MSE/ChBE/CHEM/ME 4775 – Spring 2027
Polymer Science and Engineering I

TBA, TBA

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Teaching Assistant: TBD

Office Hours: TBD, PTB 273A & *by appointment* (SD)
TBD (TA)

Course Description: This course is intended to cover the basic concepts of polymer science and engineering including polymer chemistry, structure, thermodynamics, mechanics, and dynamics.

Prerequisites: CHEM 1315 or CHEM 2312 (Organic Chemistry)
MSE 3001 or CHBE 2130/2140 or CHEM 3411 or ME 3322 (Thermodynamics)

Textbook: *Required*: None.
Suggested: Introduction to Polymers, Young and Lovell, 3rd Edition
Polymer Chemistry, Lodge and Hiemenz, 3rd Edition

Course Website: Canvas will be used to post important announcements as well as the syllabus, course schedule, lecture notes, homework, homework solutions, and other resources.

Course Outcomes: The primary course objectives are as follows:

1) Identify and classify the chemical structures, nomenclature, and common applications of major classes of polymers.
2) Differentiate among polymerization mechanisms and predict how reaction conditions influence polymer structure, molecular weight, and material properties.
3) Calculate and predict conversion, molecular weight, and molecular weight distributions resulting from polymerization reactions using appropriate kinetic and mechanistic models.
4) Interpret, analyze, and communicate polymer characterization data to determine molecular, structural, and thermomechanical properties.
5) Calculate and model polymer chain dimensions, conformations, and structural parameters using appropriate theoretical frameworks.
6) Analyze thermodynamic interactions and predict the miscibility, phase behavior, and stability of polymer solutions and blends.
7) Differentiate among polymer physical states, transitions, and self-assembled structures and explain their molecular origins.
8) Predict how polymer chemistry, molecular architecture, and morphology influence the thermal and mechanical behavior of polymer solutions, melts, glasses, crystals, and networks.

9) Describe, model, and predict the viscoelastic and rheological behavior of polymers under applied deformation and processing conditions.
10) Design and justify strategies for polymer synthesis, characterization, processing, and computational modeling for industrial or research applications while evaluating tradeoffs among performance, sustainability, economic, and societal considerations.

Grades: Your grade in the course will be determined based on your performance on homework, decision point assignments, quizzes, and exams.

Item	**Percentage of Course Grade**
Assignments, *400 points maximum*	40%
Quizzes, *20 points each*	10%
In-Class Midterm Exams, *150 points each*	30%
Take-Home Final Exam & Design Challenge, *200 points*	20%

The course grading scales are:

A: 90-100%	Pass: 60-100%
B: 80-89%	Fail: 0-59%
C: 70-79%	
D: 60-69%	
F: 0-59%	

Final grades may be curved at the instructor's discretion but will not be curved to lower grades. Errors in grading must be addressed within 7 days after return by contacting the instructor and the TA via email. Disputes after this one-week period will not be considered. Errors in recording of grades to Canvas must be addressed by the final lecture, TBA, by contacting the instructor and the TA via email.

Lectures: Attendance in lectures is highly recommended. Please be on time to minimize disruption to others. Lectures will include a combination of traditional instruction, demonstrations, active-learning activities, and discussion-based exercises designed to strengthen conceptual understanding and promote application of polymer science principles. For most lectures, blank skeleton notes will be posted to Canvas ahead of time, which we will fill in during the class period. To prepare, it is encouraged to read the assigned textbook sections prior to class. Recordings of the lecture, barring technical difficulties, will be posted to Canvas. However, these should be used as a supplement rather than a replacement for lecture and can be withheld at any time at the instructor's discretion.

Assignments: Assignments in this course consist of both traditional homework problem sets and semester-long design activities ("Decision Points"). Together, these assignments are intended to strengthen quantitative problem-solving skills, develop intuition for polymer structure-property-processing relationships, and provide opportunities to apply course concepts to realistic scientific and engineering challenges.

Homework problem sets (50 points each) will be assigned throughout the semester and will emphasize quantitative analysis, modeling, data interpretation, and application of polymer science principles. Each

question will be worth 10 points and graded on the binned scale: +10 for a fully or mostly correct answer, +5 for a mostly incorrect but on-topic answer, and +0 for an off-topic or no answer.

