Advanced Organic Chemistry Laboratory (CHMD92H)
Summer 2022
University of Toronto at Scarborough

This document contains important course information and should be kept in a safe place where you can refer to it throughout the term.

Welcome to CHMD92! This lab course will build on your previously learned chemistry lab skills and expose you to some of the modern synthetic and analytical methods required to carry out original research. The course will consist of two, six-hour labs per week and will be divided into units, each spanning several lab periods. Through these short research projects, you will be exposed to the art of multistep synthesis pertaining to the chemistry of potential pharmaceutically active agents as well as some aspects of analytical and physical chemistry and their applications. Prerequisites for this course include one of either CHMC41 or CHMC42 or CHMC31.

Lab Schedule:

Tuesdays and Thursdays, 10-4 pm in EV 124

Instructors:

Dr. Shadi Dalili (Weeks 1-4)
Email: sh.dalili@utoronto.ca
Office Hours: Wednesdays 11-12 (via Zoom)

Prof. Kagan Kerman (Weeks 5-8)
Email: kagan.kerman@utoronto.ca
Office Hours: Mondays 1-2 pm (via Zoom)

Prof. Oleksandr Voznyy (Weeks 9-12)
Email: o.voznyy@utoronto.ca
Office Hours: TBD

Learning Outcomes:

By the end of this course, you should be able to:

- Plan and execute both single step and multistep organic syntheses following procedures published in the primary literature.
- Analyze practical data and write accurate and complete scientific reports disseminating your findings.
- Use the vocabulary of organic chemicals, reactions and techniques found in modern chemistry labs.
- Troubleshoot practical mistakes and propose solutions to problems encountered during an experiment.

- Carry out modern laboratory techniques used in organic and analytical chemistry
- Became more familiar with modern organic chemistry instruments, such as HPLC, GC, GC-MS, and NMR.
- Analyze spectroscopic data for both known and unknown organic structures, including mixtures of substances.

Website:

CHMD92 maintains a Quercus page (https://q.utoronto.ca/) which archives a variety of course-related information including announcements, pre-lab assignments, synthetic procedures, references and links to outside resources. In addition, class emails will regularly be sent via Quercus. In order for you to receive these emails, you must have a valid "utoronto.ca" email account registered with ROSI.

Lab Schedule (tentative):

Lab #	Date	Lab Topic
1	May 10	Introduction to the first part of the course; Synthesis of various N-benzylated isatin derivatives
2	May 12	
3	May 17	Multistep synthesis and characterization of N-benzylated isatin oximes, hydrazones, semicarbazones, and thiosemicarbazones derivatives
4	May 19	
5	May 24	
6	May 26	
7	May 31	ADME, Molecular Modelling and Docking Studies, Final Presentations
8	June 2	
9	June 7	Introduction to biosensors and immunosensors Introduction to enzyme-linked immunosorbent assay (ELISA) Detection of a fish virus using ELISA Analysis of ELISA experimental data
10	June 9	
11	June 14	
12	June 16	
	June 21 & 23	**Reading week**
13	June 28	Introduction to electrochemical impedance spectroscopy (EIS) Detection of a fish virus using EIS Analysis of EIS experimental data Final presentations
14	June 30 - holiday	
15	July 5	
16	July 7	
17	July 12	TBD
18	July 14	
19	July 19	
20	July 21	
21	July 26	
22	July 28	
23	Aug 2	
24	Aug 4	

Lab Manual:

All required documents will be posted on Quercus as needed.

Textbook:

There is no required text for this course; however, the following book is recommended:

- **Microscale Organic Laboratory with Multistep and Multiscale Synthesis**, Dana W. Mayo, Ronald M. Pike, David C. Forbes., 5th ed., Wiley

Articles:

The following articles are recommended and can be downloaded from the library resources:

