

Semester 6 | Core Course XIV (Elective)
PHY6B14 (EL3): MATERIALS SCIENCE
54 hours (Credit - 3)

	Course Outcome	CL	KC	Class Sessions allotted
CO1	Understand the basic ideas of bonding in materials	U	C	7
CO2	Describe crystalline and non crystalline materials	U	C	8
CO3	Understand the types of imperfections and diffusion mechanisms in solids	U	C	12
CO4	Describe the different properties of ceramics and polymers	U	C	15
CO5	Describe the different types of material analysis techniques	U	C	12

Unit 1

15 Hours

Introduction

What is material science, Classification of materials-metals, ceramics, polymers, composites, Advanced materials, smart materials. (Section 1.1 to 1.6 of Callister's Material science and Engineering)

Bonds in materials

Atomic bonding in solids-bonding forces and energies, Primary bonding - Ionic bonding, Covalent bonding, metallic bonding, Secondary bonding- van der waals bonding, fluctuating induced dipole bonds, polar molecule induced dipole bonds, permanent dipole bonds example of anomalous volume expansion of water. (Section 2.5 to 2.8 of Callister's Material science and Engineering)

Crystals

Crystalline and Non Crystalline materials -Single crystals, polycrystals, Anisotropy, metallic crystal structures, atomic packing factors of FCC, BCC, Hexagonal close packed crystal structure, Density computations, Linear and planar densities, polymorphism and allotropy, non crystalline solids. (Section 3.8 to 3.11, 4.2 to 4.9 of Callister's Material science and Engineering)

Unit 2

12 Hours

Imperfections in Solids

Point defects, Vacancies and selfinterstitials, substitutional impurities, atomic point defects-Schottky defect, Frenkel defect, Dislocations-edge and screw dislocations, burgers vector, Interfacial defects-External surfaces, Grain boundaries, twin boundaries, stacking faults, Bulk and volume defects.(Section 5.2 to 5.8 of Callister's Material science and Engineering)

Diffusion in solids

Introduction, Diffusion mechanism, Vacancy diffusion, Interstitial diffusion, Steady state diffusion and Non-steady state diffusion, fick's laws, Factors that influence diffusion-temperature, diffusion species, example of aluminium for IC interconnects. diffusion in ionic and polymeric materials (section 6.1 to 6.8 of Callister's Material science and Engineering)

Unit 3

15 Hours

Ceramics and its properties

Glasses, Glass ceramics, properties, refractories -fire clay and silica refractories, Abrasives, cements, advanced ceramics-optical fibers, ceramic ball bearings, piezo electric ceramics, stress-strain behaviour of ceramics, flexural strength and elastic behaviour.(Section 12.1 to 12.8, 12.11 of Callister's Material science and Engineering)

Polymers and its properties

Different forms of Carbon-Diamond, Graphite, Fullerenes, Carbon nano tubes.

(Qualitative aspects only)(Section 4.17 of Callister's Material science and Engineering)

Hydro carbon molecules, polymer molecules, homo polymers and copolymers, molecular weight calculation, linear polymers, branched polymers, cross linked polymers, network polymers, thermo setting and thermo plastic polymers, stress-strain behaviour and viscoelastic deformation of polymers. (Section 13.1 to 13.9, 14.2, 14.3, 14.4 of Callister's Material science and Engineering)