POLYMER PHYSICS

Module-I (12 hours)

Potential energy and conformational energy of molecules - Staggered and eclipsed states - conformations and configurations, isomeric states and isomerism in polymers - Tacticity, stereoisomerism, geometric isomerism - Unperturbed and Gaussian chains - Random coils and average end to end distance - Freely jointed and freely rotating chain models - Random flight analysis.

Thermodynamics - First and second law of Thermodynamics, Carnot cycle - Entropy and enthalpy – Energy driven and entropy driven elasticity - Thermoelasticity -Thermodynamic treatment of polymers - entropic and energetic contributions to the elastic force in rubbers - Statistical mechanical theory.

Module-II (12 hours)

Amorphous State - Transition temperatures - Glass transition temperature - Free volume, kinetic and thermodynamic views of glass transition - Factors influencing glass transition temperature.

Crystalline State - Crystal systems, unit cells , primitive cell, Bravis lattices, polymorphism - Polymer singlecrystals, lamellae, spherulites, supermolecular structures, fringed micelle model - Degree of crystallinity, factors affecting crystallinity - X-ray diffraction.

Module-III (12 hours)

Chain orientation - Concept of chain orientation - orientation in amorphous and crystalline polymers – Uniaxial and biaxial orientation practical significance - Orientation processes - fibre spinning, blown film extrusion, solid state extrusion, profile extrusion - Properties of oriented polymers - Birefringence.

Polymer solutions - Terms and definitions, types of solutions - Hilderbrand approach, Flory Huggins theory - Thermodynamic view of miscibility, upper critical solution temperature (UCST), lower critical solution temperature (LCST) - Concentration regimes in polymer solutions - theta conditions.

Text and Reference Books

1. S. Glasstone and D. Lewis, Elements of Physical Chemistry, Macmillan India Press, Madras, 1995.
2. Paul C. Painter and Michael M. Coleman, Fundamentals of Polymer Science,Technomic Publishing Co. Inc., Lancaster, USA ,1994.
3. Ulf W. Gedde, Polymer Physics, Chapman & Hall, 1995.
4. Cowie; J. M. G., Polymers: Chemistry and Physics of Modern Materials, Intext Educational Publisher, International Text Book Co. Ltd., (1973).
5. Cowie; J. M. G., Polymers: Chemistry and Physics of Modern Materials, 2nd Edition, Blackie and Sons Ltd., Glasgow (1991).

6. Kuleznev; V. N. and Shershnev; V. A. The Chemistry and Physics of Polymers, MIR Publishers, Moscow (1990).
7. Lappert; M. F. and Leigh; G. J. (Eds.), Developments in Inorganic Polymer Chemistry, Elsevier Publishing Co., Amsterdam (1962).
8. Mark; J. E., Eisenberg; A., Graessley; W. E., Mandlekern; L. and Koenig; J. L., Physical Properties of Polymers, American Chemical Society, Washington D. C. (1984).
9. Perepechko; I., An Introduction to Polymer Physics, MIR Publishers, Moscow (1981).