CHM 440/1004: Synthesis of Modern Pharmaceuticals

Fall 2020 Course Syllabus

I CONTACTS

INSTRUCTOR
Name: Mark Lautens
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Office: DB359
Online student hours: Tuesday/Thursday 4-5 or by appointment through email

Instructor Bio: I am a synthetic organic chemist with an interest in catalysis and applications to the synthesis of bioactive natural products and medicinal agents. I like oral examinations for all kinds of reasons and I hope you will as well.

II COURSE OVERVIEW

COURSE DESCRIPTION:
This course provides an overview of the structures of the different pharmaceutical agents that are used for the treatment of human disease. Within each therapeutic area, representative drugs currently on the market or in advanced clinical trials are discussed with a focus on their method of synthesis. A combination of reactions learned in previous courses and new reactions will be used to understand the strategy and the synthetic routes that are presented.

STUDENT LEARNING OUTCOMES:
Students are expected to be able to predict the outcome of reaction sequences, propose reaction mechanisms and devise synthetic routes to molecules of moderate complexity using reactions taught in the course and those taught in previous organic chemistry courses. Students will have developed familiarity with the metal catalyzed reactions that were taught in the course.
In addition, students are expected to understand the different aspects of drug discovery inlcuding how pharmaceutical companies are organized to take on the task of finding, then preparing, drug candidates. An oral exam is a key part of the course. Preparing for and participating in the exam will teach important skills, useful well outside the chemistry domain.

PREREQUISITE COURSE: CHM 342H (Modern Organic Synthesis)

This course assumes you have a basic understanding of material taught in previous organic chemistry courses, in particular those involving synthesis. It is also assumed that you have basic knowledge of organometallic chemistry.

READINGS:
Required: regular reading of original research papers, review articles and other material provided by the instructor.
Recommended text: Clayden et al., ORGANIC CHEMISTRY, Oxford Press 2004, ISBN 01985013466

Supplemental readings from:

Classics in Total Synthesis, Nicolaou, K.C. Vol 1 and 2
Color Atlas of Pharmacology, Lüllman et al
Synfacts, Thieme Verlag
Pharmaceutical Substances, Kleeman and Engel

III HOW THE COURSE IS ORGANIZED

The course will include live-streamed lectures (Tuesday and Thursday at 3-4pm) in addition to recordings of the class. The course is fully online including all assessments.

COURSE SCHEDULE & RELEVANT SESSIONAL DATES (estimated):

DATES	UNIT/WEEK	TOPICS
Sept. 10 – Sept. 22	1 - 3	Basics of pharmaceutical research
Sept. 24 – Oct. 15	3 - 6	Heterocyclic chemistry
Oct. 20 – Nov. 6	7 - 10	Catalysis
Nov. 17 – Dec. 8	11 - 12	Applications to pharmaceuticals

IMPORTANT FALL 2020 SESSIONAL DATES:
First Day of F & Y classes: Thursday 10th September 2020
Thanksgiving (no classes): Monday 12th October 2020
Fall Reading Week (no classes): Monday 9th – Friday 13th November 2020
Last Day of F & Y classes: Wednesday 9th December 2020
Make-Up Day: Thursday 10th December 2020
December Assessment Period: Friday 11th – Tuesday 22nd December 2020

IV EVALUATION/GRADING SCHEME

TERM TESTS (during Weeks 5 and 9): 35% (20% + 15% based on best scores)
No make-up tests are offered. If you are absent or excused due to illness, the remainder of the course will be reweighted.
ASSIGNMENT: 15% (due at Week 8) details to be explained in opening lecture.

ORAL EXAMINATION: 25% (individually scheduled, final two weeks of the course) details to be explained in the opening lecture.
FINAL ASSESSMENT (December assessment period): 25%

Note: if an unexpected technical issue occurs with a university system (e.g., Quercus services, network outage) that affects availability or functionality, it may be necessary to revise the timing or weighting of the assessments.

