Chemistry 276 Physical Polymer Chemistry
Spring 2019

Contact Information

Instructor: Chester Simocko, PhD
Office Location: Duncan 1
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Email: chester.simocko@sjsu.edu
Office Hours: T 1:30-2:30 PM, Th 2:30-3:30 PM and by appointment
Class Days/Time: Lecture TTh 6:00 – 7:15PM
Classroom: DH 415
Prerequisites: Satisfactory background in upper division chemistry or materials science or instructor consent.

Faculty Web Page and MYSJSU Messaging

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on the Canvas site associated with Chemistry 276. I will also use the email address listed on your mySJSU account regularly to send information on Chem 276. You are responsible for checking for messages on this email and the Chem 276 Canvas site on a regular basis to learn of any updates.

Course Description and Prerequisites

Techniques for characterizing molecular weights of polymers, their distribution functions, polymer chain statistics and solution thermodynamics. Prerequisite: Satisfactory background in upper division chemistry or materials science or instructor consent.

Physical Polymer Chemistry is designed to be an introductory course on polymer chemistry and will introduce you to basic concepts of polymers such as nomenclature, molecular weight distribution, and types of polymerizations as well as more advanced topics like viscosity, polymer characterization, phase behavior, and bulk properties.
Course Goals and Learning Objectives

Course Learning Outcomes (CLOs)

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<th>CHEM 276</th>
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<tr>
<td>• Appreciation for the nature and scope of polymer chemistry.</td>
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<td>• Application of key concepts from organic and physical chemistry including bonding, mechanisms, reactions, thermodynamics, spectroscopy, phase behavior, and stereopchemistry to polymeric systems.</td>
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<td>• Identify polymers synthesized from their monomers</td>
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<td>• Identify and draw repeat units and end groups of polymers</td>
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<td>• Identify polymerizations as step, chain, or living type polymerizations</td>
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<td>• Name polymers using systematic (IUPAC) nomenclature.</td>
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<td>• Learn common names for some key polymers.</td>
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<td>• Calculate molecular weights and their distributions for polymeric systems.</td>
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<td>• Learn the theoretical foundations of chain, step, and living polymerizations.</td>
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<td>• Predict compositions of block copolymer systems</td>
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<td>• Characterize polymers via their spectroscopic, thermal, and physical properties</td>
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<td>• Understand the basics of polymers amorphous and crystalline states</td>
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Program Learning Outcomes (PLOs)

Chemistry 276 satisfies the following Graduate Program Learning Outcome for the Chemistry Department:

Program Learning Objectives #2 - To demonstrate information literacy skills for acquiring knowledge of chemistry, both as a student and as a life-long learner.

Program Learning Objectives #5 - To communicate effectively, verbally and written, for the purposes of conveying chemical information to both professional scientists and to the public.

Required Texts/Readings

Textbook: N/A

Other Readings and supplies

Additional documents will be provided, usually posted on the Canvas site for this course.

Library Liaison

The Chemistry Library Liaison is Yen Tran (yen.tran@sjsu.edu)
Course Requirements and Assignments

Catalog Description
Techniques for characterizing molecular weights of polymers, their distribution functions, polymer chain statistics and solution thermodynamics.

The scheduled time for this course is TTh 6:00-7:15PM in DH 415.

Tentative Course Outline:
A tentative outline for the semester appears at the end of this document. Note in particular the dates for the Exams.

Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally 3 hours per unit per week with 1 of the hours used for lecture) for instruction or preparation/studying or course related activities including but not limited to internships, labs, clinical practica. Other course structures will have equivalent workload expectations as described in the syllabus. More details about student workload can be found in University Policy S12-3 at http://www.sjsu.edu/senate/docs/S12-3.pdf.

NOTE that University policy F69-24, “Students should attend all meetings of their classes, not only because they are responsible for material discussed therein, but because active participation is frequently essential to insure maximum benefit for all members of the class. Attendance per se shall not be used as a criterion for grading.”

Attendance Policy

Beyond the initial day of class, roll will not be taken. However, attendance of the lectures is mandatory. If you miss a lecture, you are still responsible for all the material discussed in lecture (some of which may not be in the text). Note we will cover a significant amount of material during each class meeting. If you miss class meetings, it will be difficult to catch up due to the volume. Also, you are responsible for keeping up with any changes in the course or exam schedule, which otherwise will not be publicized outside of the lecture time. Please arrive promptly at 6:00PM. A tentative lecture and course outline is found at the end of this syllabus.

