

**Chemistry 520L: Polymer Chemistry Lab**  
**Spring 2018**  
**Friday, 1:25 – 5:15 pm in Morehead Labs 303**

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**Office Hour:** by appointment only

**HONOR CODE:**

Policy adopted by the faculty of the Department of Chemistry on Sept. 9, 1977:

*“Since all graded work (including homework to be collected, quizzes, papers, mid-term examinations, final examinations, research proposals, **laboratory results and reports**, etc.) may be used in the determination of academic progress, no collaboration on this work is permitted unless the instructor explicitly indicates that some specific degree of collaboration is allowed. This statement is not intended to discourage students from studying together or working together on assignments which are not to be collected.”*

**PREREQUISITES:**

- Chemistry 420, 421, or 425. *It is an honor code violation to register for a class for which you do not have the appropriate prerequisites.*

**GOALS and KEY LEARNING OBJECTIVES:**

- Master the basic experimental skills for the syntheses of conventional polymers via various polymerization techniques
- Further understand the fundamental principles of polymer chemistry
- Develop the ability to design a hypothesis driven research project and design and execute experiments to evaluate the stated hypothesis.

**REQUIRED MATERIALS:**

- *Polymer Synthesis and Characterization: A Laboratory Manual by S. R. Sandler, W. Karo, J. Bonesteel, and E. M. Pierce, Academic Press, New York, 1998. (We will give detailed procedure for each planned experiment; however, this Lab Manual can help you understand much better on other polymerizations, and on characterization techniques. In addition, it offers detailed information on the experiments covered in this course)*

- Lab notebook with pre-numbered, carbonless duplicate pages. The chemistry fraternity sells lab notebooks for \$10.00 (cash or check) in Morehead 102. You are welcome to use a notebook from a previous lab course that meets the requirements as long as it has a sufficient number of pages for you to use this semester.
- Lab safety glasses.

### **REQUIRED SAKAI MATERIALS:**

- Experimental procedure for each lab will be posted on Sakai (not Projects, though).
- You are required to download and follow the experiment procedure posted on Sakai.

### **TEXTBOOKS:**

- The following books are on reserve at the Kenan Chemistry Library.
  - *Polymer Handbook*
  - *Fundamentals of Polymer Science* by P. Painter and M. Coleman (ISBN: 978-1566765596)
  - *Polymer Chemistry: an introduction* by M. Stevens (ISBN: 978-0195124446)
  - *Principles of Polymerization, 4<sup>th</sup> edition* by G. Odian (ISBN: 978-0471274001)
  - *Polymer Analysis* by B. Stuart (ISBN: 978-0471813637)
- Also recommended: *Essentials of Polymer Science and Engineering* by P. Painter and M. Coleman (ISBN: 978-1932078756)

### **EXPERIMENTS:**

- The experiment schedule, with the corresponding report due dates, is available on Sakai.
- There are 6 core experiments that will teach the fundamentals of polymer synthesis and various characterization techniques.
- After the core experiments are completed, a research project will be conducted for the next 4 weeks. Preparation and background reading for the project will be carried out throughout the semester.
- The research project section of the laboratory is part of the Course-based Undergraduate Research Experiences (**CUREs**) initiative within the College of Arts and Sciences at UNC. The goal of the CUREs program is to give undergraduates a taste of “real” research in a lab course. We will be conducting a project related to work being pursued in my laboratory. These reactions have never been attempted before. Since all the experiments and results will be new, we will spend a lot of lab time critically analyzing data, revising our hypothesis, and trying to understand how and why the reactions we are running work on polymer substrates. Although this will be different than a typical “cook book” lab experience, this exercise will be similar to what you may experience if you get a position in chemical industry or enter into a graduate program in the sciences.

## GRADING:

### **1. PRE-LAB NOTEBOOK ASSIGNMENTS: 10 points each = 100 points total**

- All pre-lab assignments are to be completed in the lab notebook. For each experiment, the pre-lab assignment must be started on a new page of the lab notebook.
- The notebook will be graded at the beginning of lab.

