

Paper II

POLYMER SCIENCE

Introduction: General introduction to polymers with emphasis on important concepts such as monomer, functionality and physical state (amorphous and crystalline), classification of polymers on the basis of source, elemental composition, heat, chemical reactivity, chemical/monomer composition, geometry and stereo regularity.

Chain Configurations: Conformation of polymers-constitutional isomerism, positional isomerism, branching; configurational isomerism- geometrical isomerism, stereo isomerism; polymer conformation-conformation of small molecules and conformation of polymers; conformation of macromolecules- General shape of macromolecules –general shape of macromolecules; definition of conformational parameters of a chain-end to end distance; the freely jointed chain and its unperturbed dimensions. Polymer statistical mechanics, including random and block copolymers.

Chemistry and Mechanism of Polymerization: Definition of polymerization, factors affecting polymerization, chain (addition) polymerization (free radical, ionic and coordination polymerizations), step (condensation) polymerization-molecular weight in step growth polymerization, kinetics of step growth polymerization; polyaddition polymerization, ring opening polymerization, copolymerization – introduction, free radical, ionic and copolycondensation (with examples).

Chemistry of Polymerization: Addition and condensation, plasma polymerization, photo polymerization, electrochemical polymerization, metathetical polymerization, group transfer polymerization.

Methods of Polymerization: Bulk, solution, precipitation polymerization, suspension, emulsion, melt polycondensation, interfacial polymerization, solution polycondensation, solid phase, gas phase and formulation, mechanism, properties of the polymer produced, advantages and disadvantages of each technique.

Ring Opening Polymerizations: General characteristics and polymerizability of cyclic monomers, ring opening polymerization of cyclic ethers, anionic polymerization of epoxides, cationic polymerization of cyclic amides, cyclic polymerizations of lactones and some aspects of biodegradable ring opening polymers: glycolides and lactides.

REFERENCE BOOKS

1. **“Text book of Polymer Science”** - Fred W. Billmeyer, Jr., John Wiley & Sons, New York. 2002.
2. **“Giant Molecules”** – R.B.Seymour & C.E.Carreher, John Wiley & Sons, NY, 1990.

3. **“Principles of Polymer Chemistry”**, P.J. Flory, Cornell University Press, Ithaca, NY 1995.
4. **“Polymer Science”**, V.R.Gowariker, N.V.Viswanathan, J. Sreedhar, New Age International (P) Ltd., Publishers, New Delhi, 1986.
5. **“Polymer Science”**, Padma L Nayak, Kalyani Publihsers, New Delhi, 2005.
6. **“Introduction to Polymer Chemistry”**, C. E. Carraher Jr. 4th Edition, CRC Press, 2017
7. **“Polymer Science & Technology”**, Joel R Fried, 3rd Edition, Prentice-Hall., N. J, 2014.
8. **“Introduction to Polymers”** - R.J.Young & P.A.Lovell, Chapman & Hall, London.
9. **“Principles of Polymer Systems”** - F. Rodrignek, C. Cohen, K. C. K. Ober, L. Archer, 6th Edition, CRC Press