



## Bio-Organic Chemistry (CHMC47H3) Fall 2021 Syllabus

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Welcome to Bio-Organic Chemistry. This course covers topics on biologically important molecules such as carbohydrates, proteins, coenzymes, lipids, nucleic acids, steroids, and terpenes. The knowledge gained in this course is applicable in diverse disciplines, including Medicine, Pharmacy, Neuroscience, Biochemistry, and Biology.

Please read through the course syllabus to understand the learning expectations and assessment methods.

### Course Learning Outcomes:

Upon completing this course, students will be able to:

- Understand the applications of chemistry in biological systems.
- Explain the principles of biosynthesis and metabolism of compounds such as steroids, lipids, amino acids, peptides, proteins, vitamins, carbohydrates, and nucleic acids.
- Apply modern organic techniques such as chromatography (TLC and column), separation methods (extraction, recrystallization, etc.), and methods such as UV, IR,  $H^1$  NMR, GC, HPLC spectroscopy, etc.

### Course Instructor & Lab-Coordinator:

Professor Nirusha Thavarajah

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Office Hours: Monday 12:00-1:00 pm, Thursday 1:00-2:00 pm via Zoom and during the labs at EV107 (if not busy)

### Lectures:

LEC01: Tuesday 17:00-18:00 (in-person, AC223) and Friday 9:00-11:00 am ((in-person, AC223)

LEC70: Online Asynchronous, recorded lectures will be posted.

I encourage you to attend the lectures to engage in *active learning activities*.

### Required Text Books:

Customized P.Y. Bruice, Organic Chemistry with Study Guide and Solution Manual. 8<sup>th</sup> ed., Pearson. (You can also use the 6<sup>th</sup> edition of the book and Study Guide).

**Website:** CHMC47H3 maintains a Quercus web space that archives various course-related information including contact information, class announcements, lecture slides, handouts, assigned readings, suggested end-of-chapter problems, laboratory information, assignments, and links to some helpful outside resources. Class emails will be sent periodically to your "utoronto.ca" email account. **To log in**, go to: <https://q.utoronto.ca>. Log in using your UTORid username and password. Then click on the CHMC47H3 link.

**Email Policy:** Please use the following guidelines when sending emails:

- i. Use the "utoronto.ca" account for all CHMC47 correspondence. Emails sent from other accounts are frequently filtered out as spam and may not be received.
- ii. When composing your email, please use professional language. Also, be sure to include the *course code as part of the subject line*.
- iii. Sign the email with your first and last name, as well as your student ID.

Every effort will be made to respond to your emails within 36 Hrs (Monday-Friday), provided the above protocol is followed.

**Announcements:** Official announcements regarding test locations, material covered for each test, and other important announcements will be posted on the CHMC47H3 course website. It is your responsibility to check these postings regularly for important announcements.

**Accessibility:** Students with diverse learning styles and needs are welcome in this course. If you require accommodations for a disability or have any accessibility concerns about the course, the classroom, or course materials, please contact us and or the Accessibility Services as soon as possible: SW 302, (416) 287-7560 or [ability@utsc.utoronto.ca](mailto:ability@utsc.utoronto.ca)

**Active Learning in Bio-Organic Chemistry:**

- b) **Team Concept Maps/Flow Charts:** Students will be assigned to online study groups to create concept maps/ flow charts on the assigned lesson (s). This strategy is intended to teach collaborative learning. Additional details will be posted on the course Quercus.
- c) **Discussions:** Students will be assigned to work in groups to participate in class discussions boards actively.
- d) **Lecture format:** Each lecture will begin with a "**Bridging tool.**" The bridging tool is intended to stimulate your interest and help you see the real-world application of that day's lesson. I use videos, animations, demonstrations, images, and artifacts as bridging tools. Based on the bridging tools, we will have an actively engaging discussion on the **learning objectives** for that day. This is followed by a **pre-assessment discussion question** (5 min) (not for grading) to test your background knowledge on the subject and a **participatory lesson**. Students will be assigned groups to participate in all activities designed for active learning, such as team concept maps/flow charts, the "Chalk Board" game, "Web Quests," and course learning outcome poster at the end of the term. Each lecture will have a **post-assessment (5 min) discussion question** (not for grading) at the end to assess the learning outcomes. The lecture will conclude with a summary of the

lesson and a question in the following lesson. *I strongly encourage all of you to attend all the lectures to engage in the participatory lessons!*

### Assessment and Grading Practices:

Methods of Evaluation	Contribution to the Final Grade
Laboratory* ( <i>Must pass the lab component to pass the course</i> )	30%
Literature Assignment	10%
Oral Group Presentation	5%
Mid-Term Test	15%
Final Exam	40%
TOTAL	100%

\* To pass the course, you **MUST** pass the laboratory and receive a final course grade of 50+.