Grading Policy

GRADING (see below for numerical breakdown and percentages)

There will be 2 Exams (each approx. 60min) given throughout the semester, each with a maximum score of 100 points. These exams will be open note. You cannot use a computer, table, phone, etc. even if you have your notes on them. They must be on paper. Each exam will be worth 25% of your grade. There is no final exam.

Homework will be due one week after I assign the practice set. These assignments will be graded of correctness and completeness. There will be 4-6 practice sets. Homework is worth 15% of your grade.
The last 25% of your grade will be a review project. Each student will pick a topic from the literature and write a review of the that topic on the research done in that field in the past 5 years. I will provide a more detailed description of the project later. This project will consist of a written paper and a 20-minute PowerPoint presentation.

One lab class every 3-5 lectures will be a problem session. In these classes, you will work in assigned groups to solve problems. Each class will consist of about 50 minutes to work the problems, then I will assign each group a question (or two) to explain to the rest of the class. Your grade will be based off of your group explanation as well as the quality of work done on the worksheet. It should be noted that this is not graded based on correctness but more on effort although correctness will factor in. This will account for 10% of your grade.

Your final grade will be based on:

- 50% Midterm Exams (2 exams at 20% each)
- 25% Review Project
- 15% Homework
- 10% In Class Problems

**TOTAL 500 points**

Grades will be assigned on a "+/-" system. The course grades will be assigned according the following ranges:

<table>
<thead>
<tr>
<th>A+ = 100-97%</th>
<th>A = 96-93%</th>
<th>A- = 92-90%</th>
</tr>
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<tbody>
<tr>
<td>B+ = 89-87%</td>
<td>B = 86-83%</td>
<td>B- = 82-80%</td>
</tr>
<tr>
<td>C+ = 79-87%</td>
<td>C = 76-73%</td>
<td>C- = 72-70%</td>
</tr>
<tr>
<td>D+ = 69-67%</td>
<td>D = 66-63%</td>
<td>D- = 62-60%</td>
</tr>
<tr>
<td>F = &lt;59%</td>
<td>Unsatisfactory</td>
<td></td>
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Any modifications will be in your favor, but you should not expect significant changes. Note that the "class average" for a given exam is not necessarily a "C" grade. *Grades are assigned by these grade ranges, not by "curves."

It is possible to do poorly on one exam, but you may improve your overall grade by doing well on the other exam. In assigning grades, only one set of criteria are applied equally to all students in the class - everyone has the same opportunity as everyone else to earn their grade.

Note that "incomplete" grades will only be considered if you have an unexpected situation or emergency that prevents you from finishing the semester. It is required that you have completed most of the course work with a passing grade until that point. A typical situation is a medical emergency that prevents you from taking the final exam - to be considered you must provide information and a means to verify the emergency. Poor performance in the class or inability to keep up with the material is not an acceptable reason for an incomplete or to drop the class.
In order to estimate your current grade in this course and progress towards your course grade, keep track of your hour exam, homework, and project scores as the semester progresses. Use the percentages above to calculate your grade percentage and compare them to table.

When exams are returned to you, you will usually find written comments on incorrect answers. Read these carefully since they not only provide feedback on those exam questions, but are intended to guide you for future exams. The keys for every exam will be posted shortly after the exam is given. Use this information for a self-assessment of your progress in Chem 276. Ask me questions if something is not clear.

EXAM POLICIES:

• *Calculators and notes will be allowed during the exam. No use of computers or phones are allowed in exams. Anyone found violating this rule will receive, at minimum, an automatic score of "0 points" for the exam.*

Other Class Policies:

Audio Recording: audio (only) recording is allowed. Note I do not allow video recording. See also University Policies below.

Cell Phones: Out of courtesy, turn these off during lectures and exams.

Computers: You may use your laptop only during class lectures, as long as you can do so in a way that is not distracting to other students. Computers or any web-enabled devices are not allowed during exams.

• Exam Makeup and Regrade Policy:
You are required to take all three of the exams. A makeup will only be considered if you miss an exam due to an unforeseen emergency and provide a documented and verifiable reason. In all cases, you must contact me as soon as reasonably possible. Before any action will be taken, you will be required to provide a verifiable document describing your emergency with the doctor's name and phone number.

