PHYSICAL CHEMISTRY OF POLYMERS

SYLLABUS

Lectures: Tuesday, Thursday, 2:30 – 4:00, Amundson 156

Instructor: Frank S. Bates 391 Amundson Hall

Office Hours: By appointment (email: bates001@umn.edu).

TA: Joshua Mysona (myson001@umn.edu), 307 Amundson Hall

Prerequisites: Undergraduate physical chemistry or the equivalent.

Text: "Polymer Chemistry, 2nd Edition" by Paul C. Hiemenz and Timothy P. Lodge

Problem Sets: There will be homework problem sets. They will be due by an assigned time, and they will be graded. They will count for 30% of the course grade. Each student should submit their own problem sets, and to the extent possible they should reflect the student’s own work. However, discussing problems with classmates can be very helpful, and is therefore encouraged. If you feel that you have received significant help from someone on a particular problem, please just note this fact at the beginning of that problem set.

Quizzes: Many lectures will begin with a simple quiz, based on the assigned reading. These will count for 10% of the course grade.

Exams: There will be two in-class midterms and one comprehensive final exam. They will count for 15%, 15% and 30% of the course grade, respectively. The date of the final exam will be set during the first week of class.

Tentative Exam Schedule

Midterm #1: Thursday, March 2

Midterm #2: Thursday April 20

Final Exam: TBD
1. Introduction: polymer structures, properties and universality; molecular weight averages. (Chapter 1)

2. Coil dimensions: freely-jointed chain, characteristic ratio, persistence length, worm-like coil; radius of gyration; distribution functions. (Chapter 6)


4. Light scattering from polymer solutions: Rayleigh scattering, Zimm equation, form factors; x-ray and neutron scattering. (Chapter 8)

5. Dynamics and characterization in dilute solution: intrinsic viscosity, diffusion coefficient, hydrodynamic interactions, dynamic light scattering, size-exclusion chromatography. (Chapter 9)

6. Networks and gels: gel point by crosslinking and by step-growth polymerization; rubber elasticity; swelling equilibrium. (Chapter 10)

7. Viscoelasticity: modulus and compliance; transient and dynamic experiments; Maxwell and Voigt elements; Rouse, Zimm, and reptation models. (Chapter 11)

8. Glasses: phenomenology and interpretation of the glass transition; free volume; time-temperature superposition; properties. (Chapter 12)

9. Semicrystalline polymers: unit cells; morphology; roles of thermodynamics and kinetics. (Chapter 13)

10. Extra topics.