

Department of Polymer Science and Technology
PhD Entrance Exam Syllabus for Science Stream (Polymer Science)

Unit 1: Inorganic Chemistry

Chemical periodicity, Chemical bonding in homo- and heteronuclear molecules. Concepts of Acids and Bases: Bronsted-Lowry, Lux-Flood, Lewis, Usanovich, solvent system and leveling effect concepts. Hard and soft acids and bases (HSAB). Solvent systems: Liquid ammonia, acetic acid and sulphuric acid. Transition and Inner transition elements: structure, bonding theories, spectral and magnetic properties. Ionic solids and bonding energetics: Characteristic structures of ionic solids, Lattice enthalpy and Born-Haber cycle.

Unit 2: Organic Chemistry

IUPAC nomenclature of organic molecules, Inductive, mesomeric, electromeric effect, carbocations, carbanions and carbens. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Principles of Stereochemistry: enantiomers, diastereoisomers, configurational notations of simple molecules, DL and RS configurational notations. Stereoselective reactions; Optical isomerism, Geometrical isomerism, Conformational isomerism.

Unit 3: Physics and chemistry of polymers

Functionality, Classification of polymers, definition of polymerization, chain polymerization (free radical, ionic and co-ordination polymerizations), step (condensation) polymerization, copolymerization, methods of polymerization (bulk. solution, Suspension, Emulsion.), degree of polymerization, polydispersity, molecular weight and molecular weight distribution, methods of measuring molecular weight, crystallinity, methods of measuring crystallinity, T_g and T_m (factors affecting on T_g and T_m).

Unit 4: Polymeric materials

Thermoplastics, thermoset resins and elastomers: Industrial production methods, properties, applications of HDPE, LDPE, PP, PS, ABS, PMMA, Nylon 6 and Nylon 66, PET, PF, Epoxy, unsaturated polyester, Natural rubber, SBR, NBR, EPDM, Silicone, Fluoro elastomers, IIR.

Polymer blends: Reasons for blending, definitions of terms used in polymer blends and alloys, types of polymer blends, blend components' selection criteria, methods of blending, designing a polymer blend. Factors affecting miscibility of polymer blends, role of compatibilizer, compatibilization methods.

Unit 5: Composites, Testing and characterization of polymers

Polymer Composites: Definition, functions of constituent phases, classification of composites, advantages and limitations of polymer matrix composites, applications, fiber reinforcements (natural and synthetic), coupling agents (role, types and chemistry/mechanism).

Polymer testing and characterization: Mechanical properties (short and long term properties)
Tensile, compression, impact, hardness, creep, stress relaxation, flex fatigue, abrasion, resilience.
FTIR, XRD, DSC, TGA, SEM and DMA: Principle, procedure, instrumentation and applications.
Interpretation of analysis results.