Chem 4PP3 Polymer Chemistry

Polymer Chemistry deals with the design, preparation and properties of macromolecules. It is hard to overestimate their importance in our everyday life, and estimates have placed the percentage of all chemists that are involved in research and development of polymers at over 50%.

This course will cover fundamental concepts of polymer chemistry, as outlined below:

Introduction: history of monomers and polymers; polymer structures and molecular weights; overview over synthesis and properties;

Step Growth Polymerization (Condensation Polymerizations): Polyester, polycarbonates, polyamides, polyurethanes, and polyimides

Chain Growth Polymerization (Addition Polymerization, i.e. free radical polymerization): Examples of vinyl polymers; mechanisms and kinetics of initiation, propagation, and termination; chain transfer and inhibition; polymer stereochemistry; bulk, solution, suspension, emulsion, dispersion and precipitation polymerization;

Copolymerization (chain growth polymerizations): copolymer examples, copolymerization kinetics, and instantaneous copolymer composition

Living Polymerizations: anionic and cationic polymerizations; block copolymers; Ring Opening Polymerization and Ring Opening Metathesis Polymerization;

Living Radical Polymerizations: SFRP, ATRP, RAFT and what they have in common.

Reactions on Polymers: reactive polymers, crosslinking; chemical modification of polymers;

Properties of polymers in solution: polymer solubility; fractionation; random coil conformation; polymer molecular weights as measured by size exclusion chromatography, light scattering, viscometry

Physical states: crystalline and amorphous polymers; polymer melt flow; viscosity and elasticity; effects of molecular weight and morphology on physical and mechanical properties

Each topic will take about one week, with the remaining time to be used to discuss current literature, and schedule presentations.

We will have student presentations, individually or in teams of two. Here is some guidance for topic selections.

Topic Selection for presentations:
One good way to find a topic is to browse through Macromolecules or another major polymer journal, and pick a few papers you find interesting. Read them carefully until you feel comfortable deciding on one key paper written by a Dr. Lorne Chain and coworkers. Now assume you were just hired as a new graduate student or research chemist in L. Chains group, and asked for "the next step" to be pursued in this area. Read the paper again carefully, extract the essence of what they are trying to achieve. That is your review. Then try to find one or two 'chemical bottlenecks' in their process, and ponder ways to address them. That is your proposal section.

Presentations:
Presentations/proposal should be in power point, using a very simple style, no more than 12 slides, and these not overly loaded. We'll take 15 min for individual presenters, and 25 minutes for team presenters, including discussion.

Write-up:
5 pages including pictures, 1.5 spaced, 1 inch margin all around, point 12 times roman font. Should include some background, review of specific chemistry, and the essence of the proposed research.

Course Evaluation will be based on:

Midterm	**1 hour**	**25%**
Final	**3 hours**	**50%**
Project		**25%**

Example of Recent Class Presentation Topics CHEM 4PP3

Class Presentations are an important element of this course. They can be done individually, or in teams of two students, on a subject of your choice. We will find topics that match your interests as well as serve to elaborate on material covered in the course.

1. **The Evolution of Optical Storage**
2. **Carborane Containing Dendrimers for Boron Neutron Capture Therapy**
3. **Biodegradable Polymers and the Applications in Drug Delivery Systems**
4. **Poly(L-Lysine) Polyplexes as a Gene Therapy Vector**
5. **Recycling Poly(ethylene Terephthalate)**
6. **Polymer-based Artificial Muscles**
7. **Photo-addressable Polymers for Data Storage**