***IMPORTANT: YOU WILL NOT BE ALLOWED TO USE THE LAB MANUAL DURING LAB! So, if you do not have a pre-lab assignment for the experiment, you will not be allowed to perform the experiment and will receive a zero for that lab.***

- Follow the following format for the pre-lab assignment:
  - Experiment Title and Date
    - Include group member names
  - Objective
    - State the goal of the experiment in 1–2 sentences
  - Chemical reaction scheme and/or sketch of experiment set-up
  - Table of reagents
    - Include: molecular weight, equivalents, mmols, **mass and/or volume**, and density (if applicable).
  - Procedure outline
    - Make sure to include all of the important information that you will need to carry out the experiment. This is **not to be an exact copy** of the lab manual instructions!
  - After the procedure, make sure there is sufficient space for observations, calculations, and other experimental notes. Prepare data tables, as needed, for the experiment. When possible, data should be presented in tables to ensure clarity.

### **2. LAB PERFORMANCE: 10 points each = 100 points total**

- The TA will assess your lab preparation, skills and etiquette after each experiment.
- This includes following safety rules, proper waste disposal, and lab cleanliness (includes common supplies and hoods).

### **3. LAB REPORTS:**

- There are 6 reports total: 2 Full Paper Reports, 3 Communication-style Reports, and 1 Research Project report. Details for each are given below.
- Each report has a lab report guideline that is posted on Sakai. There are also write-up questions on the report guideline sheet.
- Reports must be typewritten, double-spaced, with 12 point Garamond font. Tables and graphs must be done on Excel, Origin, or some other graphing software. Calculations must be shown using Equation Editor, or some other mathematic program. Spectra and

chromatograms must be scanned in and converted into a picture that can be inserted into the Word document.

- **REPORT SUBMISSION: Please submit your lab reports to the TA via email by 12 pm (noon) on the date specified on the experiment schedule. No late lab reports will be accepted.**
- **Full Paper reports. 150 points each = 300 points total**
  - There are 2 Full Paper reports:
    - Report #1: Experiment 1 and 2
    - Report #2: Experiment 5
  - Full Paper-style reports are to be written in the style adopted by ACS journals for Article publications. Look up some articles in *Macromolecules* to get an idea of the overall format. Please use headings for each section. \*This will be an excellent practice/training on how to write scientific articles!\*
  - The Full Paper report must include the following:
    - Title page
      - Name of experiment
      - Your name and names of your group members
      - Date (MM/DD/YYYY)
      - Abstract
    - Introduction
      - Includes background information on the experiment that you did.
      - Use references where applicable.
    - Experimental
      - Includes synthetic and characterization procedures
    - Results and discussion
      - Includes presentation and discussion of synthetic and characterization results
      - This section must address the discussion points given in the report guidelines posted on Sakai.
    - Conclusion
    - References
    - Appendix, as needed
    - Answers to the Write-up Questions
- **Communication-style lab reports: 100 points each = 300 point total**
  - There are 3 informal reports:
    - Communication-style report #1: Experiment 3
    - Communication-style report #2: Experiment 4
    - Communication-style report #2: Experiment 6

- Informal reports are to be written in the style adopted by ACS journals for Communications. Look up some communications in the *Journal of the American Chemical Society* or *ACS Macro Letters* to get an idea of the overall format. Do not use headings for each section, except abstract on the first page.
- The informal report should include the following:
  - Title page
    - Name of experiment
    - Your name and names of your group members
    - Date (MM/DD/YYYY)
    - Abstract
  - Brief introduction
  - Brief discussion of the experimental
  - Brief discussion of results
    - Include any relevant calculations and figures.
  - Conclusions
  - References
  - Answers to the Write-up Questions

\*\* A guideline for ACS manuscript submissions is posted on Sakai and can also be accessed via the ACS website. The guideline gives a good explanation of what an ARTICLE publication versus a COMMUNICATIONS publication should be.

