

PPH326: STRUCTURE AND PROPERTIES OF MATERIALS

L	T	P	Cr
3	1	0	3.5

Course Objective(s): To give comprehensive exposure to the students regarding various engineering materials; crystalline, non- crystalline materials, crystal structure and their defects; the concept of phase and different type of phase diagrams.

Materials Classification: Engineering materials and their classification: metals/ceramics/composites, Intrinsic and extrinsic, Structure sensitive and Structure insensitive properties. Structure-property-processing co-relationship as a theme of materials science.

Non-crystalline Structures: General features and classification, Structure models for amorphous materials-microcrystalline chain and ring model, Molecular model. Structure and properties of metallic glass and amorphous semiconductors.

Crystal Imperfections: Point imperfections, Burger vector, Dislocations (edge and screw) Properties of dislocation, Generation of dislocation, Partial dislocation, stacking faults, Motion of dislocations (climb, cross-slip), Strain hardening and recovery, and Surface imperfections, Structure of high, Low angle and twin boundaries.

Diffusion: Diffusion mechanisms, Fick's rules of diffusion, Factors that influence diffusion

Phase diagrams: Phase rule and phase diagrams, Unary and binary systems, Solid solutions, Hume Rothery rules, Intermediate phases and compounds, Isomorphous and eutectic systems, Lever rule, Various phase reactions, Introduction to different phase diagrams, Ternary system, cooling curve and its use for drawing phase diagrams, Zone refining.

Mechanical Behaviour of Materials: Elastic, inelastic viscoelastic properties, stress-strain relation

Failure of Materials: Brittle and ductile fracture, Creep failure, Fatigue, Development of creep and fatigue resistant materials, Brittle failures in ceramics, Glasses and polymers.

Strengthening Mechanisms: Characteristics of dislocations, stress field around a dislocation, generation of dislocation, dislocation movement, slip systems, strengthening.

Course Learning Outcomes (CLO):

Students will have understanding of:

1. different type of materials, and their structure
2. structural dependence of various thermal, optical and mechanical properties

Recommended Books:

1. *Smallman, R.E., and Bishop, R.J., Metals and Materials, Butterworth-Heinemann, Oxford University Press, (1995).*
2. *Raghvan, V., Materials Science & Engineering, Prentice-Hall of India, (1998).*
3. *Callister, W.D., Materials Science & Engineering: An Introduction, Wiley & Sons, (2001).*
4. *Smith, W., Principles of Materials Science and Engineering., McGraw Hill, (1990).*