II Year I Semester	**L**	**T**	**P**	**C**
Code: 20ME3001	**3**	**0**	**0**	**3**

METALLURGY & MATERIAL SCIENCE

Course Objectives:

1. To understand the basic fundamentals of Material science and Physical metallurgy.
2. The basic concepts to be taught will help for the improvement, proper selection and effective utilization of materials which is essential to satisfy the ever-increasing demands of the society.

UNIT–I

Structure of Metals and Constitution of alloys: 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. Necessity of alloying, types of solid solutions, Hume Rothery rules, intermediate alloy phases, and electron compounds.

UNIT–II

Equilibrium Diagrams: Construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, 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 Fe-Fe_3C.

UNIT–III

Ferrous metals and alloys: Cast Irons and Steels: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheroidal 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, Aluminum and its alloys, Titanium and its alloys.

UNIT–IV

Heat treatment of Alloys: Effect of alloying elements on Fe-Fe_3C system, Annealing, normalizing, hardening, tempering, harden ability, surface - hardening methods, Age hardening treatment, TTT diagrams, Cryogenic treatment of alloys.

Introduction to Powder Metallurgy, methods of production of powders, steps in fabrication of component through powder metallurgy, applications and advantages

UNIT – V

Ceramics, glasses, cermets, abrasive materials, nano material – definition, properties and applications of the above

Composites: Classification of composites, and their fabrication processes, advantages and applications.

Text books:

1. Introduction to Physical Metallurgy - Sidney H. Avener – Mc Graw Hill
2. Callister's Materials Science and Engineering (English, adopted by Balasubramaniam R.) - Wiley

References:

1. Essential of Materials science and engineering - Donald R.Askeland - Cengage.
2. Material Science and Metallurgy – Dr. V.D. Kodgire- Everest Publishing House
3. Materials Science and engineering - Callister & Baalasubrahmanyam- Wiley Publications
4. Material Science for Engineering students – Fischer – Elsevier Publishers
5. Material science and Engineering - V. Raghavan-PHI Publishers

Weblinks/ Online Resources:

- http://www.doitpoms.ac.uk/
- http://www.showme.com/Simon-Hogg
- http://www.msm.cam.ac.uk/teaching/index.php

Course Outcomes:

By the end of the course the student would be able to:

CO1: Understand the basics of metallurgy, the crystalline structure and the concept of alloys.
CO2: Understand the crystalline structure of different metals and study the stability of phases in different alloy systems.
CO3: Study the behaviour of ferrous and nonferrous metals and alloys and their application in different domains.
CO4: Able to understand the effect of heat treatment, addition of alloying elements on properties of ferrous metals and Grasp the methods of making of metal powders and applications of powder metallurgy.
CO5: Comprehend the properties and applications of ceramic, composites and other advanced methods.