## 2/4 B.Tech. FIRST SEMESTER

**ME3T4 METALLURGY & MATERIALS SCIENCE Credits: 4**

**Lecture: 4 periods/week** **Internal assessment: 30marks**
**Tutorial: - -** **Semester end examination: 70 marks**

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**Objectives:**

The objectives of the course are to enable students to:

- Apply principles of mathematics, physics and chemistry to the study of iron-based (ferrous) materials in particular and non-ferrous materials in general.
- Apply principles of mathematics, physics and chemistry to the understanding of the thermodynamics and kinetics of the phase transformations in steels
- Apply principles of crystallography to the concepts of orientation relationships during the decomposition of austenite. Apply the "Central Paradigm of Materials Science and Engineering", to the relationships between processing, structure, properties and performance, to the development and application of various classes of solids.

**UNIT – I**

**INTRODUCTION:** Bonds in solids, Properties of materials.
CRYSTALLOGRAPHY: Classification of crystals – Bravais lattices – Miller Indices – Packing factor in cubic systems – coordination number – crystal imperfections – crystal deformation –Slip and Twinning.

**UNIT – II**

**STRUCTURE OF METALS:** Crystallization of metals, Effect of grain boundaries on properties of metals, Determination of grain size- Types of solid solutions, intermediate alloy phases

**UNIT – III**

**PHASE DIAGRAMS:** Binary phase diagrams – Phase rule – one component system, two component system, isomorphous, eutectic, eutectoid, peritectic and peritectoid systems, Fe-$Fe_3C$ equilibrium diagram.

**UNIT – IV**

**CAST IRONS AND STEELS:** Structure and properties of White Cast iron, Malleable Cast iron, Grey cast iron, Spheroidal graphite cast iron. Classification of steels-Plain carbon steels, Stainless steels, Tool steels.

**UNIT – V**

**HEAT TREATMENT PROCESSES:** Annealing, Normalizing, Hardening, Tempering, TTT diagrams, Austempering, Martempering, Flame hardening, Induction hardening & Chemical hardening techniques, Hardenability concept and experimental determination.

**UNIT – VI**

**NON-FERROUS METALS AND ALLOYS:** Structure and properties of Copper and its alloys, Aluminium and its alloys.

**STRENGTHENING MECHANISMS:** Grain Refinement, Strain hardening, solid solution strengthening, dispersion strengthening.

**UNIT – VII**

**POWDER METALLURGY:** Powder metallurgy process, Preparation of powders, Characteristics of metal powders, Mixing, Compacting, Sintering, Applications of powder metallurgy.

**UNIT – VIII**

**COMPOSITE MATERIALS**: Classification of composites, various methods of component manufacture of composites, particle reinforced materials, fiber reinforced composite materials and metal matrix composites, C-C composites.

## Learning resources

**Text Books:**


1. Sidney H. Avener, “Introduction to Physical Metallurgy”, Tata McGraw Hill - 2nd Edition - 1997.
2. V.D. Kodgire, “Material Science and Metallurgy”, Everest Publishing House - 25th Edition – 2009.


**Reference Books:**


1. Donald R. Askeland, “Essential of Materials Science and Engineering”, Thomson Learning - 5th Edition - 2006.
2. B.K.Agarwal, “Introduction to Engineering Materials”, Tata McGraw Hill - 1stEdition.
3. William D. Callister , “Materials Science and Engineering”, John Wiley & Sons Inc – 2010.
4. V. Raghavan, “Material Science and Engineering”,-PHI Learning - 5th Edition.
5. W.G.Vinas & H.L. Mancini, “An Introduction to Material Science”, Princeton University Press - 2004.
6. R. A Flinn and P K Trojan, “Engineering Materials and Their Applications”, Jaico Publishing House - 4th Edition - 1999.
7. R.K.Rajput, “Engineering Materials and Metallurgy”, - S.Chand - 1st Edition - 2011
8. M.Mukhopadhyay, “Mechanics of Composite Materials and Structures” Universities Press - 2004.