# SEMESTER S2

## MATERIAL SCIENCE AND ENGINEERING

**(MECHANICAL ENGINEERING)**

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|---|---|---|---|
| **Course Code** | **MSE205** | **CIE Marks** | 40 |
| **Teaching Hours/Week (L: T:P: R)** | 3:1:0:0 | **ESE Marks** | 60 |
| **Credits** | 4 | **Exam Hours** | 2 Hrs. 30 Min. |
| **Prerequisites (if any)** | None | **Course Type** | Theory |

**Course Objectives:**

1. To recognize the importance of the microstructures and physical properties of the materials to enable the material selection process.
2. To develop an understanding of the basic principles of phase transformations and apply those principles to engineering applications.

## SYLLABUS

| Module No. | Syllabus Description | Contact Hours |
|---|---|---|
| **1** | Introduction to material science: Classification of engineering materials, Structure of solids- Metallic, Ionic and covalent bonding. Properties based on atomic bonding. Crystallography: - SC, BCC, FCC, HCP structures, APF - theoretical density simple problems – Miller Indices: - crystal plane and direction - Modes of plastic deformation:- Slip and twinning | **11** |
| **2** | Crystal imperfections – - Point defects, Line defects, Surface defects, Volume defects. edge and screw dislocations – Burgers vector – interaction between dislocations.<br>Polishing and etching, Metallographic characterisations of metallic | **11** |

| | | |
|---|---|---|
| | materials. SEM, TEM- Grain size determination<br>Wear, Roughness, Corrosion. Diffusion in solids, fick's laws, mechanisms, applications of diffusion in mechanical engineering, simple problems. Applications of Diffusion. | |
| **3** | Mechanical properties: Tensile properties, Hardness and hardness measurement, Impact properties, Fatigue, Creep, DBBTT, Super plasticity.<br>Types of steels- low, medium and high carbon steels, stainless steels, alloy steels and their applications. Properties and applications of composites, super-alloys, intermetallic- Stoichiometric and Non stoichiometric compounds- Applications. maraging steel, Titanium-Ceramics:- structures, applications | **11** |
| **4** | Phase diagrams: - need of alloying - classification of alloys - Hume Rothery`s rule – equilibrium diagram of common types of binary systems: isomorphous (Cu- Ni) eutectic (Pb- Sn), lever rule and Gibb`s phase rule.<br>Detailed discussion on Iron- Carbon equilibrium diagram with microstructure and properties -Heat treatment: - TTT, CCT diagram, applications - Tempering- Hardenability, Jominy end quench test, applications-Surface hardening methods. | **11** |

## Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

**Continuous Internal Evaluation Marks (CIE):**

| Attendance | Assignment/ Microproject | Internal Examination-1 (Written) | Internal Examination- 2 (Written) | Total |
|---|---|---|---|---|
| **5** | **15** | **10** | **10** | **40** |

## End Semester Examination Marks (ESE)

*In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions*

| Part A | Part B | Total |
|---|---|---|
| • 2 Questions from eachmodule.<br>• Total of 8 Questions, eachcarrying 3 marks<br><br>**(8x3 =24marks)** | • Each question carries 9 marks.<br>• Two questions will be given from each module, outof which 1 question should be answered.<br>• Each question can have a maximum of 3 subdivisions.<br>**(4x9 = 36 marks)** | **60** |

## Course Outcomes (COs)

At the end of the course students should be able to:

| Course Outcome | | Bloom's Knowledge Level (KL) |
|---|---|---|
| **CO1** | Understand the crystal structures (BCC, FCC, and HCP), and their relationship with the properties. | **K2** |
| **CO2** | Understand the crystallographic defects through metallography | **K2** |
| **CO3** | Compare the material properties among different materials for material selection. | **K2** |
| **CO4** | Define and differentiate the microstructure of metallic materials using phase diagrams. | **K4** |

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

**CO-PO Mapping Table:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | | | | | | | | |
| **CO2** | 3 | 2 | | | | | | | | | |
| **CO3** | 3 | | | | | | | | | | |
| **CO4** | 3 | 2 | | | | | | | | | |

| **Text Books** | | | | |
|---|---|---|---|---|
| **Sl. No** | **Title of the Book** | **Name of the Author/s** | **Name of the Publisher** | **Edition and Year** |
| **1** | Material Science and Engineering, 2014 | Callister William.D | John Wiley | 2014 |
| **2** | Engineering Metallurgy part-I | Higgins R.A | Arnold | 6th ,1998 |

| **Reference Books** | | | | |
|---|---|---|---|---|
| **Sl. No** | **Title of the Book** | **Name of the Author/s** | **Name of the Publisher** | **Edition and Year** |
| **1** | The science and engineering of materials | Donald R Askeland | Thomson | |
| **2** | Introduction to Physical Metallurgy | Avner H Sidney | Tata McGraw Hill | 2009 |
| **3** | Material Science and Engineering | Raghavan V | Prentiece hall | 2004 |

| **Video Links (NPTEL, SWAYAM…)** | |
|---|---|
| **Module No.** | **Link ID** |
| **1** | https://archive.nptel.ac.in/courses/113/105/113105103/ |
| **2** | https://archive.nptel.ac.in/courses/113/105/113105103/ |
| **3** | https://archive.nptel.ac.in/courses/113/105/113105103/ |
| **4** | https://archive.nptel.ac.in/courses/113/105/113105103/ |