MOLECULAR MOTIONS IN POLYMERS

Unit – I

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.

Unit – II

Types of mechanical deformation – Elastic materials – Viscous materials – Viscoelasticity – effect of rate of strain, temperature and time on mechanical behaviour of polymeric materials – creep – stress relaxation – Boltzman principle – time temperature super position principle – WLF equation.

Mechanical models – stress strain response of spring and dashpot–viscoelstic models – Maxwell element – Voigt kelvin element – response to creep and stress relaxation – four-parameter model – dynamic mechanical properties.

Unit – III

Fluid flow – types of fluid flow – time dependant fluids, shear rate dependant fluids, Newtonian and Non Newtonian fluids – viscosity of polymer melts – shear thinning and shear thickening – zero-shear rate viscosity – laminar flow of Newtonian fluids – power law – general treatment of isothermal viscous flow in tubes.

Unit – IV

Transition temperatures - Glass transition temperature - Free volume, kinetic, and thermodynamic views of glass transition - Factors influencing glass transition temperature. Cryatalline Polymers –degree of crystallinity, factors affecting crystallinity- Melting transition, Crystallization kinetics.

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.

Text Books:

1. Ulf W. Gedde, Polymer Physics, Chapman & Hall, 1995.
2. Brydson: J. A., Flow Properties of Polymer Melts, 2nd Edition, George Goodwin Ltd., London (1981).
3. Polymer Melt Rheology, F.N. Cogswell, Woodhead Publishing, 1983.

References:

1. Richard C. Progelhof and James L. Throne, Polymer Engineering Principles, Hanser Publishers, Munnich Vienna New York, 1993
2. J. D. Ferry, Viscoelastic Properties of Polymers, John Wiley & Sons, New York.
3. Paul C. Painter and M. Michael Coleman, Fundamentals of Polymer Science, Technomic Publishing Co. Inc., Lancaster, USA 1994.