**Laboratory:** Lab Manual for this course will be posted on the course Quercus page. The introductory part of the Lab Manual explains the format of the labs, lab schedule, and all the other lab-related information. It is your responsibility to read through the lab information and come prepared to do the experiment of the day.

PLEASE NOTE: To provide the latest technology to enhance the student learning experience, UTSC will be charging ancillary fees for all chemistry courses with a laboratory component. Those fees are used to recover the cost of materials and services used during the lab and maintain and upgrade students' equipment. To view a complete list of those fees, students are encouraged to visit the following link:  
[http://www.planningandbudget.utoronto.ca/Assets/Academic+Operations+Digital+Assets/Planning+\\$!26+Budget/2012-13+Category+5+Ancillary+Fees.pdf](http://www.planningandbudget.utoronto.ca/Assets/Academic+Operations+Digital+Assets/Planning+$!26+Budget/2012-13+Category+5+Ancillary+Fees.pdf)

**Literature Assignment and Oral Group Presentations:** A Literature assignment, including an oral group presentation component, will be given to you during the second lab period. A detailed description of the format and submission of the assignment will be posted on the course Quercus page.

### Midterm Test and Final Exam Policy:

**Midterm:** The midterm test is counted as 15% of your courses grade. The midterm exam will be written outside of class time, just before or just after the reading week. The exact date, time, and location will be announced as soon as they are available from the registrar.

**Final Exam:** There is a 3-hour *cumulative exam* during the exam period. The date, time, and location will be announced as soon as they are available. ***Please note that if you miss the Final Exam, you must petition the Registrar's Office to write a deferred exam in the next formal exam period.*** Check the UTSC Calendar for instructions and deadlines.

### **Missed Evaluations (Midterm Test & Assignments)**

Please follow the procedures outlined below for missed term work due to illness, emergency, or other mitigating circumstances for missed term work.

Notes:

- The following reasons are not considered sufficient for missed term work: travel for leisure, weddings, personal commitments, work commitments, human error.
- Missed Final Exams are handled by the Registrar's Office and should be declared on eService: <http://www.utsc.utoronto.ca/registrar/missing-examination>
- Instructors cannot accept term work any later than five business days after the last day of class. Beyond this date, you would need to file a petition with the Registrar's Office:  
<https://www.utsc.utoronto.ca/registrar/term-work>

### **Accommodations for Illness or Emergency, Religious Conflicts**

For missed work due to ILLNESS, EMERGENCY, or RELIGIOUS CONFLICTS please complete the following process:

1. Complete the **Request for [Missed Term Work Form](#)**
2. **Declare your absence** on [ACORN](#) (Profile & Settings > Absence Declaration)

**Deadline:** You must complete the above forms **within 5 business days** of the missed work.

### **Accommodations for Academic Conflicts, Time Zone Conflicts**

For missed term work due to an ACADEMIC CONFLICT (i.e., two quizzes or tests scheduled at the same time), please complete the following process:

1. Complete the **Request for [Missed Term Work Form](#)** choosing "Other" as your reason for missed work and explaining the conflict in the space provided.

**Deadline:** You should report the conflict **at least two weeks (10 business days) before the date of the conflict**, or as soon as possible if it was not possible to identify the conflict earlier.

*Note: Multiple assignments due on the same day are not considered conflicts.*

*Accommodations may only be possible in quizzes and tests that are both scheduled during the same discrete period. Back-to-back tests/quizzes are not considered conflicts.*

*Note: Students are responsible for keeping their course timetables conflict-free. Students who choose to register in two synchronous courses with overlapping lecture/tutorial/lab schedules may not necessarily be accommodated.*

**After submitting your documentation:**

**You are responsible for checking your Quercus course announcements daily, as accommodations may be time-critical.**

You should continue to work on your assignments to the best of your ability, as extension accommodations may be as short as one business day, depending on the nature of the illness/emergency.

Suppose an accommodation has been granted but you are unable to meet the conditions of the accommodation (ex. you need a longer extension, or you missed a make-up test). In that case, you will need to repeat the missed term work procedure and submit additional forms to request further accommodation. Note that an opportunity to write a second make-up test may not be provided in the case of a missed make-up test.

Completion of this form does not guarantee that accommodations will be made. The course instructor reserves the right to decide what accommodations (if any) will be made. However, failure to adhere to any aspect of this policy may result in a denial of your accommodation request.

**Missed Accommodations**

Suppose an accommodation is granted but a continued illness/emergency prevents you from meeting your accommodation requirements. In that case, you must repeat the missed term work procedure to request additional accommodations.

**Academic Integrity:**

Academic integrity is one of the cornerstones of the University of Toronto. Therefore, it is critically important to maintain our community that honors the values of honesty, trust, respect, fairness and responsibility and protects 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 Behavior 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 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 behaviour on Academic Matters.

