

Advanced Physical Chemistry of Polymers
3 credits graduate course in Polymer Engineering curriculum
Amirkabir University of Technology

Chapter 1: Theory of Polymer Chain Flexibility: Internal rotation and chain conformation, The flexibility of macromolecules, Theory of rotational isomerism

Chapter 2: Thermodynamics of Polymer Solutions and Mixtures: Lattice theory for solutions of small molecules, Lattice approach to polymer solutions and mixtures, Compressible regular solution model, Flory-Orwall-Vrij equation of state

Chapter 3: Phase Evolution and Morphology Control: Determination of the phase boundary, Processing conditions and morphology development, nanoparticles and miscibility of polymer blends, Polymerization induced phase separation

Chapter 4: Diffusion in Polymeric Systems: Solvent self-diffusion in rubbery polymer-solvent systems, Polymer-polymer Interdiffusion, Interfacial layering in a three-component polymer system

Chapter 5: Molecular Basis of Glass Transition (GT): Heterogeneity in chain dynamics, GT in hydrogen-bonded polymer mixtures, Chain confinements and glass transition of polymers, the composition dependence of GT in polymer mixtures

Chapter 6: Thermodynamics and Kinetics of Polymer Crystallization: Density fluctuation and the nucleation event, Lamellar thickening growth versus lateral growth, Theory of spinodal decomposition assisted crystallization

Chapter 7: Polymer Surfaces and Interfaces: Polymer friction and adhesion, Mobility of polymers at the Air/Polymer Interface, Polymeric droplets on soft surfaces

Chapter 8: Gelation and Polymeric Gels: Rheological images of PVC gels Viscoelastic behavior and early stage of crystallization, Strain-induced nonlinearity of filled rubbers

References:

1. L. H. Sperling, "Introduction to Physical Polymer Science" 4th ed, Wiley, New York, 2006.
2. S. F. Sun, "Physical Chemistry of Macromolecules" Wiley, New York, 2012.
3. M. Rubinstein and R. Colby, Polymer Physics, Oxford University Press, London, 2003.
4. G. Strobel, "The Physics of Polymers" Springer, New York, 1997.
5. D. W. Van Krevelen and K. Te Nijenhuis, Properties of Polymers: Their Numerical Estimation and Prediction from Additive Group Contributions, 4th ed., Elsevier, Amsterdam, 2009.
6. Teraoka, "Polymer Solutions: An Introduction to Physical Properties", John Wiley, New York, 2002.