

Syllabus

CHE 475: Physical Properties of Polymers

Spring 2023

CHE 475 is a broad introduction to polymer physical properties and characterization, relationship to synthesis techniques and processing techniques, natural and synthetic materials, property optimization and modern applications. The goal of this course is not to make you an expert in any single aspect of this broad field, but to give you a sufficient background to carry on an informed conversation about polymer science within the context of current industrial or academic polymer research.

Lectures

Monday and Wednesday, 4:00 – 5:50 pm, VHE 217

Primary Instructor - Kareesa Kron

Office: VHE 720 | Email: kareesak@usc.edu | Office hours: TBD first Class

Secondary Instructor - Noah Malmstadt

Office: RTH 504 | Email: malmstad@usc.edu

Teaching Assistant - Stacey Bacheller

Email: bachelle@usc.edu | Office hours: TBD First Class

Learning Objectives:

1. Students will be able to explain basic polymer physical properties.
2. Students will be able to assess and explain why certain synthesis and characterization techniques might be useful for a particular polymer research problem.
3. Students will be able to analyze and find errors in scientific writing in the field of polymer research with a focus on explaining the proposed methods for synthesis and characterization of polymers
4. Students will be able to write a project proposal that extends a current research area in industrial or academic polymer research and identify at least two relevant synthesis or characterization techniques.
5. Students will be able to communicate through a presentation about a proposed research project focused on addressing a current industrial or academic question in polymer science and engineering
6. Students will be able to facilitate a discussion on a special topic in polymers research and relate the research to fundamental polymer properties and methods of characterization and synthesis.

Prerequisites

Though this course has no formal prerequisites, a previous course in organic chemistry is recommended.

Text

Polymer Science and Technology by Joel R. Fried, second edition, ISBN 0-13-018168-4

Grading and Assessment

Grades will be based on in-class assignments, homework assignments, one student led discussion in groups, three reports, and an in-class presentation on Report 3. The proportions of the final grade determined by each of these elements will be as follows:

In-Class Assignments:	10%	Learning Objective 1, 2
Homework:	20%	Learning Objective 1, 2
Three reports:	30% (10% for 3 reports)	Learning Objective 3, 4
Presentation:	20%	Learning Objective 5
Student Led Discussion:	20%	Learning Objective 6

In-Class assignments will be graded for completion. All other assignments will be graded by rubric that will be provided upon return of graded homework assignments and at least one week prior to the scheduled dates or presentations, reports, and student led discussions.

No late report drafts, report reviews, or presentations will be accepted. Late homework and late reports will be accepted with a progressive $n \times 10\%$ reduction in possible score according to the following time ranges:

- 30 min late – no penalty
- 30 min late – 24 hrs – 90% of original score possible
- 24 hrs – 48 hrs late – 80% of original score possible
- Etc.

For the final course grades, the arithmetic mean of the weighted percentage scores will be determined. If the highest score in the class is ten or more percentage points higher than this mean, the mean score will receive a B, ten percentage points above the mean will receive an A, ten percentage points below the mean will receive a C, twenty percentage points below the mean will receive a D, etc. If the highest score in the class is less than ten percentage points above the mean, the highest score will receive an A, ten percentage points below the highest score will receive a B, ten percentage points below that will receive a C, etc.

Reading:

All specifically recommended readings should be completed prior to class as in-class activities and assignments will rely on a basic understanding of the recommended readings. Recommended readings will be provided at the lecture one week prior to the relevant lecture according to the course schedule.

In Class Assignments:

In-Class assignments will be completed and turned in at the end of each class unless otherwise specified. In the case of an absence, a make-up assignment can be requested by emailing the primary instructor and must be completed before the next lecture.

Homework

Homework assignments will be handed out at least one week prior to due date. No homework will be due on the days that report first drafts, peer reviews, and final drafts are due (see “Special Dates” below). Homework assignments turned in on time will be graded within one week of submission. All late assignments will be graded at instructor and teaching assistant’s earliest convenience.

Reports

Each student will be required to prepare two approximately 5-page reports and one approximately 8-page report on special topics in polymer science and engineering. As part of the report-writing process, a draft of your report will be peer-reviewed by at least one fellow student, and you will review at least one fellow student’s draft. For Report 3, it will also be required to meet with either the primary instructor or the TA for 20 mins outside of class so that the students proposed topic can be approved. Grades will be based on both the quality of your reviews and on your final report. All reports will be graded and returned within two weeks and prior to subsequent reports.

Presentation

The final report will culminate in a final presentation. A rubric for grading of presentations will be provided as least one week prior to student presentations. Presentations will be scheduled for the final course week (not finals week). Each student will review all other presentations and part of their score will be based on quality of feedback.

Student-Led Discussion

Students will be grouped based on the number of students and interest in provided (or approved) discussion topics. Students will then prepare a one-hour discussion around provided (or approved) discussion topics that will be scheduled for lectures at least two weeks prior. Students hosting the discussion will be graded based on a provided rubric. All other students will be graded on feedback to discussion leaders.

Technological Proficiency Required

All reports and homework’s must be uploaded as .doc, .docx files or .pdf files to blackboard by the associated due date. If students are unable to upload due to internet connection issues or issues with blackboard, it is necessary to email the primary instructor the files as soon as possible and not later than 10 am the following day. Potentially helpful resource: [USC Computing Center Laptop Loaner Program](#)

Lecture and Reading Schedule (Under Revision)

Prior Class Offering schedule: (Will be revised/finalized by end of Week 1).

