BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Hyderabad Campus
FIRST SEMESTER 2021-2022
Course Handout (Part II)

20.08.2021

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 : CHEM F333

Course Title : CHEMISTRY OF MATERIALS

Instructor-in-charge : BALAJI GOPALAN

Course Description:

The course gives an introduction to the structure and property of the materials at the atomic and microscopic level. The relation between structure and properties of materials is also highlighted. The course mainly discusses about the synthesis, structure and properties of different types of materials such as metals, ceramics and polymers and organic compounds.

Scope and objective of the course:

The objective of the course is to introduce the fundamentals of materials science to undergraduate students from chemistry point of view. It gives a basic understanding of the structure and properties of different types of materials such as metals, ceramics, polymers and organic compounds. The course also deals how the type of bonding and crystal structure influence the materials property.

Text Book:

T1. MATERIALS SCIENCE AND ENGINEERING-AN INTRODUCTION by WILLIAM D.CALLISTER, JR. Seventh Edition, John Wiley (2007)

Reference books:

R1. **Solid State Chemistry** by Lesley E. Smart and Elaine A. Moore
R2. Solid State Chemistry by A.R. West

Course Plan:

L.No.	Learning Objectives	Topics to be covered	Chapter in the Text Book
1-2	Crystallography	Unit cell, Crystallographic directions and planes, Crystalline and Noncrystalline materials (Directions and indices of Hexagonal crystals excluded)	T1 3.1 - 3.11
3-4	Metallic structures	FCC, BCC, Linear and planar densities, close-packed crystal structures	T1 4.1 - 4.9
5-6	Polycrystalline and Anisotropy	Defects, diffusion and anisotropy	
7-8	Phase diagrams	Phase Equilibria, Binary Isomorphous Systems, Binary Eutectic Systems, Gibbs Phase Rule, Iron-Carbon System	T1 7.1-7.20
9-11	Phase Transformations	Kinetics of Phase Transformation, Isothermal Transformation Diagrams, Continuous Cooling Transformation Diagrams,	T1 8.1-8.6 Class notes
12-15	Mechanical	Stress-Strain, Elastic and plastic deformations,	9.5 - 9.7,

	Properties of materials	Mechanical properties and behavior of Fe-C alloys. stress and strain, elastic and tensile properties, hardness, phase transformations, microstructure, alteration of mechanical properties	8.7 - 8.9, 14.2
16-20	Magnetic properties	Atomic magnetism in solids, the exchange interaction, classification of magnetic materials, diamagnetism, pauli paramagnetism, ferromagnetism, antiferromagnetism, ferrimagnetism, superparamagnetism, ferromagnetic domains, hysteresis loop, hard and soft ferrites, applications	T1 18.1-18.12 Class notes
21-25	Electrical Properties of Materials	Electrical characteristics of Metals, Ceramics conductivity, band theory, types of semiconductors, time dependence of conductivity, mobility of charge carriers, metal-metal junction, metal–semiconductor junction, n-type and p-type semiconductors;	17. 4 - 17.13, 17.16 - 17.17
26-29	Thermal properties of materials	Glass Transition, glass ceramics, processing, Crystallization and Melting Phenomenon, heat capacity, thermal expansion, conductivity, thermal stresses	14.10 - 14.14, 12.14 - 12.16
30-32	Optical properties:	Refraction, reflection, absorption, transmission, luminescence, photoconductivity, opacity and translucency in insulators, optical fibers;	
33-35	Polymer structures	Synthesis, structure, properties, inorganic polymers, Molecular weight, Molecular configurations of polymers, and Polymer crystallinity, electrical and magnetic properties of polymers, Polyacetylene and Related Polymers, Molecular Metals, Polymers and Ionic Conduction,	T1 13.1 - 13.4,14.20, 13.5- 13.10, 4.18 - 4.19 Class notes R1: 6.1-6.5
36-40	Zeolites and Related Structures and Metallo-organic Frameworks	Composition, Structure, Synthesis, Uses: Synthesis and applications of metallo-organic framework materials	R1: 7.1-7.9 Class notes

Learning outcomes:

Lect. 1 to 6: Understanding of arrangement of atoms and molecules in solids. Besides, this chapter will also pave way to the understanding of origin of the anisotropy in the properties of materials. The concepts of x-ray diffraction in simple metals and few complex oxides will be clear.

Lect. 7 to 11: Understanding of formation of a phase (a crystal structure) from thermodynamics and kinetics point of view. The understanding on the purpose of usage of imaging techniques (SEM, TEM) and thermal analyses.

Lect. 12 to 15: Understanding of mechanical properties from structure-property relations. Advanced materials from chemistry and structure point of view.

Lect. 16 to 20: Understanding of magnetic property from structure-property relations. Advanced materials from chemistry, structure and technological point of view.

Lect. 21 to 25: Basic understanding of electrical property and the structure-property relations. Advanced materials from chemistry and structure point of view.

Lect. 26 to 29: Basic understanding of structure of glass and its characterization. The chemistry and structure point of view.

Lect. 30 to 32: Understanding of interaction of light with matter. The properties of advanced materials.

Lect. 33 to 35: The properties and application of polymer materials from chemistry point of view.

Lect. 36 to 40: The understanding of porous structures and its applications.

Evaluation Scheme :

Component	Duration	Weightage%	Date Time	Nature of Component
Mid sem	90 min	30%	23/10/2021 9.00 - 10.30AM	Open Book
Assignments	-	20%	Will be announced by IC	-
Quiz*	-	15%	Surprise component	Closed Book
Comprehensive Examination	120 min	35%	27/12 AN	Open Book

*There will be a total of **6 quizzes** will be conducted out of which **best 4** will be considered for final evaluation and grading.

Note:

6. **Chamber Consultation Hours**: To be announced through a notice.
7. **Notices**: Notices, if any, concerning the course will be displayed on the **Chemistry department Notice Board and course page on CMS**.
8. **Make-up-policy**: Make up would be considered only for **genuine reasons**.
9. **Chamber Consultation hour:** To be announced in class by instructors.
10. **Mid-Semester grading**: The midsem, one assignment, and atleast 2 quiz marks will be considered. It is done in the same manner as that of the final grading.
11. **Make-up Policy**: Make-up will be granted only to genuine cases. For cases related to illness, proper documentary evidence is essential. Prior permission is necessary if the student is out of station on the test date.
12. **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.

Instructor-in-charge
CHEM F333