

Chemistry 770 Course Outline 2010

Principles of Polymer Science

Time/Place: Tuesday & Thursday, 8:30-9:50, CPH-3604 (Starting Tuesday September 14)
Instructor: Mario Gauthier, C2-169, 888-4567, Ext. 35205, e-mail: gauthier@uwaterloo.ca
Course web site: http://www.chemistry.uwaterloo.ca/undergrad/courses/web_courses/chem370/

Course content

1. Basic definitions: Monomers, polymers, polymerization reactions. Polymer structure, nomenclature. Molecular weight distributions and molecular weight measurements (osmometry, light scattering, viscosity, gel permeation chromatography).
2. Step-growth polymerization. Types of reactions. Reactivity, kinetics. Molecular weight distribution and control, branching and cross-linking. Step copolymerization. Polymerization equilibria. Preparation of polyesters, polycarbonates, polyamides.
3. Radical chain polymerization. Types of reactions (bulk, solution and heterogeneous polymerizations). Polymerization kinetics and energetics, molecular weight distribution. Autoacceleration. Preparation of polyethylene, polystyrene, vinyl polymers.
4. Emulsion polymerization. Initiators, surfactants and other components. Polymerization rate. Molecular weight and particle size distributions. Surfactant-free emulsion polymerization, core-shell polymers. Applications.
5. Polymer isomerism and conformation. Dimensions of macromolecules (end-to-end distance, radius of gyration). Thermodynamic treatment of rubber elasticity.

Evaluation

3 Assignments: 20%

Mid-term exam (2.5 hours duration): 30%

Final exam (2.5 hours duration, only on second half of the course): 30%

Term paper (topic related to the course and relevant to the student's research, or else to be assigned by the instructor): 20%. See term paper handout for details.

Prerequisites: CHEM 254 (Thermodynamics), 264 (Organic chemistry) or equivalents.

Texts (on reserve at library for 3-hour loans)

"Principles of Polymerization" 4th ed., G. Odian, Wiley: New York, 2004. QD281.P6O3 2004

"The Elements of Polymer Science and Engineering" 2nd ed., A. Rudin, Academic Press: Orlando, 1999. QD381.R8 1999

"Polymers: Chemistry and physics of modern materials" 3rd ed., J.M.G. Cowie, Taylor & Francis: Boca Raton, 2008. QD381 .C68 2008

CHEM 770 TERM PAPER

Graduate students registered for credit (non-audit students) are required to write a term paper that will be worth 20% of the total course mark.

Topic: Should be related to the course material (i.e. one of the topics listed in the course outline) AND, whenever possible, to your own thesis research. However it should **not** be a discussion of your own research (don't think about rewriting that CHEM 794 report!). For example, you may want to learn more about a specific characterization or polymerization technique you will use in your own research. If you don't have any idea about which topic to choose, come see me and I can help you select one (or else assign you one). **I must personally approve the topic of your term paper by Thursday, October 7 at the latest. Students who have not submitted a topic by then will receive a 25% penalty on their term paper (equivalent to 5% of the total course mark).** Do **NOT** wait until the last minute to seek approval, nor simply assume that whatever topic you selected will be appropriate.

Format: The paper should be 15-30 pages in length overall (double line spacing, figures included) and written in the format of a review with the following sections: Title page, table of contents, introduction, main body, conclusions, and supporting references. The main body of the text should be in the format of a review paper, divided into sections discussing different aspects of the topic in an organized (coherent) fashion. The conclusions section should summarize the main points brought up in the review. The scope of the topic must be restricted so that you can find only ca. 10-20 references overall, and **NOT** all from the same 1-2 research groups. Note that the literature should be cited throughout the text (with the references appearing in numerical order), not simply provided as a bibliography. The source of any figure borrowed from the literature should be specified by adding a reference number in the caption.

Due date: All term papers are due at the last lecture, i.e. **Thursday, December 2**. Please note that due to the tight exam schedule, no extensions can be granted to suit individual needs. Get started **early** so you don't run out of time! Both hard copy (paper) and electronic (Acrobat PDF or Microsoft Word) submissions will be required.

Grading of the papers will be based on the overall quality of writing, i.e. logical organization of the sections, quality of grammar and lack of typographical errors, quality and appropriateness of figures, etc. Do **NOT** simply cut and paste blocks of text from the references to assemble into your term paper – this is plagiarism! Always say it in your own words. Please note that if you have problems writing in English, you should seek the help of a qualified person to proof-read your text before submission so that you are not penalized.

For detailed information on what is considered plagiarism at the University of Waterloo, please consult the following web site:

<http://www.uwaterloo.ca/academicintegrity/Students/index.html>

This includes many examples of what is considered academic misconduct at UW:

http://www.uwaterloo.ca/academicintegrity/Students/stdt_examples.html

PLAGIARISM DETECTION SOFTWARE (TURNITIN) WILL BE USED TO SCREEN TERM PAPERS IN THIS COURSE. THIS IS BEING DONE TO VERIFY THAT USE OF ALL MATERIAL AND SOURCES IN TERM PAPERS IS DOCUMENTED.