

Syllabus

Fall 2002, Chemistry 664
9:55 M,W
Rm. B387, Chem. Bldg.

Instructor: Hyuk Yu
Room 4227, Chem.Bldg.
yu@chem.wisc.edu

PHYSICAL CHEMISTRY OF MACROMOLECULES

2-3 credits (3rd credit requires a term paper on a subject to be chosen)

Textbook: "Polymer Physics ", Michael Rubinstein & Ralph Colby,
Oxford University Press, December 2002, will be distributed as a handout

- Those registered for 3 credits must report to the instructor by September 23, concerning their preferences for the term paper topics.
- There will be 11 problem sets, to be graded and will count toward the final course grade by 15%.
- There will be a mid-term examination, counting toward the final course grade by 35% during the week of October 28 outside of the scheduled class hours. The exact time will be found at the conveniences of all registered.
- The final examination will be held at the specified time as indicated in the Time Table, December 18 (Wed), 12:25 pm.
- The course grading is in the standards of graduate course, i.e., C and below is a failing grade.
- There will be no classes on October 2 and possibly October 7, due to the instructor's medical excuse (an elective surgery).
- References given in lectures are to be consulted as the time allows, but specific ones to be read will be brought to the attention of the class.

Lecture Outline:

I. *Introduction*

Introduction to the structural orders of macromolecules and polymers; Conformational regularities and chain configurations; Molecular weight distributions; Determinations of molecular weights

II. *Single chain conformation*

A. Ideal chains

- Models of freely-jointed chains, freely-rotating chains, worm-like chains, chains with hindered rotation, & rotational isomeric state
- Linear chain dimensions; radius of gyration and end-to-end vector
- Distribution of end-to-end vector
- Free energy & pair correlation function of ideal chain
- Determinations of linear dimensions

B. Real chains

- Self-avoiding random walk & excluded volume effects
- Deformations under tension, compression and by adsorption on substrate
- Scaling model of real chains, temperature effects and virial coefficients
- Determinations of linear dimensions

III. *Thermodynamics of Blends & Solution*

- Statistical thermodynamics of mixing
- Free energy of binary mixing
- Equilibrium & stability
- Phase diagram

- IV. ***Statistical thermodynamics of polymer solutions***
 - Cell model and Flory-Huggins theory
 - Solvent quality and chain dimensions
 - Semi-dilute solutions
 - Scaling models of brushes & mushrooms
- V. ***Network & Gelation***
 - Random branching & gelation
 - Networks & Gels
- VI. ***Chain Dynamics***
 - Unentangled polymer dynamics
 - Entangled polymer dynamics