

MSE/CHEM/CHBE 6752 Polymer Characterization Fall 2024

Week	Date	Topic	Comment
1	8/20	Course Introduction + Macromolecular Parameters	$M_w, M_n, A_2, R_g, R_h, a_p, \eta, [\eta] d_f$
	8/21	Reading Assignment/homework	
	8/22	Overview of things to come	$M_w, M_n, A_2, R_g, R_h, a_p, \eta, [\eta] d_f$
2	8/27	Dimensions, Models of chains, Self-Avoiding Walk, Persistence Lengths	Random walks & Analogies
	8/28	More Reading	
	8/29	Continuation of Chain Dimensions	
3	9/3	Polymer Solvent Interactions, $[\eta]$ isn't η	
	9/4		
	9/5	$[\eta]$ isn't η – Continuation	Quiz 1 (material covered till 9/3)
4	9/10	Scattering – Way of thinking about scattering – Blue sky, osmotic pressure, Van't Hoff Law	
	9/11		
	9/12	Scattering – Continued – (Static Scattering)	
5	9/17	Scattering – Continued – (Static Scattering)	
	9/18		Quiz 2 (Till 9/17)
	9/19	Scattering (Dynamic, and Differential Dynamic Microscopy –DDM)	
6	9/24	Polarization and Polarized Light Microscopy, Liquid Crystals	
	9/25		
	9/26	Optical Microscopy: Confocal/FPR/FCS/SuperResolution	
7	10/1	Solution NMR	Dr. Peter Mirau, AFOSR Labs
	10/2		Quiz 3 (Till light microscopy)
	10/3	Solid State NMR	Dr. Peter Mirau, AFOSR Labs
8	10/8	Viscometric Methods (Melts and Solutions)	
	10/9	Part 1 Exam-1	
	10/10	Part 2 start: Properties prediction Mechanical properties: fundamentals	
9	10/15	Break	
	10/16	Mechanical lab/homework 1 assignment	
	10/17	Mechanical properties 2 – viscoelastic behavior, dynamic	
10	10/22	UV, IR and Raman spectroscopies 1	
	10/23	Spectroscopy lab/homework 2	
	10/24	UV, IR and Raman spectroscopies 2	Last Day to Withdraw, 10/26
11	10/29	Thermal Analysis 1: DSC, TGA, TMA, DMA, and SThM	Quiz 1
	10/30	SEM lab/HW2 due	
	10/31	Thermal Analysis 2: DSC, TGA, TMA, DMA, and SThM	
12	11/5	Scanning Probe Microscopy (SPM) 1: general principles	
	11/6	Thermal lab/Homework 3 (Thermal)	
	11/7	SPM 2: main modes and critical results: STM, AFM	
13	11/12	SPM 3: Imaging modes: FFM, NSOM, QNM, KPFM, EFM	Quiz 2
	11/13	SPM lab 1/HW3 due	
	11/14	Electron microscopies 1: TEM, HRTEM, STEM, SEM/HW	
14	11/19	Electron microscopies 2: SEM, ESEM, EDS, EDX	
	11/20	SPM lab 2/Homework 4 (SPM+SEM)	
	11/21	Surfaces 1: XPS, ellipsometry, contact angle, tribology	
15	11/26	Surfaces 2: XPS, ellipsometry, contact angle, tribology	Quiz 3
	11/27	GT break	
	11/28	GT break	
16	12/2	Summary, overview exam, feedback on part 2	Final Instructional Day
	Dec 5-12,	TBD Exam, Part 2	

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Syllabus

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Description:

This course is a sequence of advanced topics dealing with polymer characterization, and in particular practical aspects of data collection and analysis. Topics to be covered include property predictions, and techniques for bulk and molecular characterization of structure as well as polymer properties. While there is no formal pre-requisite, students should have a basic knowledge of polymer science, including such concepts as polydispersity, radius of gyration, virial coefficients, glass transitions, and viscoelasticity.

Requisite Knowledge Recommended: MSE 6751 or MSE 4775 or permission of instructor.

Class Time: T/Th 9:30—10:45 PM W 3:30—6:15 PM	MRDC 3403 (This class room has been reserved till Dec) Howey Physics S204, MoSE 4243 or Other Facilities as announced
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Modality: In-class lectures (150 minutes/week) + practical experiences (up to 180 minutes/week). Either lab or lecture may be supplemented by “watch at home” videos or “watch-in-class” videos, but the goal is for dynamic exchange during lecture and hands-on competence in lab, within reason. The times normally used for lecture (T/Th mornings) may be used for lab operations to maximize the educational experience and hands-on activities without crowding. Some lab time on Wed may be used for lecture/quizzes, if needed.






Electronic Delivery: CANVAS

Textbook: *There is no standard text book (yet) which covers all the topics in this course. Therefore, notes will be provided as well as suggested bibliography as appropriate for the various topics.*

Grading: 20% Quizzes, 30% Assignments, 25% Part 1 Exam, 25% Part 2 Exam

Grading scale: A: 86 – 100%; B: 76 – 85%; C: 66 – 75%; D: ≤ 65%.

Course Expectations:

-  Short quizzes will be given in class or on Canvas. In-class quizzes will be generally closed book unless otherwise indicated.
-  Some assignments will come in the form of homeworks, perhaps integrated with lab activities.
-  Midterm and final exams will be closed book unless otherwise indicated, relevant equations will be supplied. Any changes will be announced at least 5 days before the exam.
-  We rely on various facilities across campus for lab training and/or familiarity.
-  All assignments need to be completed in the time stated. Any late submissions (except where proper reasons are given) will be given a score of 0.

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Course Outcomes. At the end of the course you will be able to:

1. Make predictions about critical polymer properties, often without calculator or internet access.
2. Learn to determine polymer macro and micro structure, as well as properties.
3. Identify which structure and properties are to be analyzed to evaluate the polymer.
4. Determine which techniques are most appropriate to determine the property of interest.
5. Understand how to prepare the sample and collect the data.
6. Understand the fundamental basis of the measurement technique.
7. Analyze the experimental data and determine/calculate the relevant properties.

Honor Code

We believe in the Georgia Tech Honor code: <https://policies.gatech.edu/academic-affairs/academic-honor-code>
Students are urged to ask questions about what is permissible when it comes to working together on assignments and what is not, plagiarism, or other issues.

Wellness

We expect another semester in which challenges due to public health factors add to the normal stresses of academic life. We enjoy talking with students, so don't be shy about letting us know if you are feeling stressed. Remember GT's various resources for wellness, too: <https://hw.gatech.edu/>

Disabilities

We get it! If you qualify for an accommodation, be assured that we are eager to work with you.
<https://disabilityservices.gatech.edu/>