BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
HYDERABAD CAMPUS
SECOND SEMESTER 2020-21
Course Handout (Part II)

Date: 16/01/2021

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 **: D.Purnima**

Scope and Objective of the Course:

The objective of the course is to introduce the fundamentals of materials science to Chemical Engineering undergraduate students. It gives a basic understanding of the structure (crystalline and amorphous) and properties (thermal, mechanical and electrical) of different types of materials such as metals, ceramics and polymers. The course also deals how the type of bonding, crystal structure, formation of structure (defects, diffusion, phase diagrams and phase transformation) and dynamics influence the properties of these materials. The course will include case studies and 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:

i. Classify the materials, describe the basic structure of materials at the molecular, microscopic, and macroscopic scales and understand structure-property correlation.
ii. Understand the type of force/environments that a material should withstand for different applications, select appropriate type of material for specific application and offer different approaches to modify structure/microstructure in order to get desired properties.
iii. Suggest best methods of characterizing different categories of materials.

Text Book:

T1. MATERIALS SCIENCE AND ENGINEERING-AN INTRODUCTION by WILLIAM D. CALLISTER, JR. Ninth Edition, John Wiley (2013)

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)
3-5	Crystallography	Unit cell; Crystallographic points, directions and planes; Crystalline and Noncrystalline materials	Ch. 3 (T1)
6-8	Metallic structures	FCC, BCC, Linear and planar densities;	Ch. 3 (T1)

		close-packed crystal structures	
9-10	X-ray diffraction	Determination of crystal structure; Bragg's Law; Diffraction technique	Ch. 3 (T1)
11-13	Imperfections in solids	Vacancies and interstitials; dislocations and grain boundaries	Ch. 4 (T1)
14-16	Diffusion	Diffusion mechanisms	Ch. 5 (T1)
17-20	Phase diagrams	Phases; Microstructure; Phase equilibrium; Iron-Carbon system; Development of microstructure in Fe-C alloys	Ch. 9 (T1)
21-23	Phase Transformations	Avrami rate equations; Isothermal transformation; Continuous cooling transformation diagrams	Ch. 10 (T1)
24-26	Mechanical Properties of materials and characterization	Stress-Strain; Elastic and plastic deformations; Mechanical properties and behavior of Fe-C alloys.	Ch. 6 (T1)
27-28	Dislocations and strengthening mechanisms	Fractography; Slip systems; plastic deformation; strengthening mechanisms; Recovery, recrystallization and grain growth	Ch. 7 (T1)
29	Ceramic structures	Crystal structures of ceramics	Ch. 12 (T1)
30-31	Polymer structures	Molecular weight; Molecular configurations of polymers; and Polymer crystallinity	Ch. 14 & 15 (T1)
32-34	Thermal properties of materials and characterization	Glass Transition; Crystallization and Melting Phenomenon; calorimetry; thermal conductivity	Ch. 19 (T1)
35-37	Electrical Properties of Materials and characterization	Electrical characteristics of Metals; Ceramics and Polymers; dielectric spectroscopy; piezoelectrics	Ch. 18 (T1)
38	Magnetic Properties of materials and characterization	Diamagnetism; Para magnetism; Ferromagnetism, Hysteresis; Superconductivity	Ch. 20 (T1)
39-42	Composite materials	Fiber phase; Matrix phase; PMC (polymer matrix composite; interfaces and characterization	Ch. 16 (T1)

6. Evaluation Scheme:

Component	**Duration**	**Weightage**	**Date & Time**	**Nature**
Quiz (2)	TBA	15%	TBA	Open book
Assignments (1)	TBA	10%	TBA	Open book
Presentation(1)	TBA	10%	TBA	Open book
Mid-Term Exam	90 min	30 %	03/03 1.30 - 3.00PM	Open book
Comprehensive Exam.	2 hours	35%	08/05 AN	Open book

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

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

Make-up Policy: Make-up will be granted for genuine cases with prior approval of IC.

Note: A student will be likely to get "NC", if he / she doesn't appear / appear for the sake of appearing for the evaluation components / scoring zero in pre-comprehensive total.

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.

D.Purnima
INSTRUCTOR-IN-CHARGE