

CHM249S (2008): "Organic Chemistry"

"Organic chemistry appears to me like a primeval forest of the tropics, full of the most remarkable things." Friedrich Wöhler, 1835.

Organic chemistry has grown beyond recognition from its beginnings as a science in the early 19th century. Our understanding of organic chemistry, the science of carbon derived molecules, continues to grow unabated, and its constant evolution as a discipline will ensure that Wohler's observation will be no less true tomorrow than it was at the dawn of the science. Organic molecules, whether synthetic or naturally derived, impact virtually every aspect of our lives. With an almost infinite diversity, they range from simple hydrocarbons to complex proteins, transient reactive intermediates to persistent environmental toxins, exotic natural products to block-buster pharmaceuticals, and industrially important organometallic complexes to household synthetic polymers. The richness of the subject is evident from the ever-growing number of scientific papers in the area.

The aim of CHM249H is to give you a firm grounding in the basic principles of organic chemistry. This is done with the aid of laboratory experiments, lectures, readings, problems and notes. The course builds from the basic principles laid out in CHM 151Y or CHM 138H. Basic knowledge of structure, bonding, thermodynamics and kinetics is assumed. We will build upon these principles to gain an understanding of reactivity and mechanism of basic reactions. The main analytical methods that are used to determine the structure of organic molecules will be reviewed. The basic concepts of organic synthesis necessary for the formation of organic molecules and pharmaceuticals are also introduced in this course. Finally, the growing importance of research that lies at the interface between chemistry and biology will be referenced.

The course is intended for students who have an ongoing interest in chemistry. We assume that students who complete CHM249H will continue into the next year to take our more advanced organic/biological course(s) such as CHM342H, CHM343H, CHM347H, CHM348H and CHM379H. These courses build upon the material covered in CHM249H.

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Lecturer and Course Spokesperson:

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Term Tests, Final Examination and Grading:

The course material is acquired through lectures, readings, problem solving, and laboratory experiments. Please note that the course text is there to assist you in learning the material, but it does not define the course. Tests will be conducted during regular class periods. The overall course grade is determined by a combination of factors based on your performance in examinations and in the laboratory:

First Exam (50 min, in class): **Thursday Feb 7th**
Second Exam (50 min, in class): **Thursday March 27th**

	CHM 249
First Hour Exam	12.5%
Second Hour Exam	12.5%
Laboratory	35%
Final Exam	40%

There are no make-up examinations for missed hour exams. If you miss a term test, you may, within one week of the missed test, submit a written request for consideration. The request must explain the reason for missing the test and be supported with appropriate documentation, such as a medical certificate that states why attendance was not possible (refer to section six of the Faculty of Arts and Science Calendar, Rules and regulations: term tests).

We will cover a considerable amount of material over the coming semester. The key to successfully completing this course is to work through the material and problems as we go along. Any questions or problems can then be addressed by meeting with me during the office hours. Finally, on a cautionary note, this is not the type of course where "cramming" the night before the exam will work out for you.

Lectures:

LM 158: Monday at 1:10 – 2:00 p.m., Tuesday and Thursday at 3:10 – 4:00 p.m.

The course meets three times per week in a large lecture room, normally with seats to spare. *Please sit as close to the front of the room as possible so that you can interact with the lecturer and see the material on the blackboards. Come prepared by having done any assigned reading and take notes as the lecture proceeds. Questions are welcomed either during class or during office hours.*

Laboratory:

LM 117: Friday from 9:00 a.m. – 1:00 p.m.

Office Hours (Prof. Batey):

LM 365: t.b.a.

I will also meet with students by appointment. *It is best to meet with me in my office during office hours or by appointment, rather than use email.* Also, in preparation for examinations, please do not leave all of your questions until the last minute!

Discussion Board:

A discussion board for the course is available if you click the "discussion board" button on the left hand navigation bar of the course web-site. To see it you must logon using your UTORID and then navigate through the "My Courses" section opening the CHM249H page, and then hit "Discussion Board" on the lefthand side navigation bar.

