Chem 654, Spring 2003
Handout

#1, 01/22/03 #1-1

Syllabus
Chem 654, Chemistry of Polymeric Materials.

Instructor: Hyuk Yu (*yu@chem.wisc.edu*), Room 4227, Chem. Bldg.
Lectures: M &W 11:00, B351 Chem. Bldg. *2-3 credits, a 1st year graduate course, 30 lectures for 2 cr., and a directed project for an additional cr.*

Prerequisite: Senior or graduate standing in chemistry, chemical engineering or related areas, with Chem 345 (2^{nd} semester organic chemistry) and Chem 561 (1^{st} semester physical chemistry)

Tentative textbook: "Polymers: Chemistry and Physics of Modern Materials", 2^{nd} edition, J.M.G. Cowie (Chapman and Hall, 1991).

Exams: There will be one mid-term exam plus a final. Exams will account for approximately 70% of the course grade.

Problem Sets: There will be problem sets about once every two weeks. Problems sets will account for approximately 30% of the course grade.

Third credit: You have an option of taking this course for three credits. The third credit will be fulfilled by submission of a literature research report on a topic of student's choice from the list to be provided.

Outline

1. Polymer classification:
   Principal uses of thermoplastics, thermosetting resins, crosslinked elastomers.

2. Molecular architectures of polymers:
   Synthetic methods of polymers; homogeneous and heterogeneous catalysis of polymerization; polycondensation, unidirectional and reversible free radical, anionic, Ziegler-Natta, and emulsion polymerizations; linear, branched, hyperbranched homopolymers, and random, alternating, block, multi-armed star copolymers

3. Solid state structure of amorphous & semi-crystalline polymers:
   Diffraction and scattering methods for characterization of films and fibers, and morphological characterization

4. Glassy state and glass transition:
   Relaxation behaviors in glassy state and glass transition probes by thermo-analytical, thermomechanical and spectroscopic methods

Syllabus-continued

5. Thermodynamics of concentrated polymer solutions and gels:
   Osmotic pressure in semi-dilute and concentrated solutions; vapor sorption; network swelling

6. Mechanical properties of polymers
   Rubber-like elasticity; linear viscoelasticity; time-temperature superposition; failure mechanisms; yielding, crazing & cracking

7. Transport properties in and of polymers
   Gas sorption, gas diffusion, self diffusion & tracer diffusion; release mechanisms of adsorbates in gels

8. Dielectric, electrical & electro-optical properties of polymers
   Relaxation & non-linear behaviors of amorphous and semi-crystalline polymers; conducting polymers and electroluminescence

9. Surface & interfacial properties of polymers
   adhesive and cohesive properties & surface treatments

10. Applications of commercial and non-commercial polymers
    Targeted properties of plastics, elastomers, viscous liquids & swollen gels; uses as structural and non-structural components; applications in transportation, architectural, aerospace, optics and electro-optics, microelectronics, biomedical devices, tissue engineering, and hygienics