ChE/Chem C178: Polymer Science and Technology
Spring 2015

Lectures: TuTh 11-12:30 pm, 180 Tan Hall

Instructor:
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Graduate Student Instructors (GSI):
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Text: Polymer Chemistry, Second Edition (2007) by Paul C. Hiemenz and Timothy P. Lodge

Website: bcourses.berkeley.edu
Pre-lab quizzes must be taken through the website before noon on the day of your lab. Please post all questions related to homework and course material to the bspace forum so that all members of the class can benefit from the response.

Homework: Due at the start of the specified class. No late homeworks will be accepted.

Laboratory: 5 sessions conducted in **302 Latimer** on dates specified on attached schedule. Written reports are due on dates specified in syllabus. Since this is a 3 credit course, 5 lectures will be cancelled to take the place of labs.

Prelab Quiz: Taken on bspace by noon on the day of your lab. See below for details.

Grading:

Homework:	8%
Laboratory:	8%
Midterm 1:	22%
Midterm 2:	22%
Final:	40%

Date	Topics	Sections of H & L
1. Introduction		
Week 1	Course Introduction, nomenclature & basic definitions, molecular weight	Pgs 1-19
	Molecular weights & molecular weight distributions, intro to polymerization reactions	Pgs 24-35
	Step growth polymerization; intro & distribution of molecular sizes	Pgs 43-49, 55-60
2. Polymerization		
Week 2	Kinetics of Step Growth, ways of controlling MW	Pgs 49-55, 67-71
	Branching, gelation, & crosslinking	Pgs 381-392
	Chain-Growth Polymerization	Pgs 77-86
	Lab 1: Step Growth Polymerization **LAB 1 MEETS WEEK of 2/2-2/6**	
Week 3	Chain-Growth reaction scheme & Kinetics	Pgs 86-96
	MW distribution, radical lifetime, rate constants in chain-growth	Pgs 96-104
2/5	**No Lecture #1**	
	Lab 2: Free Radical Polymerization **LAB MEETS WEEK of 2/9-2/13**	
Week 4	Chain transfer & MW control	Pgs 104-110
	Living polymerization, anionic and cationic polymerization	Pgs 117-118, 126-129, 137-140
2/12	**No Lecture #2**	
Week 5	Stereo-isomerism, Stereo-regularity, & Ziegler –Natta Catalysts	Pgs 20-24, 193-200, 205-208.
3. Polymer chain shape and thermodynamics		
	Polymer chain conformations, random walk statistics	Pgs 217-225
	Freely jointed chains, freely rotating chains, radius of gyration	Pgs 230-242
Week 6	Self-avoiding walks, solvent quality, excluded volume	notes
	Intro to thermodynamics of polymer solutions	Pgs 247-254
2/26	**MIDTERM 1**	
Week 7	Flory Huggins theory	Pgs 254-258
	Flory-Huggins theory & phase behavior of polymer solutions	Pgs 264-275
	Lab 3: Lithography and Scattering **LAB MEETS WEEK of 3/9-3/13**	
4. Polymer molecular weight and chain shape characterization		
Week 8	Osmotic pressure & the virial expansion	Pgs 258 -264
	Light Scattering	Pgs 289-312
	Frictional properties of polymers in solution	Pgs 327-334
Week 9	Intrinsic viscometry	Pgs 334-345
	Size Exclusion Chromatography	Pgs 360-373

	MW determination examples	notes
	Lab 4: Dilute Solution Viscometry	
	Lab meets week of 3/30-4/3	
5. Polymer Structure + Mechanics		
Week 10	Networks, gels, and deformation of elastomers	Pgs 392-398
	Rubber elasticity theory	Pgs 398-406
4/2	**No Lecture # 3**	
Week 11	Viscoelasticity & mechanical models	Pgs 419-426
	Constitutive equations for viscoelastic materials	Pgs 426-432
4/9	**Midterm 2**	
	Lab 5: TBA	
	LAB MEETS week of 4/20-4/24	
Week 12	Dynamic mechanical spectroscopy & rheometry	notes
	Bead-spring models of viscoelasticity, MW dependence of properties	Pgs 432-444
	Advanced models of viscoelasticity	Pgs 444-458
	Lab 5: TBA	
	LAB MEETS week of 4/20-4/24	
Week 13	Amorphous polymers and the glass transition	Pgs 465-471
	The glass transition temperature	Pgs 479-491
4/23	**No Lecture #4**	
Week 14	Crystalline polymers	Pgs 511-526, 545-556
5/1	**No Lecture #5 – optional review session**	

FINAL EXAM: THURSDAY, MAY 14, 2015 from 8-11 am

Special instructions for laboratory and reports:
This laboratory is supposed to be fun and give you some hands-on experience related to what you've learned in the lecture portion of this class.
****Long pants and close-toed shoes are required for lab participation****

Prelab quizzes will be posted on the website at least one week before the lab meeting. Quizzes are designed to make sure you are aware of and understand the safety issues associated with each lab. They are pass/fail and may only be taken once. They must be taken by noon on the day of your lab and a passing grade of 80% is required to perform the lab. If you fail or neglect to take the quiz, you must turn in a handwritten document (maximum 2 pages) summarizing the laboratory procedure and the major safety hazards of the lab (including specific chemical hazards as listed in MSDS's) before beginning the lab.

Lab Reports should be short, clear, and concise. No lab report should be more than 3 pages of text including figures (but not including appendices).
This report should consist of a list of responses to all questions posed in the lab manual and supporting material:

> Note any deviations from laboratory procedures and include a detailed solution method and major equations
>
> Please include your data and sample calculations. Please include a detailed explanation of your formulas and variables (particularly if you are using a spreadsheet to do your calculations). Include graphs and tables of your results as appropriate. Include a list of references and *remember that plagiarism is the use of ideas or quotations from another source without referencing*.

A few words about mechanics: the main text of the reports must be typed. Neatly hand-drawn graphs and hand-written equations will be accepted given that we will not spend much time trying to decipher work. When in doubt, type it up. Each group will turn in one report and each member will earn the same grade. It is up to your group to split the duties.

The overall laboratory grade will reflect both participation during the laboratory period, including safe practices, and an evaluation of written lab reports.

If you need disability-related accommodations in this class, if you have emergency medical information you wish to share with the instructor, or if you need special arrangements in case the building must be evacuated, please inform the instructor immediately, privately after class or in her office.