Department of Chemical Engineering and Materials Science
University of Southern California

CHE 472: Polymer Science and Engineering
Fall 2014

Course Outline

This course aims to provide students with a **broad introduction to major concepts in chemistry and physics of synthetic polymers, and understanding of how they are applied in modern engineering applications**. In the first half of the course, major classes of chemical pathways to synthesize polymers will be introduced with an emphasis on how to control over size, molecular structure, and properties of polymers. The second half of the course will cover thermodynamic, thermal, mechanical properties of polymers in melt, solution, and solid-state, structure-property relationship that provide polymers with unique characteristics compared to small molecules, experimental techniques for characterization, together with their relevance to engineering applications, emphasizing understanding of underlying physics and physical chemistry.

Instructor

Prof. Jongseung Yoon
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Teaching assistant

TBD
Office location:
Office phone:
Email:

Class Hours

Tuesday, Thursday: 5:00-6:20PM, in KAP 148

Office Hours

Friday: 11:00-12:00 or as requested by appointment.

Text Book

R.J. Young and P.A. Lovell, *Introduction to Polymers,* 3rd. ed. CRC Press, 2011
(2^{nd} edition will be also fine if you already have one)

Class Topics

Step polymerization
Radical polymerization
Ionic polymerization
Thermodynamics of polymer solution
Chain statistics
Amorphous and crystalline state
Viscoelastic properties of polymers

Grading

The course consists of two lectures per week. The final course grades are based on the distribution of total points accumulated on **one mid-term exam, a comprehensive end-term exam, a group**

presentation, and assigned problem sets.

Mid-Term Exam	:	30%
Final Exam	:	35%
Problem Set	:	20%
Group Presentation	:	15%
Final Grade	:	100%

Exams

A mid-term exam will be held on **Thursday, October 16** from **5:00– 6:20 pm**. A comprehensive final exam will be held on **the week of final exam**. The exact location and schedule for the final exam will be announced later. All exams will be closed-book tests. Scientific calculators are permitted for use in the exams.

Problem Set

Problem sets will be assigned approximately every two or three weeks to ensure that the students keep current with the class materials and are prepared for the exams. These problem sets are to be turned in for grading on the specified due dates at the beginning of the class. **Problem sets submitted late will be graded with a penalty (penalty = (-10% of total score) x day(s) of delay). No problem sets will be accepted after two days of delay.**

Group Presentation & Report

A small group of students will be required to prepare a short presentation and report on a special topic in polymer science and engineering. Detailed guideline, along with a list of potential topics, will be discussed on September 2nd. **Grades will be based on both the quality of your presentation and final report.** Special dates for the term paper are as follows.

October 7, Tuesday: First draft due.
October 28, Tuesday: Peer-review due.
November 27, Thursday: Final report due.

Collaboration Policy on Problem Sets

Students are encouraged to discuss and work together on problem sets. However, each student must develop and submit his/her own solutions. **Direct copying even a part of another student's work is considered a cheating, and will result in zero score for all involved students.**

Academic Integrity

Students must read and abide by the USC Student Conduct Code for academic integrity, which can be found at *http://web-app.usc.edu/scampus/1100-behavior-violating-university-standards-and-appropriate-sanctions/.* **Plagiarism on problem sets and term papers, and consulting with another student during an exam all constitutes cheating in this course. Students are subject to disciplinary sanctions including failure in the course, and will be referred to the Office of Student Judicial Affairs and Community Standards for further review.**

Disability

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m. – 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776. More information can be found at: http://sait.usc.edu/academicsupport/centerprograms/dsp/facultyinformation.html.

Missed Exams

Any student who misses a mid-term exam for a documented, valid reason (e.g., a medical situation, a family emergency, etc.) will be able to make up the exam. Students must arrange their absence in advance with their instructor (preferentially at least two days earlier than the exam date). Any student who misses a mid-term exam without a documented, valid reason will automatically be given a zero score. **Students must take the final exam to receive a grade for the course.** Students who miss the final exam for any reason will be given a final course grade of INCOMPLETE. Any student who misses the end-term exam without a documented, valid reason will automatically be given an "F" for the class.

Class Etiquette

Students are expected to be on time for the class. If you must arrive late or depart earlier, please do so quietly so that you do not disturb the class. Cell phones, laptops, and other distracting activities will not be tolerated and allowed during the class hours.

Tentative Class Schedules

No.	Date	Class topics	Reading assignment
1	Aug. 26	Class overview, Polymer vs. Monomer	1.1, 1.2
2	Aug. 28	Classification of polymers, Molecular weight distribution	1.2, 1.3
3	Sept. 2	Classification of polymerization	2.1-2.4
4	Sept. 4	Step-polymerization	3.1, 3.2.1
5	Sept. 9	Step-polymerization, Theory of linear step polymerization	3.2.1, 3.2.2
6	Sept. 11	Theory of linear step polymerization	3.2.3
7	Sept. 16	Kinetics of step polymerization	Handout, 3.2.3
8	Sept. 18	Nonlinear step polymerization	3.2.5, 3.3
9	Sept. 23	Radical polymerization	4.1-4.2
10	Sept. 25	Kinetics, chain transfer	4.3
11	Sept. 30	Molecular weight distribution, ceiling temperature	4.3
10	Oct. 2	No Class	
11	Oct. 7	Bulk, solution, suspension polymerization	4.4
12	Oct. 9	Suspension, emulsion polymerization	4.4
13	Oct. 14	Emulsion, cationic polymerization	4.4
14	Oct. 16	Mid-term Exam	
15	Oct. 21	Chain dimension	10.3.1
16	Oct. 23	Characteristic ratio	10.3.1, 10.3.2
17	Oct. 28	Excluded volume, theta condition	10.3.2, 10.3.3
18	Oct. 30	Ideal solution, Flory-Huggins theory	10.2.1, 10.2.2
19	Nov. 4	Flory-Huggins theory	10.2.1,10.2.2
20	Nov. 6	Flory-Huggins theory, Partial molar quantity	10.2.2, 10.2.3
21	Nov. 11	Dilute polymer solution, membrane osmometry	10.2.4, 10.2.5
22	Nov. 13	Membrane osmometry	11.1, 11.2
23	Nov. 18	Glass transition	16.1, 16.3
24	Nov. 20	Linear viscoelasticity	20.1, 20.2
25	Nov. 25	Linear viscoelasticity	20.2-20.4
26	Nov. 27	Time-temperature superposition	20.4-20.6
27	Dec. 2	Term presentation	
28	Dec. 4	Term presentation	