

Polymer Science & Engineering for Chemical Engineers
ECH 6828, ECH 4905

Class Periods: Monday | Period 7 (1:55 pm – 2:45 pm)
Wednesday | Period 6-7 (12:50 pm – 2:45 pm)

Location: ARCH 0423

Academic Term: Spring 2024

Instructor

Prof. Yeongseon Jang

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(352) 294-1289

Teaching Assistant/Peer Mentor/Supervised Teaching Student

No TA/ST. Please contact Prof. Jang directly through the Canvas website

Course Description

(3 credits) This course offers an overview of polymer science and engineering for chemical engineers. This course aims to provide a general understanding of structure-property relationships of polymers at microscopic and macroscopic levels.

Course Pre-Requisites / Co-Requisites

N/A

Course Objectives

This course will introduce students to understand structural, chemical, and physical properties of polymers from molecular level to bulk. Topics will include 1) polymer structure and nomenclature, 2) polymerization synthesis and growth kinetics of polymer chains, 3) thermodynamics and phase behavior of polymer solution, polymer blends, and multicomponent systems, and 4) thermal transition, mechanical properties, and viscoelastic properties. Examples of recent research publications in each subject will be discussed. The goal is to provide students with the knowledge of nomenclature, synthesis methods and reaction kinetics in polymerization, phase behavior of polymer solutions and blends, and mechanical, thermal, and viscoelastic properties of semicrystalline polymers, which is useful to design a new polymer material for sustainability and human health. By the end of this course, students will be able to:

- Know chemical structure and formulas of common polymeric materials
- Characterize molecular weight (MW) and MW distribution
- Distinguish different polymerization reactions and mechanisms
- Predict conversion kinetics and MW resulting from polymerization reactions
- Estimate the thermodynamic interaction and miscibility of polymer solutions and blends
- Identify the physical states and transition temperatures of polymers
- Describe the methods to characterize properties of polymers
- Apply the knowledge to critically analyze polymer engineering results in the current literature

Materials and Supply Fees

N/A

Required Textbooks and Software

Course notes will be developed and provided by the instructor through combination of the chapters in part from the textbooks below.

Recommended Materials

- Introduction to Polymers, 3rd Edition, Robert J. Young and Peter A. Lovell, ISBN: 978-14-398-9195-7
- Contemporary Polymer Chemistry, Harry Allcock, Fred Lampe Deceased, James Mark, Prentice Hall, 2003 (3rd edition), ISBN-13: 978-0130650566
- Polymer Physics, Michael Rubinstein, Ralph H. Colby, Oxford University Press, 2003, ISBN: 978-0-19-852059-7
- Other recommended reading materials and research articles will be suggested during classes.

Course Schedule

- Week 1: Basic Principles: Definition and Classification
- Week 2: Effect of Chemical Structure on Polymer Properties
- Week 3: Molecular Weight: Determination and Characterization
- Week 4: Step-Growth Polymerization
- Week 5: Chain-Growth Polymerization
- Week 6: Ring Opening Polymerization
- Week 7: Polymer Chain Dimension
- Week 8: Thermodynamics of Polymer Solution: Gibbs Free Energy of Mixing, Solubility, Flory-Huggins
- Week 9: Thermodynamics of Polymer Blends: LCST, Block Copolymer Phase Separation
- Week 10: Secondary Bonding in Polymer: Self-Assembly, Inter-/Intra-chain Molecular Interaction
- Week 11: Semicrystalline Polymer: Crystallization, Thermal Transition
- Week 12: Mechanical Properties of Polymers, Rubber Elasticity
- Week 13: Polymer Diffusion in Rubbery and Glassy Polymers
- Week 14: Flow Behavior of Polymeric Fluids and Viscoelastic Property
- Week 15: Recent Development of Functional Polymers

Attendance Policy, Class Expectations, and Make-Up Policy

Excused absences must be in compliance with university policies in the Graduate Catalog (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>) and require appropriate documentation.

Dates and format for Midterm will be announced at least 2 weeks in advance. Students who do not attend an exam at the scheduled time will receive a score of zero for that exam. **Requests for make-up exams will be considered only for those students who missed due to an acceptable reason.** It is required that, **whenever possible, the student notifies the instructor about the situation prior to the exam, preferably at least two weeks in advance.**

Evaluation of Grades

Grades will be based on weekly assignments (in class problems), Midterm and Final Exams, and Term paper.

Assignment	Total Points	Percentage of Final Grade
Attendance (in class problems)	100	20 %
Midterm Exam	150	30%
Final Exam	150	30%
Term Paper	100	20%
Total	500	100%

- **Attendance: Attendance is required** as it is critical to the success of this coursework that all lectures are well-attended. Students are only allowed as many as two absences for any reasons. Students anticipating absences due to religious observances must inform the instructor, consistent with UF policy (<https://administrativememo.ufl.edu/2018/10/uf-religious-observances-policy-3/>). Additional excused absences due to health-related issues beyond the two allowed absences require appropriate documentation and must be consistent with university policies. Students should be turned in scanned copies of homework

to self-make-up study of the missed classes to Canvas by the due dates (within a week). Late homework will not be accepted. Excused absences must be in compliance with university policies in the Graduate Catalog (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>) and require appropriate documentation.

- **Midterm & Final:** Students will be allowed to have their notes for formulas during exams. Calculator is required. Partial credit will be assigned to the right solving process, but no credit will be given for problems that have a solution only with no work leading to this solution.
- **Term Paper:** The term project aims to assist students in gaining better insights into state-of-the-art polymer science and engineering. Students must submit the term paper that summarizes the background and fundamental applied for the topic and provides a summary including perspectives in the fields. **The report will be limited to 3,000 words/5 pages.** Detailed writing guidelines will be posted to Canvas. The report grading rubric includes both technical and writing merits.

Grading Policy

Percent	Grade	Grade points
93.0 - 100	A	4.00
87.0 - 92.9	A-	3.67
83.0 - 86.9	B+	3.33
80.0 - 82.9	B	3.00
78.0 - 80.9	B-	2.67
75.0 - 77.9	C+	2.33
72.0 - 74.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>). It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at

<https://gatorevals.aa.ufl.edu/students/>.

Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via

<https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding

by the Honor Code.” On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied:

On my honor, I have neither given nor received unauthorized aid in doing this assignment.

The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see:

<http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.

<https://lss.at.ufl.edu/help.shtml>

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.

<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.

<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.