- **Multiplexed immunosensors and immunoarrays**, A. Jones, L. Dhanapala, R. N. T. Kankanamage, C. V. Kumar, J. F. Rusling, *Analytical Chemistry* **2020**, *92*, 345-362. https://doi.org/10.1021/acs.analchem.9b05080
- **Electrochemical impedance spectroscopy: an overview of bioanalytical applications,** Edward P. Randviir and Craig E. Banks, *Analytical Methods* **2013**, *5*, 1098-1115. https://doi.org/10.1039/C3AY26476A
- **Electrochemical sensing directions for next-generation healthcare: Trends, Challenges, and Frontiers**, J. F. Hernandez-Rodriguez, D. Rojas, A. Escarpa, *Anal. Chem.* **2021**, *93*, 167-183. https://doi.org/10.1021/acs.analchem.0c04378
- The Journal of Visualized Experiments (JOVE) article videos can be viewed using the UofT library connection:
  - **https://www.jove.com/v/10496/elisa-assays-indirect-sandwich-and-competitive**
  - **https://www.jove.com/v/5061/the-elisa-method**
  - **https://www.jove.com/v/10491/electrochemical-impedance-spectroscopy**
- Video article on the development of an electrochemical DNA biosensor. https://www.jove.com/v/2922/fabrication-electrochemical-dna-biosensors-for-reagentless-detection
- Video article on the development of an electrochemical DNA biosensor. https://www.jove.com/v/4282/bacterial-detection-identification-using-electrochemical-sensors
- Video article on the development of an electrochemical immunosensor. https://www.jove.com/v/1588/elime-enzyme-linked-immuno-magnetic-electrochemical-method-for

Recommended Websites:

The following websites may be of use to you while preparing for new experiments and writing your formal reports, these links will be also posted on a Quercus course web-page:

- Virtual Textbook of Organic Chemistry http://www.cem.msu.edu/~reusch/VirtualText/intro1.htm
- Interactive Tutorials http://www.cem.msu.edu/~reusch/VirtualText/Questions/problems.htm
- Access to a free copy of ChemDraw – a chemistry drawing software
- https://chemistry.library.utoronto.ca/research/chemdraw

- Proton chemical shifts
  http://www.chem.wisc.edu/areas/reich/handouts/nmr-h/hdata.htm
- Not Voodoo – a site devoted to demystifying the organic chemistry techniques
  http://chem.chem.rochester.edu/~nvd/
- Video on some simple laboratory techniques
  http://webapps.utsc.utoronto.ca/chemistryonline/solubility.html

Method of Evaluation:

Your grade in this course will be determined as follows:

Graded Item	Weight	Comments
Lab Performance	55%	Includes attendance, pre-lab assignments and/or quizzes, pre-lab notebooks, products, performance in the lab – 18.3% for each 4-week module
Lab Reports	30%	Three reports
Oral presentation	15%	Final oral presentation (The students will prepare a 15-min oral presentation in the end of each module. There will be a 5-10 min Question & Answer session following each presentation. Since we have a small class, each student will present individually, not in teams) – 5% for each 4-week module

Accessibility:

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the Access*Ability* Services Office as soon as possible. I will work with you and Access*Ability* Services to ensure you can achieve your learning goals in this course. Enquiries are confidential. The UTSC Access*Ability* Services staff (located in S302) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations (416) 287-7560 or ability@utsc.utoronto.ca.

Academic Integrity:

Academic integrity is one of the cornerstones of the University of Toronto. It is critically important both to maintain our community which honours the values of honesty, trust, respect, fairness and responsibility and to protect you, the students within this community, and the value of the degree towards which you are all working so diligently.

According to Section B of the University of Toronto's Code of Behaviour on Academic Matters http://www.governingcouncil.utoronto.ca/policies/behaveac.htm which all students are expected to know and respect, it is an offence for students to:

- To use someone else's ideas or words in their own work without acknowledging that those ideas/words are not their own with a citation and quotation marks, i.e. to commit plagiarism.
- To include false, misleading or concocted citations in their work.
- To obtain unauthorized assistance on any assignment.
- To provide unauthorized assistance to another student. This includes showing another student completed work.
- To submit their own work for credit in more than one course without the permission of the instructor.
- To falsify or alter any documentation required by the University. This includes, but is not limited to, doctor's notes.
- To use or possess an unauthorized aid in any test or exam.

There are other offences covered under the Code, but these are by far the most common. Please respect these rules and the values which they protect. Offences against academic integrity will be dealt with according to the procedures outlined in the Code of Behavior on Academic Matters.

Statement of Use for Plagiarism Detection:

"Normally, students will be required to submit their course essays to the University's plagiarism detection tool for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the tool's reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of this tool are described on the Centre for Teaching Support & Innovation web site (https://uoft.me/pdt-faq)