**Ph D entrance syllabus**

Section 1:

Schrödinger’s wave equation. Quantum numbers and their significance. First law of Thermodynamics. Reversible and irreversible process. Isothermal and adiabatic conditions. Concept of entropy. Statement of the second law of thermodynamics. Calculation of entropy change for reversible and irreversible processes. Third Law of Thermodynamics. Free Energy Functions: Gibbs and Helmholtz energy. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state. Free energy of mixing and spontaneity. Le Chatelier principle, equilibrium between ideal gases and a pure condensed phase

Section **II**

Crystal structures, Space lattice, Symmetry elements, Unit cells, Crystal systems, Packing factors, Miller indices, Single crystals, Polycrystalline materials, X-ray diffraction & Bragg’s law. Types of imperfections, Point defects. Dislocations: Edge dislocation & Screw dislocation, Phase Equilibria, Microstructural changes during cooling, The Lever rule and its applications, Gibbs phase rule. Born-Haber cycle and its application, Solvation energy. Semiconductors and insulators, defects in solids.

Section **III**

Plastic deformation of pure metal. Diffusion in solids. Solidification in binery alloys. Fe-C phase diagram. Ternary phase diagram. Metal working, Deformation processing. Preparation of solid solution. Surface hardening. Structural steel. Ultra high strength steel. Principles of electrochemistry. Pyrometallurgy, Hydrometallurgy, electrometallurgy, electrolysis, electrorefining.

Section **IV**

Monomers, Functionality, Degree of Polymerization, Molecular weight and its distribution. The glassy state, rubbery state and the glass transition. Rheological and Mechanical properties of polymer. Thermodynamics of Polymer solutions. Properties of common polymer (Polythene, PP, PVC, PS, PMMA, PET, Nylon, PTFE). Properties of elastomer (NR, SBR, Silicone rubber).

Section V:

Classification of polymers, Monomers, functionality, degree of polymerizations, Kinetics of addition and condensation polymerization, copolymerization, monomer reactivity ratios different copolymers, random, alternating, azeotropic copolymerization, block and graft copolymers, techniques for polymerization bulk, solution, suspension, emulsion.

Section VI:

Concept of average molecular weight, determination of number average, weight average, viscosity average and Z-average molecular weights, polymer crystallinity, Polymer blends and composites, Miscible and immiscible blends, polymer alloys, glass transition, melting transition, FRP composites. Compression molding, injection molding, blow molding, reaction injection molding, extrusion, pultrusion, calendaring, rotational molding, thermoforming, rubber processing in two-roll mill, internal mixer.

Section 8:

Instrumental analysis: FTIR, UV-VISIBLE, TGA, DSC, DMTA, NMR, XRD. Optical Microscope, SEM, TEM.

Mechanical behaviour of solids tensile, flexural, compressive, abrasion, endurance, fatigue, hardness, tear, resilience, impact, toughness. Yield strength of solid, Introduction to Fracture, Fatigue and Creep.