#### 4. RESEARCH PROJECT

- **Project Preparation: 100 points**
  - Two separate short summaries will be required making sure students have read and understand the background literature on the project.
  - A list of chemical, glassware, and other supplies, with the corresponding amounts, is also required. This list must be as complete as possible, especially if chemicals must be specially ordered.
- **Project Presentation: 150 points**
  - A 15 - 20 minute Powerpoint presentation of your project will be done in front of your peers and a panel of graduate students, and/or faculty.
  - Your presentation must be emailed to your TA by 5:00 pm on the Thursday before your presentation.
  - Your presentation will be evaluated by your audience.
- **Full Paper Report: 150 points**
  - Each group will submit ONE formal report following the guidelines presented above (e.g., ACS Article style).
- **Poster Presentation: 50 points**

- The class will assemble the combined data into a scientific poster and present it at the Research and Making Expo on April 26<sup>th</sup>, 2018 from 3 to 5 pm in Great Hall. Attendance is mandatory. Your contribution to the poster and attendance will fulfill this requirement.

#### **FINAL GRADE BREAKDOWN:**

Pre-lab assignments	100 points
Lab performance	100 points
Formal lab reports	300 points
Informal lab reports	300 points
Research project	400 points
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<b>TOTAL = 1250 points</b>	

#### **LATE LAB REPORT POLICY:**

- Late reports are deducted 20% per day. Reports emailed after 48 hours will not be accepted and will result in a zero grade.
  - For example, report #1 is due at 12 pm on Feb 6. A **20%** late penalty will be assessed for reports received **between 12:01 pm on Feb 6 until 12:00 pm on Feb 7**. A **40%** late penalty is assessed for reports for reports received **between 12:01 pm on Feb 7 until 12:00 pm on Feb 8**. After 12:00 pm on Feb. 8, **NO** lab reports will be accepted and the grade will be **zero**.
- Late reports are to be emailed to the faculty instructor (FrankL@unc.edu). Your TA cannot and will not accept late reports.

#### **LAB ABSENCE POLICY:**

*If you are going to miss lab, it is your responsibility to contact your TA and faculty adviser as soon as possible.*

- Lab absences and make-up labs will be dealt with on a case-by-case basis. It is in your best interest to limit your absence to only 1 experiment. If you think you will miss more than 1 lab, talk with your TA and faculty adviser as soon as possible.
- List of approved absences:
  - Illness – Must have a doctor’s note for lab make-up.
  - Death in the family
  - Professional school interviews – Must have letter for lab make-up.

**CHEM 520L POLYMER CHEMISTRY LABORATORY**  
**SPRING 2017 EXPERIMENT SCHEDULE**  
**FRIDAY 1:25 pm – 5:15 pm in MOREHEAD 303**

DATE	EXPERIMENT	REPORT DUE DATE Email to the TA by 12 pm
1/12	<b>Check-in and Group assignments</b>	----
1/19	<b>Experiment 1:</b> Free Radical Bulk Polymerization of Styrene	----
1/26	<b>Experiment 2:</b> Atom Transfer Radical Polymerization of Styrene/Reversible addition-fragmentation chain-transfer polymerization	----
2/2	<b>Experiment 3:</b> Living Anionic or Cationic Polymerization of Styrene	<b>Research project summary #1 due</b>
2/9	<b>Experiment 4:</b> Synthesis of Poly(methyl methacrylate) via Heterogeneous Polymerization Methods	<b>Full Paper report #1 due: Experiment 1 and 2 (by 12 noon)</b>
2/16	<b>Experiment 5:</b> Ziegler-Natta Synthesis of HDPE and LLDPE	<ul style="list-style-type: none"> <li>• <b>Communication-style Report #1 due: Experiment 3</b></li> <li>• <b>Research project summary #2 due</b></li> </ul>
2/23	<b>Experiment 6:</b> Synthesis of Polyamides	<b>Communication-style Report #2 due on Experiment 4</b>
3/2	<b>Research Project day 1</b>	<b>Full Paper Report #2 due: Experiment 5 (by 12 noon)</b>
3/9	<b>Research project day 2</b>	<b>Communication-style Report #3 due: Experiment 6</b>
3/16	<b>SPRING BREAK – NO LAB</b>	---
3/23	<b>Research project day 3</b>	---
3/30	<b>Research project day 4 (and check out)</b>	---
4/6	<b>Research Project Presentation (Location TBA)</b>	<b>Research Project report due (Full Paper Report); Group Presentation day</b>
6/26	<b>Research and Making Expo, 3-5 pm in Great Hall</b>	<b>Poster Presentation</b>