

# 22ME201 MATERIALS SCIENCE AND METALLURGY

Hours Per Week :

L	T	P	C
3	0	2	4

**PREREQUISITE KNOWLEDGE:** Basics of Bonding, Crystal Structures.

## COURSE DESCRIPTION AND OBJECTIVES:

This course offers fundamentals of crystallography, metallurgy, heat treatment, powder metallurgy, strengthening mechanisms and composites. The objective of this course is to impart basic knowledge on various classes of materials, structures, manufacturing methods and its properties.

## MODULE-1

### UNIT-1

9L+0T+6P=15 Hours

#### STEELS AND CAST IRONS

#### STRENGTHENING MECHANISMS AND HEAT TREATMENTS

**Steels and Cast Irons:** Phase diagram; Constitution and properties of different types of Steels, Cast Irons and Stainless Steels.

**Strengthening Mechanisms:** Introduction and types.

**Heat Treatments:** Introduction and types.

### UNIT-2

15L+0T+10P=25 Hours

#### STEELS AND CAST IRONS

Phase Identification, Grain size measurement, Material Properties and Solidification behavior using Image Analysis Software's.

**Strengthening Mechanisms:** Alloying, Severe Plastic Deformation, Grain size reduction.

**Heat Treatments:** Annealing, Normalizing, Hardening, Tempering, Surface Treatments.

#### PRACTICES:

- Preparation of metallurgical specimen for microstructural analysis.
- Quantitative metallurgical analysis (grain size determination and phase analysis) of metals/ alloys using optical and scanning electron microscopy.
- Effect of normalizing on microstructure and hardness of mild steel.
- Effect of quenching on microstructure and hardness of mild steel.
- Analysis of hardenability of mild steel using Jominy End Quench Test.
- Influence of grain size reduction on mechanical properties of aluminum specimen using severe plastic deformation technique (ECAP).

## MODULE-2

### UNIT-1

9L+0T+6P=15 Hours

#### POWDER METALLURGY AND COMPOSITE MATERIALS

**Powder Metallurgy:** Introduction, Process Parameters, Products of Powder Metallurgy

**Composites:** Introduction, Types of composites based on matrix and reinforcement, Influence of reinforcement and matrix materials.

**UNIT-2****15L+0T+10P=25 Hours**

**Powder Metallurgy:** Characterization of Metal Powders, Fabrication of components using Powder Metallurgy Techniques.

**Composites:** Effect of Fibre Length, Orientation and Concentration, Manufacturing methods for Composite Fabrication: MMCs, PMCs, CMCs; Evaluation of properties.

**PRACTICES:**

- Sintering behavior of copper or aluminum powder compacts using power metallurgical.
- Technique.
- Fabrication of aluminum metal matrix composites using powder metallurgy route.
- Fabrication of polymer matrix composites at different orientation of fibers using hand layup
- Technique.
- Fabrication of aluminum metal matrix composites using stir casting.
- Characterization of randomly given metal powders.

**COURSE OUTCOMES:**

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Assess cast iron and steels with desired properties compliance to end usage.	Apply	1	1, 2, 5, 12
2	Analyse heat treatment processes to achieve desired properties for a specific application.	Analyze	1	1, 2, 3, 5, 12
3	Apply suitable strengthening mechanisms for metals and alloys.	Apply	1	1, 2, 5, 12
4	Fabricate components by powder metallurgy process.	Apply	2	1, 2, 5, 12
5	Develop composites by using various manufacturing techniques.	Analyze	2	1, 2, 12

**TEXT BOOKS:**

1. James F Shanckelford, "Introduction to Materials Science for Engineers", Pearson 8th Edition, 2020.
2. Donald R Askeland, "The Science and Engineering of Materials", Cengage, 7th Edition, 2020.

**REFERENCE BOOKS:**

1. William D. Callister, "Materials Science and Engineering an Introduction", John Wiley and Sons, 2nd Edition, 2014.
2. Avner, "Introduction to Physical Metallurgy", McGraw Hill International Book, 2nd Edition. Company, 1997.
3. Kodgire UD, "Material Science and Metallurgy", Everest Publishing House, 37th Edition, 2015.

**SKILLS:**

- ✓ Specify carbon compositions in cast iron and steels.
- ✓ Identify the effects of alloying elements on properties of cast iron and steels.
- ✓ Recognize series of heat treatment processes to achieve desired properties for a specific application.