V COURSE POLICIES

- I will aim to respond to email within 24 hrs on weekdays and I can be reached for 1:1 meetings via Zoom or Teams. Please indicate the course number CHM440/1004 in the subject line. Attendance at live lectures is best, if possible, to address any questions you have regarding the material

- The University of Toronto is committed to equity, human rights and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. U of T does not condone discrimination or harassment against any persons or communities.

- Privacy language and appropriate use of course materials: https://teaching.utoronto.ca/ed-tech/audio-video/sample-statements/

- Deadlines for assignment submissions and late policy (e.g. 50% will be deducted daily).

- Submission methods: use Quercus only. Oral exam will be a 20-25 min live Zoom meeting at a scheduled time.

- There will be no make-up tests or assignments. If you are ill during the slot assigned to your oral exam, an effort will be made to reschedule within 48 of the originally assigned time. Otherwise the course will be reweighted, as will be the case for missed term tests.

VI TECHNOLOGY REQUIREMENTS

Specific guidance from the U of T Vice-Provost, Students regarding student technology requirements is available here: https://www.viceprovoststudents.utoronto.ca/covid-19/tech-requirements-online-learning/

Advice for students more broadly regarding online learning is available here: https://onlinelearning.utoronto.ca/getting-ready-for-online/

This course requires the use of computers, and of course sometimes things can go wrong when using them. You are responsible for ensuring that you maintain regular backup copies of your files, use antivirus software (if using your own computer), and schedule enough time when completing an assignment to allow for delays due to technical difficulties. Computer viruses, crashed hard drives, broken printers, lost or corrupted files, incompatible file formats, and similar mishaps are common issues when using technology, and are not acceptable grounds for a deadline extension.

VII INSTITUTIONAL POLICIES AND SUPPORT

ACADEMIC INTEGRITY

On Academic Integrity:
Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. The University of Toronto's Code of Behaviour on Academic Matters (https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

In papers and assignments:

1. Using someone else's ideas or words without appropriate acknowledgement.
2. Submitting your own work in more than one course without the permission of the instructor.
3. Making up sources or facts.
4. Obtaining or providing unauthorized assistance on any assignment.

On tests and exams:

1. Using or possessing unauthorized aids.
2. Looking at someone else's answers during an exam or test.
3. Misrepresenting your identity.

In academic work:

1. Falsifying institutional documents or grades.
2. Falsifying or altering any documentation required by the University.

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have

questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from your instructor or from other institutional resources (see https://www.academicintegrity.utoronto.ca/).

Use of Turnitin

Normally, students will be required to submit their assignment to Turnitin.com for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their work to be included as source documents in the Turnitin.com reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of the Turnitin.com service are described on the Turnitin.com web site.

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Note for instructor: *sample statements for instructor recording of online courses are available here:* https://teaching.utoronto.ca/ed-tech/audio-video/sample-statements/

If a student wishes to copy or reproduce lecture presentations, course notes or other similar materials provided by instructors, he or she must obtain the instructor's written consent beforehand. Otherwise all such reproduction is an infringement of copyright and is absolutely prohibited. More information regarding this is available here: https://teaching.utoronto.ca/ed-tech/audio-video/copyright-considerations/

ACCESSIBILITY NEEDS

Students with diverse learning styles and needs are welcome in this course and my assessment methods aim to offer an opportunity for all students to excel. The University of Toronto is committed to accessibility: if you require accommodations for a disability, or have any other accessibility concerns about the course, please contact Accessibility Services as soon as possible.

ADDITIONAL SERVICES and SUPPORT

The following are some important links to help you with academic and/or technical service and support:

- General student services and resources at Student Life
- Full library service through University of Toronto Libraries
- Resources on conducting online research through University Libraries Research
- Resources on academic support from the Academic Success Centre
- Learner support at the Writing Centre
- Information for Technical Support/Quercus Support