manufacture of composites, particle – reinforced materials, fiber reinforced materials, metal ceramic mixtures, metal – matrix composites and Carbon – Carbon composites.

Text Books :

1. Introduction to Physical Metallurgy / Sidney H. Avener.
2. Essential of Materials science and engineering/ Donald R.Askeland/Thomson.
3. Materials Science and Engineering / William and collister.

References:

1. Material Science and Metallurgy/kodgire.
2. Science of Engineering Materials / Agarwal
3. Elements of Material science / V. Rahghavan
4. An introduction to materialscience / W.g.vinas & HL Mancini
5. Material science & material / C.D.Yesudian & harris Samuel
6. Engineering Materials and Their Applications – R. A Flinn and P K Trojan / Jaico Books.
7. Engineering materials and metallurgy/R. K. Rajput/ S.Chand.

Course outcomes

After completion of this course the student will have:

- The ability to apply advanced science (such as chemistry and physics) and engineering principles to materials systems
- The ability to integrate understanding of the scientific and engineering principles underlying the four major elements: structure, properties, processing, and performance related to material systems appropriate to the field
- The ability to apply and integrate knowledge from each of the above four elements of the field to solve materials selection and design problems