Week 1 (Jan. 9 & Jan. 11):	Terminology, nomenclature, and classification; stereochemistry; molecular weight. <i>Chapter 1</i>
Week 2 (Jan. 16 & Jan. 18):	Synthesis I. Step growth reactions. Free-radical chain reactions. <i>Section 2.1-2.2.1 (up to "Free-Radical Polymerization Kinetics")</i>
Week 3 (Jan. 23 & Jan. 25):	Synthesis II. Ionic chain reactions; reaction kinetics; copolymerization, cross-linking, and other reactions of polymers. <i>Section 2.2.1 (starting with "Free-Radical Polymerization Kinetics") – 2.2.3</i>
Week 4 (Jan. 30 & Feb 1):	Synthesis III. Polymerization techniques; structure determination techniques; specialized polymerization reactions. <i>Sections 2.3-2.6</i>
Week 5 (Feb. 6 & Feb. 8):	Solution thermodynamics I. Chain conformation and dimensions; measuring chain dimensions. <i>3.1 and 3.3.2</i>
Week 6 (Feb. 13 & Feb. 15):	Solution thermodynamics II. Activity; Flory-Huggins theory; equation-of-state theories; phase equilibria and interaction parameters. <i>Sections 3.2.1-3.2.5</i>
Week 7 (Feb. 20 & Feb. 23):	Solution thermodynamics III. Predicting solubility; UNIFAC-FV; measuring molecular weight. <i>Sections 3.2.6-3.3.1</i>
Week 8 (Feb. 27 & Mar. 1):	Solid-state properties I. Amorphous and crystalline states; T_g and T_m . <i>Sections 4.1-4.2</i>
Week 9 (Mar. 6 & Mar. 8):	Solid-state properties II. Thermodynamics of state transitions; non-viscoelastic modes of deformation. <i>Sections 4.3-4.4</i>
Week 10 (Mar. 20 & Mar. 22):	Elasticity and viscoelasticity. <i>Chapter 5</i>
Week 11 (Mar. 27 & Mar. 29):	Polymer rheology and flows. <i>Sections 11.2-11.4</i>
Week 12 (Apr. 3 & Apr. 5):	Working with polymers: Survey of polymer categories and industrial applications. <i>Chapters 9 and 10</i>
Week 13 (Apr. 10 & Apr. 12):	Polymer fibers. Material properties and polymer processing. <i>Sections 8.2 and 11.1</i>
Week 14 (Apr. 17 & Apr. 19):	Polymer blends, block copolymers, interpenetrating networks, and polymer hydrogels. <i>Chapter 7</i>
Week 15 (Apr. 24 & Apr. 26):	Polymer applications: Membranes, drug delivery, and biomaterials. <i>Chapter 12</i>

Note: Lectures may occasionally be pre-recorded for student viewing on DEN. You will be alerted prior to the dates on which pre-recorded lectures take place. Lectures may also include guest speakers.

Reports, Discussion Sections, and Presentation Dates:

Mon. Jan. 30:	Draft Report 1 Due
Mon. Feb. 6:	Report 1 Peer Review Due
Thu. Feb. 9:	Report 1 Due
Mon. Feb. 27:	Draft Report 2 Due
Mon. Mar. 6:	Report 2 Peer Review Due
Thur. Mar. 9:	Report 2 Peer Due
Mon. and Wed. Mar 27 & 29	Discussion Section for 1 hr. during lecture
By Wed Mar. 9	Report 3 topic must be discussed/approved by TA or PI
Mon. and Wed. Apr 3 & 5	Discussion Section for 1 hr. during lecture
Wed. Apr. 12:	Draft Report 3 Due
Wed. Apr. 19:	Report 3 Peer Review Due
Fri. Apr 28:	Report 3 Due
May 3- 4:30-6:30 PM:	Final Presentations

Collaboration Policy

Students are encouraged to discuss and work together on homework assignments, but the work each student hands in must be his or her own. It is not acceptable to merely copy another student's effort; each student must be capable of fully understanding and describing everything he or she has written in the submitted homework assignment. For any assignments where collaboration has taken place, students must include the names of collaborators on the top of their assignment. If you have any doubts regarding whether a certain instance of collaboration is acceptable at any point in the semester, ask the instructor for clarification.

Academic Integrity Policy

The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is in contrast to the university's mission to educate students through a broad array of first-rank academic, professional, and extracurricular programs and includes any act of dishonesty in the submission of academic work (either in draft or final form).

This course will follow the expectations for academic integrity as stated in the [USC Student Handbook](#). All students are expected to submit assignments that are original work and prepared specifically for the course/section in this academic term. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the [student handbook](#) or the [Office of Academic Integrity's website](#), and university policies on [Research and Scholarship Misconduct](#).

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

Course Content Distribution and Synchronous Session Recordings Policies

USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relationship to the class, whether obtained in class, via email, on the internet, or via any other media. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

[Counseling and Mental Health](#) - (213) 740-9355 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness

workshops, and crisis intervention.

[988 Suicide and Crisis Lifeline](#) - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

[Relationship and Sexual Violence Prevention Services \(RSVP\)](#) - (213) 740-9355(WELL) – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

[Office for Equity, Equal Opportunity, and Title IX \(EEO-TIX\)](#) - (213) 740-5086

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

[Reporting Incidents of Bias or Harassment](#) - (213) 740-5086 or (213) 821-8298

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

[The Office of Student Accessibility Services \(OSAS\)](#) - (213) 740-0776

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

[USC Campus Support and Intervention](#) - (213) 740-0411

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

[Diversity, Equity and Inclusion](#) - (213) 740-2101

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

[USC Emergency](#) - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

[USC Department of Public Safety](#) - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call

Non-emergency assistance or information.

[Office of the Ombuds](#) - (213) 821-9556 (UPC) / (323) 442-0382 (HSC)

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

[Occupational Therapy Faculty Practice](#) - (323) 442-2850 or otfp@med.usc.edu

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.

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