

Beginning of Course Memorandum
CHE 4449/6449: Polymer Chemistry and Engineering
Fall 2015

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Required *Introduction to Polymers*, Third Edition

Resource: R. J. Young and P. A. Lovell (referenced as Y&L throughout)
Comprehensive, classic textbook covering both chemistry and physics of polymers

Why should you care about polymers? “Life in plastic, it's fantastic.” ~ Aqua

Polymers are everywhere! You're likely wearing some or carrying some in your hand or on your back. In fact, *you* are made of polymers. But what is a polymer? And what is a -mer anyway? How do you make them, characterize them, and how do you process them? What dictates their properties, and therefore their functions? What is the difference between plastics #1-7? Why are Kevlar and Gore-Tex so special? Why is Styrofoam so hard to recycle? Why does caulk smell funny? Can you use a polymer to replace human tissue? We will chart a path toward understanding these questions and many more!

What is success as a Polymer Chemistry and Engineering student?

1. Use knowledge of chemistry and physics to integrate understanding of chemical and physical properties of polymers and predict properties of novel polymers.
OR
Why do polymers behave differently than other chemicals? Why do different polymers have different properties? How would you design a polymer?
2. Explore and value the technical and market influence of polymers in commercial processes, medicine and energy.
OR
How and why are polymers used in consumer products? Inside people? In batteries?
3. Evaluate and critique polymer research literature and identify and use valid, relevant resources to develop knowledge outside of class
OR
What are the latest polymer discoveries and do they make sense? Where can I learn more about polymers? Are those resources legitimate?
4. Effectively communicate technical content in oral and written form.
OR
How do I convince family and friends that what I'm learning is interesting, useful, and relevant to everyday life? How do I convince someone to hire me to work on a technical subject I love?
5. Work as an engineering team to complete a common goal.
OR
How do engineers work together to develop and complete a specific technical project?

How will your progress be evaluated?

Homework: Homework is practice. Eight regular problem assignments are designed to integrate our class learning with the assigned readings and your own [research](#) and will typically be due at the beginning of class. You are encouraged to work in groups on the homework assignments, although all work that is turned in must be your own, i.e. not identical to another student's homework. Homework turned in late (including at the end of class) without prior approval will have the grade reduced 20% for each late day. Your lowest homework grade will be dropped at the end of the semester.

Quizzes: Several (7-10) short quizzes will be administered during the course of the semester. These will take place online, ahead of class and will prime you to participate in class activities. This will help you prepare for and actively participate in class discussions (see below). This is proven to enhance learning and retention of course material. Your lowest quiz grade will be dropped at the end of the semester.

In class participation and practice: You should plan to prepare for, attend, and actively participate in class discussions. Education research shows that this will enhance your learning and retention. Since you all come from different backgrounds and science experiences your peers are valuable resources for learning, offering suggestions, volunteering ideas, etc. Help yourself and your peers by coming to class prepared and ready to [engage](#).

Exams: Two exams will be based on material covered in the readings and during class. Exams will take place Wednesday, Oct 7, and Monday, Nov 26, and be scheduled outside of class and be closed-book, closed-notes. This will assess your knowledge of the material, your ability to apply it to similar situations, and integrate different course topics into a single challenge. These exams will initially be taken independently. As a second phase of your learning and to reflect on your learning methodology, small groups will work together to take the exam and fill in any missing knowledge or context.

Team project: You will work in small teams to develop a project on a polymer topic of your choice for presentation to the entire class. You will research and form your own ideas about your selected topic on the summary basis of the course information and then teach it to your fellow classmates via a 25-minute group presentations Dec XX-YY.

Grades will be based on:	<u>CHE 4449</u>	<u>CHE 6449</u>
	Homework (20%)	Homework (15%)
	Quizzes (10%)	Quizzes (10%)
	In class participation (10%)	In class participation (10%)
	Exams (30%)	Exams (30%)
	Team project (30%)	Projects/paper (35%)

Grades will not be curved. If you earn 90% of the points available you will receive and AGraduate students will complete different homeworks and a separate paper/project with a written paper and oral presentation component.

Where can you find resources?

