Physical Chemistry of Polymers

Undergraduate 3 credit course in Polymer Engineering curriculum

Amirkabir University of Technology

Chapter 1: The basic of polymer science (Polymer behavior, molecular weight and its distribution, the physical states of polymers, crosslinking and additives, molecular engineering).

Chapter 2: Polymer chain: Microstructure and conformation (making a polymer chain, comparison of microstructure and chain local conformation, overall chain conformation, molecular architecture, multicomponent polymers.

Chapter 3: Molecular weight and chain dimension (solubility parameter, surface tension and interfacial tension, measurement of number average molecular weight, weight average molecular weight and chain radius of gyration, gel permeation chromatography.

Chapter 4: Concentrated solutions and phase diagrams (phase diagrams and polymer partitioning, different regions of polymer- solvent phase diagrams, phase separation in polymer blends, small molecules permeability through polymers).

Chapter 5: Amorphous state and glass transition temperature (amorphous polymer, the structure of amorphous polymers: Chain aggregation models in bulk and amorphous state, macromolecular dynamics, the theories of glass-rubber transition).

Chapter 6: Crystalline state and equilibrium melt temperature (melting phenomenon, methods of crystal structure determination, the structure of crystalline polymers, methods of crystal content determination, the theories of crystallization kinetics, melting thermodynamics).

Chapter 7: Rubber or entropic elasticity (thermodynamic equation of state, modification of rubber elasticity theory, the swelling of cross-linked polymers in solvents, the effect of strain on melting temperature).

Chapter 8: Molecular principles of viscoelasticity (stress relaxation and creep, relaxation and retardation times, dynamic mechanical experiment, molecular processes of stress relaxation, physical aging in glassy state).

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. D. W. Van Krevlen and K. Te Nijenhuis Properties of Polymers, Elsevier, 4th Ed. 2009.
4. M. Rubinstein and R. Colby, Polymer Physics, Oxford University Press, London, 2003.
5. G. Strobel, “The Physics of Polymers" Springer, New York, 1997.