## PPH449 STRUCTURE AND PROPERTIES OF MATERIALS

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| 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.

**Structure of Solids:** Bravais lattice and reciprocal lattice concept; Metallic, ionic and covalent solids; Crystal structures of NaCl, CsCl, Diamond cubic, Zinc Blende, Wurtzite, Rutile, Flourite, Fullerenes, Spinel, Perovskite etc.,

**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.

**Thermal Properties:** Lattice vibrations, vibrations of simple lattice-optical and acoustic phonons, Heat capacity, Thermal expansion, Thermal conductivity thermal stress in materials with example and characteristics in metals and non-metals.

**Optical Behavior:** Interaction of radiation with matter (metals and non-metals), Phosphorescence, luminescence and optical active materials, Structure property relationship in anisotropic media.

**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.

**Dislocations and Strengthening Mechanisms:** characteristics of dislocations, stress field around a dislocation, generation of dislocation, dislocation movement, slip systems, strengthening.

**Course learning outcomes:** Students will have achieved the ability to:

1. differentiate betweendifferent type of materials, and their structures.
2. explain thestructural dependence of 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).*


**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessionals (May include assignments/quizzes) | 25 |