

**CHM426 / CHM1310 / CHE562 / CHE1310: Polymer Chemistry (an introductory course)**  
**Winter Term 2011**

Instructors:	Professor Mitchell Winnik	m.winnik@utoronto.ca
	Professor Tim Bender	tim.bender@utoronto.ca

Lectures: **Tuesdays 5 – 7 pm, LM 158**

Office hours: Tuesdays 4-5 pm; Thursdays 5-6 pm by appointment.

MAW: LM 520; TB: WB 225 (Tuesdays only);

Recommended text: Painter P.C.; Coleman, M.M. *Essentials of Polymer Science and Engineering* (ISBN 978-1-932078-75-6)

(Other useful text books: there are several)

Young, R.L.; Lovell, P.A. *Introduction to Polymers*, 2<sup>nd</sup> ed

Sperling, L.H., *Physical Polymer Science*, 2<sup>nd</sup> or 3<sup>rd</sup> ed.

Please note that you are responsible for all material presented in lecture, whether or not this topic is also presented in the recommended text or in the Web notes.

Webnotes: [www.chem.utoronto.ca](http://www.chem.utoronto.ca) ⇒ Course notes ⇒ chm 426

[user name: “chm426” (one word, all lower case); password: (to be given out in lecture)]

For CHE562 and CHE1310 students a **BlackBoard** site will also be maintained as a mirror. It should be visible on your homepage if you are properly registered in ROSI.

**For CHM426 / CHM1310 / CHE562:**

Assignments and tests:	Midterm test (TBD)	25%
	Quizzes	5%
	Term paper	30%
	Final exam	40%

Quizzes: There will be a 5-min quiz at the start of most lectures. The lowest quiz mark will be dropped from the average.

Term Papers: Suggested topics will be provided in early to mid February along with detailed instructions. The term papers themselves are due in class on the last day of classes. Late penalty: 2 marks/day. Term papers should be no more than 12 pages long (12 pt font, 1.5 spaced lines) including figures and references.

**For CHE1310 only:**

If you are a Ph.D. registered student or intend to undergo M.A.Sc. bypass examinations to the enter the Ph.D. program in the Department of Chemical Engineering and Applied Chemistry then you should register in CHE1310 and not CHE562. If you are enrolled in CHE1310, and due to the course requirements in the Graduate Unit of the Faculty of Applied Science and Engineering, you will be required to take an enriched version of this course as follows:

You will be required to attend an additional lecture hour with Prof Bender. Time TBD. These extra hours will likely start the week of January 17 2010.

You will not be required to take the beginning of class quizzes.

The grading scheme for **CHE1310** will be as follows:

Assignments and tests:	Midterm test (TBD)	25%
	Term paper	25%
	Final exam #1 with rest of class	25%
	Final exam #2 CHE1310 only on enrichment material	25%

**1. Introduction**

Classification of polymers  
General concepts of molecular weight distribution

**2. Polymer synthesis: Step growth polymerization**

Statistics of step-growth polymerization

**3. Polymer synthesis: Addition polymerization**

Anionic and cationic (living) polymerization  
Kinetics and mechanism of free radical polymerization  
Controlling  $M_n$ : chain transfer  
Copolymerization and reactivity ratios  
“Living” radical polymerization

**4. Polymer synthesis: other topics**

Ziegler-Natta and metallocene polymerization of olefins  
Ring-opening metathesis polymerization  
Gel formation  
Kinetics of step-growth polymerization

----- midterm test --- TBD -

**5. Experimental determination of the sizes and shapes of macromolecules**

Conformation of macromolecules  
End-group analysis  
Osmometry  
Scattering techniques  
Viscometric techniques

**6. Polymer solutions**

Polymer interactions in solutions; concentration regimes, solvent quality  
Solution and melt thermodynamics (Flory-Huggins theory)  
Solubility parameter approach  
Association in polymer solution and melts  
Phase separation

**7. Polymers in the bulk state**

Melts and amorphous states  
Glass transition  
Crystalline polymers  
Morphology  
Macroconformation, packing, chain folding  
Kinetics of crystallization

Calendar for 2011

January							February							March							April						
Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa
					1				1	2	3	4	5			1	2	3	4	5						1	2
2	3	4	5	6	7	8	6	7	8	9	10	11	12	6	7	8	9	10	11	12	3	4	5	6	7	8	9
9	10	11	12	13	14	15	13	14	15	16	17	18	19	13	14	15	16	17	18	19	10	11	12	13	14	15	16
16	17	18	19	20	21	22	20						26	20	21	22	23	24	25	26	17	18	19	20	21	22	23
23	24	25	26	27	28	29	27	28						27	28	29	30	31			24	25	26	27	28	29	30
30	31																										

Jan 11, 18, 25; Feb 1, 8, 15      Mar 1, 8, 15, 22, 29      Apr 5