Textbook and Course Aids:

"Organic Chemistry", 6th edition by J. McMurry plus the accompanying Study Guide and Solutions. A molecular model set is very useful for most of the course. The model set Molecular Visions by Darling Models is recommended for this course (as for other undergraduate organic chemistry courses at U of T). The set may be used in tests and examinations. "Foundations of Organic Chemistry" by M. Hornby and J. Peach, is also recommended as an excellent brief guide to the basic principles of organic chemistry, and as a review of material covered in your first year course. Although we will not be using it, my favourite introductory organic text remains the one I first learned from: "A Guidebook to Mechanism in Organic Chemistry" by Peter Sykes (6th Edition).

Course Web-page:

Material that will be posted on the web-site include supplementary notes and other course updates.

www.chem.utoronto.ca/coursenotes/CHM249/CHM249Intro.html

Additional information for each chapter of the course textbook can be found on the web-site:

http://www.brookscole.com/cgi-wadsworth/course_products_wp.pl?fid=M20b&product_isbn_issn=0534389996&discipline_number=12

Other useful sites having web-based problems suitable for this course include:

Problems from Prof. William Reusch at Michigan State University:

<http://www.cem.msu.edu/~reusch/VirtualText/Questions/problems.htm>

More challenging problems (upper level courses) from Prof. David Evans at Harvard:

<http://daecr1.chem.harvard.edu/problems/>

Knowledge and Concepts that are assumed for this Course:

- Basic Structure and Bonding.
- IR and MS spectroscopy.
- Stereochemistry of organic compounds, stereocentres, R and S configurations, optical activity, meso compounds etc.
- Structure and reactivity of alkenes and alkyl halides.
- Energy considerations, basic thermodynamic and kinetic principles, and describing reactions using energy diagrams.
- Aromaticity.

Topics to be Covered:

- (i) Review of 1st Year - Introductory Principles
- (ii) Spectroscopy of Organic Molecules
- (iii) Basic Review of Thermodynamics and Kinetics
- (iv) Acidity and Basicity
- (v) Alkynes
- (vi) Aromatic Compounds
- (vii) Electrophilic Aromatic Substitution
- (viii) Nucleophilic Aromatic Substitution and Benzyne
- (ix) Introduction to Multi-step Synthesis: Synthesis of Aromatics
- (x) Amines
- (xi) Oxidations
- (xii) Aldehydes and Ketone
- (xiii) Carboxylic Acids and their Derivatives
- (xiv) Enolate Chemistry
- (xv) Pericyclic Reactions

CHM 249H1

LIST OF EXPERIMENTS (2008)

Lab Period	Title of Experiment	Date
1	Check-in. Solubility and Crystallization. Melting Points.	January 11
2	Extraction: Part 1 (Microscale); Drawing of Chemical Formulas	January 18
3	Infrared and NMR Spectroscopy	January 25
4	Reduction of Conjugated Ketones with NaBH ₄	February 1
5	Multistep Synthesis 1. Part A: Reduction of 4-Nitrophenol	February 8
6	Multistep Synthesis 1. Part B: Acetylation of 4-Aminophenol	February 15
7	Multistep Synthesis 1. Part C: Etherification of 4-Hydroxyacetanilide	March 1
8	Multistep Synthesis 2. Part A: Synthesis of 4-Bromoacetanilide	March 8
9	Multistep Synthesis 2. Part B: Synthesis of 4-Bromo-2-chloroacetanilide	March 15
10	Multistep Synthesis 2. Part C: Hydrolysis of 4-Bromo-2-chloroacetanilide	March 29
11	Multistep Synthesis 2. Part D: Synthesis of 1-Bromo-3-chlorobenzene	April 4

Notes:

1. The lab starts on the hour (9:00 a.m. sharp), not at 9:10 a.m.
2. There will a quiz during first several minutes of the lab (including one on January 11).
If you are late, you will not be allowed to write a quiz.
3. If you are late by more than 15 minutes, you will not be allowed to perform the experiment.
4. There are no make-ups. The labs are only on Friday mornings every week.
5. Bring your safety glasses (goggles), lab coat and a note book on January 11.