Decision Point assignments (50 points each) will also be assigned throughout the semester. Early in the course, students will select a polymer application area and will revisit that application through a sequence of design decisions focused on polymer chemistry, polymer structure and morphology, and polymer performance and processing. These assignments are intended to simulate the iterative decision-making process used in industrial and research environments, requiring students to evaluate alternatives, justify recommendations, and consider technical, economic, sustainability, and societal tradeoffs.

Periodic surveys on Canvas will provide additional points for completion. No late assignments or surveys will be accepted. However, while the overall assignments score has a maximum of 400 points, there will be more than 400 points available across all assignments.

All assignments must be entirely a student's own work. Discussion with other students on homework problems or design decisions is highly encouraged but copying from one another or from generative AI resources will be considered academic misconduct. You can ask questions regarding your homework, although you should try to think about the problems before asking the instructor or the TA. Note that collectively the homework and decision points represent 40% of the course grade; neglecting assignments will jeopardize your performance in the class.

Quizzes: Short quizzes (10 min) will be conducted in-class through Canvas periodically throughout the semester. Quizzes will be non-cumulative and cover course material introduced since the last quiz or exam.

Midterm Exams: The two midterm exams will be in-class during regularly scheduled lectures, with a 1h 15min time limit (unless accommodations given by GT.) They will be closed book and closed notes except a single 8.5"x11" double-sided, handwritten notes sheet. The midterms will not be cumulative. Exam 1 will focus on polymer chemistry, covering approximately the first third of the course. Exam 2 will focus on polymer physics, covering approximately the second third of the course. Exams will include a mix of quantitative problems to solve as well as discussion questions. The use of a calculator is permitted and encouraged.

Final Exam: The final exam will be a cumulative take-home assessment, due at TBA (the date and time of the scheduled final exam by the Registrar). The final exam will be open book and open notes; however, all submitted work must represent the student's own understanding and analysis. No collaboration with other students is permitted unless explicitly authorized by the instructor.

The final exam consists of two components: (1) cumulative exam with problems similar to the midterms; and (2) an integrated polymer design challenge in which students revisit their selected application area and

develop a technically justified polymer design strategy that integrates concepts from throughout the course.

Make-up Policy: Make-up quizzes or exams will only be permitted when absences are due to legitimate reasons such as illness, religious observance, or other events recognized by Georgia Tech as a valid excuse. In any situation, you must notify the instructor in advance of the scheduled assessment via email to schedule a make-up and provide documentation from Georgia Tech through the Dean of Students. If you do not contact the instructor in advance, it may not be possible to schedule a make-up quiz or exam. Whenever possible, make-up assessments will be administered during the week following the scheduled date of the original activity. Make-ups may be different from those administered during the regular period.

Academic Integrity: Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. All students in this class are expected to respect the Georgia Tech Honor Code and behave in a professional manner when it comes to academic integrity. Copying from other students (current or former), instructor/TA solutions from previous semesters, solution manuals, websites, or AI-generated solutions is considered an honor code violation. Any students violating the honor code or suspected of academic misconduct will be turned over to the Office of Academic Integrity, Dean of Students, to investigate the incident(s). While generative AI tools may be used for limited purposes such as brainstorming or improving writing clarity where explicitly permitted, students remain fully responsible for all submitted work, and all technical reasoning, calculations, analysis, and decisions must reflect the student's own understanding. Cheating off anyone else's work is a direct violation of the Georgia Tech Academic Honor Code and will be dealt with accordingly. For any questions involving honor code issues, consult the instructor, the TA, or honor.gatech.edu.

Accommodations: Georgia Tech encourages qualified persons with disabilities to participate in its programs and activities. If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at disabilityservices.gatech.edu as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. If you anticipate needing any additional accommodation in this course or have questions about physical access, please tell the instructor as soon as possible. Finally, if you encounter extenuating circumstances that interfere with your ability to complete exams or homework as scheduled, please meet with the Dean of Students. The Dean’s office is your best resource so that you do not need to discuss the details of your personal situation with the instructor.

Expectations: At Georgia Tech we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.