

6751 Physical Chemistry of Polymer Solutions (3-0-3) (45 hrs)

Prerequisites: Consent of Department

Recommended: Physical chemistry

Text: Polymer Physics by Colby and Rubinstein, Oxford University Press.

Description:

Study of polymer solutions, absorptions, sorptions, plasticization, molecular weights, molecular weight distributions, and interfacial phenomena using thermodynamics, statistical mechanics, information and fluctuation theories, and relaxation methods.

Course Outline

1. Thermodynamics: emphasizing solutions.
2. Conformations and spatial configurations of polymer chains.
3. Determination of conformations – methods used for such measurements.
4. Dilute polymer solutions: viscosity, light scattering, and colligative properties.
5. Thermodynamics of transitions in polymer solutions: liquid–liquid, liquid crystalline phase transitions.
6. Concentrated solutions, and melts.
7. Statistical theories of viscosity and diffusion in polymers.
8. Introduction to scaling laws.

Detailed Course Content

Hrs Lecture Breakdown (will very likely not be followed closely)

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| 3 | 1. A Generic introduction to polymer science – dealing with macroscopic properties |
| 3 | 2. Dimensions of polymer chains – chain statistics |
| 1 | 3. Rotational Isomeric State |
| 2 | 4. Analogy of polymer chains to Ising model – another way to think about polymers |
| 3-6 | 5. Determination of chain dimensions – scattering, fluctuations, osmotic pressure, osmotic compressibility and analogy to ideal gas laws |
| 2 | 6. Scaling Concepts in Polymer Solutions (include static & dynamic flexibility) |
| 3 | 7. Mixing of Polymers – phase behavior – Flory-Huggins Theory |
| 3-6 | 8. Modes of Phase separation – nucleation and growth, Spinodal decomposition |
| 1 | 9. A Review of what has been accomplished |
| 2 | 10. Block Copolymers and Phase Separation |
| 3 | 11. Rods in Solution and Liquid Crystalline phases (Tobacco Mosaic Virus etc) |
| 2 | 12. Frictional Properties of polymers in solution (Rouse, Zimm models) |
| 3-6 | 13. Dynamics of Polymer Chains (motion in unentangled and entangled chains) |
| 3 | 14. Rheo-Optics and Rheology of Polymers |

Other Topics:

Polyelectrolytes, single molecule experiments etc to probe the dynamics of polymer chains.

Exams

Exam 1 (Time and date will be specified – very likely in late February)

Exam 2 (early part of April)

Final Exam (week of April 26)

Student Paper

Students have to prepare a Research Proposal based on the course that can be sent out for evaluation. The proposals will be evaluated.

From time to time you will be given current papers and will be asked to discuss those papers in class. You will have sufficient time to prepare for these.

Summary of Course Grading Policy:

Two 1-Hour Exams	40%
Final Exam	30%
Research Proposal	30%