



**SECOND SEMESTER 2024-25**

**Course Handout (Part II)**

Date: 28.12.2024

In addition to part -I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

**Course No.** : CHE F243  
**Course Title** : Materials Science and Engineering  
**Instructor-in-charge** : Prof. Debirupa Mitra

**Scope and Objective of the Course:**

The objective of the course is to introduce the fundamentals of materials science to Chemical engineering undergraduate students. The course will impart a basic understanding of the structure and properties of different types of materials such as metals, ceramics and polymers. The course will include examples to expose students to recent developments in materials science & engineering research and applications.

**Learning Outcomes:**

On completing this course the student should be able to:

- Understand the application of materials in various aspects of Chemical engineering
- Classify materials, describe the basic structure of materials at the molecular, microscopic, and macroscopic scales and understand structure-property correlations.
- Select appropriate type of material for specific application
- Understand basic materials characterization

**Text Book:**

**T1. Callister's Materials Science and Engineering** by William D. Callister, Jr. and David G. Rethwisch, Adapted by R. Balasubramiam, Second Edition, John Wiley (2019)

**Reference Books:**

**R1. Material Science and Engineering** by V. Raghavan, Sixth Edition, Prentice-Hall of India Private Limited (2018)

**Course Plan:**

Lect. No.	Learning Objectives	Topics to be covered	Chapter in the Text Book
1	Introduction	Classification of Materials	Ch. 1 (T1)
2	Atomic structure and Bonding in materials	Bonding forces & Energies; Primary and Secondary bonds	Ch. 2 (T1)
3-9	Crystallography and Metallic structures	Unit cell; Crystallographic points, directions and planes; Crystal structures, Diffraction technique	Ch. 3 & 4 (T1)
10-11	Imperfections in solids	Vacancies and interstitials; dislocations and grain boundaries	Ch. 5 (T1)

12-13	Diffusion	Diffusion mechanisms	Ch. 6 (T1)
14-16	Phase diagrams	Phases; Microstructure; Phase equilibrium; Iron-Carbon system	Ch. 7 (T1)
17-19	Phase Transformations	Kinetics of transformation; Microstructure changes in Fe-C alloys	Ch. 8 (T1)
20-21	Mechanical properties of metals	Stress-Strain; Elastic and plastic deformations; Mechanical properties of Fe-C alloys.	Ch. 9 (T1)
22-23	Failure of metals	Fracture; fatigue; creep	Ch. 11 (T1)
24-25	Ceramic structures	Crystal structures of ceramics	Ch. 12 (T1)
26-29	Polymer structures	Molecular weight; Molecular configurations of polymers; and Polymer crystallinity	Ch. 13 & 14 (T1)
30-32	Composite materials	Fiber phase; Matrix phase; polymer matrix composite; interfaces and characterization	Ch. 15 (T1)
33-34	Electrical Properties of Materials	Electrical properties of metals, ceramics and polymers	Ch. 17 (T1)
35	Magnetic Properties of materials	Diamagnetism; Paramagnetism; Ferromagnetism	Ch. 18 (T1)
36-37	Thermal properties of materials	Glass Transition; Crystallization and Melting; calorimetry; thermal conductivity	Ch. 19 (T1)
38	Optical properties of materials	Light interaction with solids; applications of optical phenomena	Ch. 20 (T1)
39-40	Advanced/Functional materials	Nanomaterials; Biomaterials; Materials for energy and environment	Material to be provided
41-42	Materials selection	Selection of materials for different applications	Ch. 21 (T1)

## 6. Evaluation Scheme:

Component	Duration	Weightage	Date & Time	Nature
Quiz/Class test (Minimum 2)	TBA	20%	TBA	CB
Project (To be evaluated continuously)	TBA	15% [5% before Mid and 10% after Mid]	TBA	OB
Mid-Term Exam	90 min	25%	TBA	CB
Comprehensive Exam.	180 min	40%	TBA	20% OB + 20% CB

**Chamber Consultation Hour:** To be announced in the first class.

**Notices:** All notices related to the course will be uploaded in LMS.

**Make-up Policy:** Make-up for quiz/class test/project will NOT be taken. Make-up for Mid-term or Compre will be granted for genuine cases with PRIOR approval of IC.

**Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**Prof. Debirupa Mitra**  
**INSTRUCTOR-IN-CHARGE**