1. As professor, I am the most important resource available to you! We can meet during office hours or by appointment to discuss any aspect of the course or any difficulties you may be experiencing. You are invited to schedule individual sessions with me to discuss homework, project ideas, my comments on your work, and so forth.
2. Anywhere you want! "Real" engineers use handbooks, textbooks, online resources, peer-reviewed articles, personal communications with colleagues, etc. to learn what they need to know to answer complex questions like the ones listed above. As your colleague, I will recommend some resources and post my notes on the class Collab site, but you should not feel limited to only the materials I suggest. In fact, you will probably need additional resources to complete the full story surrounding some of these challenging questions.
3. Supplemental reading beyond the required textbook will be provided for some lectures and either placed on reserve or made available via the course website. Some homework assignments may require additional research using supplemental readings or online resources.

Recommended additional textbooks/references:

Polymer Physics, Michael Rubinstein and Ralph H. Colby

Principles of Polymerization, George Odian

Fundamental Principles of Polymeric Materials for Practicing Engineers, 2nd Ed, Stephen L. Rosen

Principles of Polymer Systems, F. Rodriguez, C. Cohen, C.K. Ober, and L.A. Archer

4. *Your colleagues:* You are encouraged to work in groups to complete homework assignments and most in-class activities.
5. I am committed to supporting and encouraging students, staff and faculty to take responsibility for safety on our campus. Because I know that interpersonal violence will impact the lives of my students I am committed to violence prevention and campus safety. Please ask me how you can contribute.

There are a host of resources available for students who have academic or personal stressors throughout the semester. The School of Engineering and Applied Science has two full time staff members who you can contact to help manage academic or personal challenges. Do not wait until the end of the semester to ask for help!

Julie Caruccio, Associate Dean of Students, caruccio@virginia.edu

Lisa Lampe, Director of Undergraduate Success, ll4uu@virginia.edu

Professional and Academic Integrity

As practicing professionals, engineers are trusted to maintain the highest standards of ethics, integrity, and personal responsibility. Since you have joined this community of trust to prepare for your future career, you should fully comply with all of the provisions of the UVa Honor System. In addition to pledging that you have neither received nor given unauthorized aid on an assignment, your signature also affirms that you have not knowingly represented as your own any opinions or ideas that are attributable to another author in published or unpublished notes, study outlines, abstracts, articles, textbooks, or web pages. In other words, all assignments and reports must be your original work and references must be cited appropriately. Breaking this trust agreement not only will result in zero credit for the assignment in question and referral to the Honor Committee but also will jeopardize your future as a professional engineer. Don't let yourself down.

Date:	Tantalizing Topics	Please read:	Save these dates:
Module 1: Building Blocks of Polymers			
Week 1: 8.26-28	What is a polymer? Where are polymers in the world around you? What makes a polymer? Why are polymers different than other chemicals? How long is a polymer? Who are you?	Y&L p 1-43	Quiz 1, HW 1 Quiz 2
Module 2: Polymer Synthesis			
Week 2: 8.31	How do I turn a -mer into a polymer? Step growth and chain growth synthesis Building blocks and their functionality determine reaction mechanism How fast can I make a polymer?	Y&L p 43-68 Screencasts on www.learncheme.com	Case Study: baby bottles Quiz 3 Team Project: ideation
Week 3: 9.7	So are there more exciting ways to make a polymer? What other weird syntheses are out there? Ionic polymerization Copolymerization: can I make two polymers at the same time? Nature does it: Biopolymers! How do you present data?	Y&L p 69-140 (Finish Ch 2) W	Class activity: percolation theory Team Project meetings HW 2
Module 3: Polymer physics			
Week 4: 9.14	How to polymer behave and misbehave? Crosslinking: What happens when polymers link up? What's in a gel? Polymers in solution: do they like it? ΔH , ΔS , ΔG : oh my! Flory-Huggins is my favorite theory?	Y&L Ch 3	Class activity: group synthesis Team Project: ideation
Week 5: 9.21	How big is a polymer? "It depends;" Scaling "laws" for sizing them up Chain rigidity and tacticity Size can change: coiling and uncoiling	Y&L Ch 4	HW 3 Team meetings with Prof. Lampe Individual project: Infographic
Week 6: 9.28	What makes a solution ideal? Thermo and Flory-Huggins revisited Where have we come from? Exam review Exams and learning: what's the point?	Y&L Ch 5	HW 4 Group project: Infographic Exam 1, 10.2

Week 7: 10.5

No class 10.5, Reading Day

Exams and learning: what's the point?

Where are we going?

Class activity,
Group exam, 10.7

Module 4: Quantitative characterization