Any request for a regrade or recalculation of any exam must be made within one week after the exam is returned in class (if you are not in class the day it is returned, it is your responsibility to obtain your exam from me). No regrades will be considered beyond this time. The exam must be left with me, and I will review the entire exam.

University Policies

As a student at SJSU, you should review these University Policies which apply to ALL university courses.

http://www.sjsu.edu/gup/syllabusinfo/#GeneralExpectations

The topics include the following:

General Expectations, Rights and Responsibilities of the Student
Dropping and Adding
In addition to the university policies above, I have additional policies that apply specifically to Chem 276. Please note the following:

**Consent for Recording of Class and Public Sharing of Instructor Material**

Audio recording of lectures is allowed. I do not allow video recording of lectures. Much of the material I prepare for Canvas is prepared by me and is considered my personal property. It may not be shared with anyone who is not enrolled in Chem 276.

**Academic integrity**

Your commitment as a student to learning is evidenced by your enrollment at San Jose State University. The University Academic Integrity Policy S07-2 at http://www.sjsu.edu/senate/docs/S07-2.pdf requires you to be honest in all your academic coursework. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The Student Conduct and Ethical Development website is available at http://www.sjsu.edu/studentconduct/.

Instances of academic dishonesty will not be tolerated. Cheating on exams or plagiarism (presenting the work of another as your own, or the use of another person’s ideas without giving proper credit) will result in a failing grade and sanctions by the University. For this class, all assignments are to be completed by the individual student unless otherwise specified. If you would like to include your assignment or any material you have submitted, or plan to submit for another class, please note that SJSU’s Academic Integrity Policy S07-2 requires approval of instructors.

**Campus Policy in Compliance with the American Disabilities Act**

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 at http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf requires that students with disabilities requesting accommodations must register with the Accessible Education Center (AEC) at http://www.sjsu.edu/drc/ to establish a record of their disability.

**Emergencies and Building Evacuations**

If you hear a continuously sounding alarm, or are told to evacuate the building by an Emergency Coordinator, walk quickly to the nearest exit. Take your personal belongings as you may not be allowed to return. Follow the instructions of the Emergency Coordinators. Be quiet so you can hear instructions. Once outside, move away from the building. Do not return to the building unless the Police or the Emergency Coordinator announces that this is permissible.
1. Introduction
   a. What is a macromolecule?
   b. Types of Polymers and Polymerizations
   c. Nomenclature
   d. Molecular Weight
   e. Polymer Architectures
   f. Physical States

2. Step Polymerization
   a. Functional Group Reactivity
   b. Kinetics
   c. Cyclization vs. Linear Polymerization
   d. Molecular Weight Control and Distribution
   e. Crosslinking
   f. High-Performance Polymers

3. Radical Chain Polymerization (RCP)
   a. Chain Vs. Step Polymerization
   b. Rate of RCP
   c. Initiation
   d. Molecular Weight
   e. Chain Transfer
   f. Molecular Weight Distribution
   g. Commercial Examples

4. Ionic Chain Polymerization
   a. Cationic Polymerization
      i. Propagation
      ii. Chain Transfer and Termination
      iii. Kinetics
      iv. Living Cationic Polymerization
   b. Anionic Polymerization
      i. Initiation
      ii. Termination
      iii. Kinetics
   c. Polymer Architectures

5. Chain Copolymerization
   a. Copolymer Composition
   b. Reactivity
   c. Ionic Copolymerization
6. Stereochemistry
   a. Types of Stereoisomerism
   b. Properties of Stereoregular Polymers
   c. Ziegler-Natta Polymerization
   d. Metallocene Polymerization
   e. Commercial Applications

7. Polymers in Solution
   a. Thermodynamics
   b. Chain Dimensions
   c. Frictional Properties of Polymers in Solution

8. Molecular Weight Analysis
   a. GPC
   b. End-Group Analysis
   c. Osmometry
   d. Effects of low molar mass impurities on $M_n$
   e. Viscosity
   f. Light Scattering

9. Chemical Composition Analysis
   a. UV-Vis
   b. IR
   c. Raman
   d. NMR
   e. Mass Spectroscopy

10. Thermal Characterization
    a. DSC
    b. TGA
    c. TMA

Maybe more if we have time.

**Major Dates:**
Exam 1: Thursday, March 28th
Exam 2: Thursday, May 9th
Final Project Due: Thursday, May 16 at 7:30PM
Presentations: TBA