

## 2.8 30908 POLYMER SCIENCE

### UNIT-1

History & classification of polymers History of Polymers – Special characteristic and general applications of polymer –elastomers plastics, fibers paints and surface coating adhesives, science of macromolecules, definition of terms – monomer, oligomer, polymer, macromolecules, examples for each. Degree of polymerization (DP), relationship between DP and molecular weight, worked out examples classification of polymer- biological, non-biological, natural, synthetic, and derived thermoplastic, thermosets crystalline and amorphous, organic and inorganic, homo chain and hetro chain.

Homo and copolymers, linear, branched and cross-linked, block and graft, copolymers, alternating and random, copolymers. Stereo regularity of polymers – optical and geometrical isomerism with reference to isoprene, butadiene, chloroprene, isotactic syndiotactic and atactic configuration with reference to poly propylene, effect of stereo regularity in properties of polymer Functionality, Polymerizability and polymer formation Definition of functionality – mono, di and poly functional monomers with examples, effect of unsaturation in functionality of monomers like ethylene styrene, acrylonitrile, and acetylene. Functionality of phenol dicarboxylic acid, diammine diol, average functionality principle of polymerisation Source of monomers Petroleum origin – light naphtha cracking – C2- C6 stream – catalytic reaction involving the production of monomers like– styrene, ethylene, butadiene, acrylonitrile, isoprene etc.

### UNIT-2

Polymerization reaction and techniques Types of polymerization reaction – chain and step polymers with examples – various steps in chain polymerization, initiation, propagation and termination, mechanism, propagation and termination mechanism of free radical, ionic and coordination polymerization, living polymer, initiators, inhibitors, chain transfer agents with examples. .

Step growth polymerization, ring scission polymerization and interfacial polymerization with examples correlate with step growth and chain polymerization Polymerization techniques bulk, solution, suspension, emulsion polymerization, CMC Reactions of polymers Difference between reactions of polymers and simple molecules Behavior of functional groups in polymers, various reactions like hydrolysis, acidolysis, aminolysis, addition, substitution, reactions of various groups like hydroxyl, aldehyde, and ketone, carboxylic, cyclization reaction.

### UNIT-3

Molecular weight, various methods of determining molecular weights  $M_w$ ,  $M_n$ , and their derivation,  $z$ - average molecular wt, viscosity average molecular weight , problems Degree of polymerization (DP) Poly dispersity and molecular weight distribution of polymers and its significance experimental determination of molecular weight and MWD-end group analysis, vapour phase osmometry, light scattering, viscometry and GPC – their principles 51 Structure - property relationship polymers Chemical configurations – isomerism – molecular chain length-  $T_g$ - rubber elasticity - chemical nature – effects on mechanical, electrical and chemical properties- compare with metals, ceramics.

#### **UNIT-4**

Polymer degradation Types of degradation, chain and random degradation, examples of degradation due to thermal, mechanical, high energy radiation, oxidative degradation/reactions, rubber oxidation, ozone degradation, oxidation of saturated polymers, oxidation of P.F, Hydrolytic degradation of pvc advantages and disadvantage of degradation, factors affecting thermal stability– polymer stabilisation various additives incorporated in polymer to prevent degradation- anti oxidant, antiozonant, light stabiliser- mechanism of stabilisation various methods to study polymer degradation – TGA, DSC, DTA, IR, etc.

Methods of modification of polymers Physical and chemical modification - physical means - blends, alloys, and composites - Chemical methods – co-polymerization, grafting, cross-linking and interpenetrating network (IPN). Additives, and mechanism of addition of materials in polymer– common additives – curatives accelerators, antioxidants, activators, plasticizers – internal and external, reinforcing filler, extenders, stabilizers and special purpose additives – function of each –(elementary study only)

#### **UNIT-5**

Individual polymers Brief study of various Elastomers, plastics, fibres, surface coatings and paints and adhesives – elastomers. NR, SBR, BR, IIR, EPDM, NBR, CR, CSM, FKM, Plastics – PE, PVC, PP, P.S, ABS, PF, PTFE, PMMA Nylons, Epoxy, PET, Polyester fibers – cotton, Nylon 6 & Nylon 6, 6, Polyesters, rayon, Aramid fibres (structure and row polymer properties only) Identification of polymers Need of identification, preliminary tests, elementary analysis, and chemical tests for plastics and elastomers (general idea only)–Physical analyzing methods – principles of TGA, DSC, DTA, NMR, & IR, Spectroscopy

#### **Reference Books:**

1. Polymer Science: V.R. Gowarikar, N.V. Viswanathan, Jayadev Sridhar.
2. Text book of Polymer Science: Frew. Billmeyer J.R.
3. Introductory Polymer Chemistry: G.S. Misra
4. Polymer Science & Technology: Premanoy Ghosh of plastics and Rubbers