**CHMC47H3 Lecture Schedule (\*Tentative):**

Week	Subject	Bruice book 6 <sup>th</sup> ed.	Bruice book 7 <sup>th</sup> ed.	Bruice book 8 <sup>th</sup> ed.
1	Carbohydrates	Ch 22	Ch 21	Ch 20
2	Carbohydrates Cont.	Ch 22	Ch 21	Ch 21
3	Amino Acids, Peptides, and Proteins	Ch 23	Ch 22	Ch 25
4	Lipids/Terpenes	Ch 27	Ch 16; 25	Ch 19
5	Heterocyclic Compounds	Ch 21	Ch 20	Ch 19
<b>6</b>	<b>Reading Week (Oct 9<sup>th</sup>-15<sup>th</sup>)</b>			
7	Nucleic Acids	Ch 28	Ch 26	Ch 28
8	Catalysis	Ch 24	Ch 23	Ch 22
9	The Organic Mechanisms of the Coenzymes	Ch 25	Ch 24	Ch 23
10	The Organic Mechanisms of the Coenzymes	Ch 25	Ch 24	Ch 23
11	The Chemistry of Metabolism	Ch 26	Ch 25	Ch 24
12	The Organic Chemistry of Drugs: Discovery and Design	Ch 26 Ch 31	Ch 25	Ch 24 Ch 31

**Lecture Topics and Learning Outcomes:**

- 1. Carbohydrates:** Students will be able to
  - i. Write notations to describe the D and L configurations of monosaccharides.
  - ii. Understand reactions that convert monosaccharides to polyhydroxy aldehydes and polyhydroxy ketones.
  - iii. Describe Killani-Fischer synthesis to increase the carbon chain of an aldose & Wohl degradation to decrease the carbon chain by one carbon.
  
- 2. Amino Acids, Peptides, and Proteins:** Students will be able to
  - i. Explain the mechanics of electrophoresis, paper chromatography, and thin-layer chromatography.
  - ii. Understand the separation of a mixture of amino acids by ion exchange: chromatography and kinetic resolution.
  - iii. Describe automated solid-phase peptide synthesis
  - iv. Distinguish between primary, secondary, and tertiary structures of the proteins.

3. **Lipids/Terpenes:** Students will be able to
  - i. Understand the synthesis of prostaglandins.
  - ii. Distinguish between triglycerols and phosphoglycerols.
  - iii. Explain terpene synthesis.
  - iv. Write down and explain the biosynthesis of cholesterol.
  
4. **Heterocyclic Compounds:** Students will be able to
  - i. Classify primary, secondary and tertiary amines.
  - ii. Understand the electrophilic aromatic substitution of pyrrole, furan, and thiophene.
  - iii. Explain the structure of nucleic acids (DNA and RNA) containing substituted purines and pyrimidines.
  
5. **Nucleic Acids:** Students will be able to
  - i. Understand the primary structure of the nucleic acids.
  - ii. Explain the semiconservative replication of DNA.
  - iii. Write down the transcription code of RNA from a given DNA code.
  - iv. Determine the synthesis of a protein (translation) from a given RNA code.
  
6. **Catalysis:** Students will be able to
  - i. Understand the difference between general-acid catalysis & specific acid catalysis.
  - ii. General base catalysis and specific base catalysis.
  - iii. Explain the difference between a nucleophilic catalyst and an electrophilic catalyst.
  - iv. Understand examples of intramolecular reactions and intermolecular catalysis.
  - v. Identify the factors contributing to the catalytic ability of the enzymes.
  
7. **The Organic Mechanisms of the Coenzymes:** Students will be able to
  - i. Understand the origin of coenzymes.
  - ii. Recognize the role of coenzymes in a variety of roles in biochemical reactions.
  - iii. Explain transamination and transamination reactions.
  
8. **The Chemistry of Metabolism:** Students will be able to
  - i. Explain the catabolic and anabolic reactions in the process of metabolism.
  - ii. Understand phosphoryl transfer reaction and glycolysis.
  - iii. Identify the steps in the citric acid cycle.
  
9. **The Organic Chemistry of Drugs: Discovery and Design:** Students will be able to
  - i. Understand the mechanism of selected drugs.
  - ii. Define therapeutic index of drugs.
  - iii. Explain the process of combinatorial organic synthesis.

**Strategies to Succeed in this Course:**

- Read through the pre-lecture notes before each class to prepare for the lecture.
- You are responsible for reading the recommended sections from your text and bringing an e-copy of the lecture notes to add in-class notes during the class.
- Lectures will be recorded as an additional review material of the content covered.
- Schedule study time every week.
- Do the recommended practice questions every week.
- Participate in lecture discussions.
- Attend office hours.
- Preapre in advance of the lab sections.