

Introductory Chemistry II – CHMA11 Winter 2022

University of Toronto Scarborough

Welcome to Introductory Chemistry II! Chemistry is an exciting subject with far-reaching applications in countless disciplines (biology, medicine, geology, environmental science, materials science, food science, neuroscience, forensics—the list goes on!). CHMA10 might have given you a foretaste, but in CHMA11 we're going to take things further. We'll continue to tackle the fundamentals of the subject, with the goal of making you appreciate the depth and importance of this discipline. Take a few minutes to read through this document, which contains important information and the tools you need to succeed in this course.

Instructors

Prof. Alex Voznyy, EV564 (weeks 1–6)

Email: o.voznyy@utoronto.ca

Discord: <https://discord.gg/xdkrqN3pPt>

Office Hours: Wednesdays 4–5 PM and Fridays 4–5 PM, or any other day by appointment

Prof. Ruby Sullan, EV566 (weeks 7–12)

Email: ruby.sullan@utoronto.ca

Office Hours: Flexible in the afternoons but by appointment. Please email or message via Quercus.

Lab Coordinators

Prof. N. Thavarajah

Monday and **Tuesday** lab Sections

Email: nirusha.thavarajah@utoronto.ca

Office Hours: Monday and Tuesday

11:10-12:00 (will be via Zoom until in-person labs resume)

Link: <https://utoronto.zoom.us/j/>

86891476936 Meeting ID: 868 9147 6936

Passcode: 610032

Prof. M. Zimmer-De Iuliis

Wednesday and **Thursday** lab Sections

Email: m.zimmer.deiuliis@utoronto.ca

Office Hours: TBA

Required Textbook

CHEMISTRY: A Molecular Approach, 3rd Canadian Edition, by Nivaldo J. Tro, Travis D. Fridgen, Lawton E. Shaw, Pearson Canada Inc.

Lecture Schedule

Note that until further notice, all lectures and labs in CHMA11 will be given online until January 31st, 2022.

LEC01: Monday, Wednesday, Friday in AC223, 12:00–13:00

LEC02: Monday, Wednesday, Friday in AC223, 13:00–14:00

Course Schedule

Week	Dates	Topic(s)	Suggested Reading
1	Jan 10–14	Solutions	12.1–12.7
2	Jan 17–21	Chemical Equilibrium	14.1–14.8
3	Jan 24–28	Acids and Bases	15.1–15.6
4	Jan 31–Feb 4	Acids and Bases cont.	15.7–15.11
5	Feb 7–11	Aqueous Ionic Equilibria	16.1–16.4
6	Feb 14–18	Aqueous Ionic Equilibria cont.	16.5–16.8
7	Feb 21–25	Reading Week	N/A
8	Feb 28–Mar 4	Gibbs Energy and Thermodynamics	17.1–17.5
9	Mar 7–11	Gibbs Energy and Thermodynamics cont.	17.6–17.9
10	Mar 14–18	Electrochemistry	18.1–18.4
11	Mar 21–25	Electrochemistry cont.	18.5–18.8
12	Mar 28–Apr 1	Chemical Kinetics	13.1–13.4
13	Apr 4–Apr 8	Chemical Kinetics	13.5–13.7
14	Apr 9–12	Study Break	
15	Apr 13–29	Final Exam Period	

Website

Check Quercus (<https://q.utoronto.ca>) for important announcements, updates to readings, assignment topics, requirements, and evaluation, etc. Students are responsible for checking the course website regularly. Make sure that your ".utoronto" emails can accept the course announcements.

Discord channel

You are strongly encouraged to join the UTSC CHM Discord server which provides up to date information for ALL chemistry courses at UTSC.

<https://discord.gg/xdkrqN3pPt>

Examinations

Midterm:

There will be **two 90-minute mid-term tests** written outside of class time. The exact dates, times and locations will be announced as soon as they are available. If you miss the mid-term due to a legitimate reason, you must submit appropriate documentation within one week of your absence, then, the weight of the midterm mark would be transferred to the final exam. If the reason is medical, an official UTSC medical form should be downloaded from the Registrar's website: http://www.utsc.utoronto.ca/~registrar/resources/pdf_general/UTSCmedicalcertificate.pdf and completed and signed by your physician. Students will not be permitted to write a make-up exam. If no acceptable documentation is received, you will receive a grade of zero for that test.

Final Examination:

There will be a **3-hour, cumulative exam** written during the end of semester exam period. The exact 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 make-up exam in the next formal exam period. E.g. for a missed April Final Exam, the make-up Exam is in August. Your documentation is crucial for a successful petition and must be submitted by the last day of the exam period. Check the UTSC Calendar for instructions and deadlines.

Laboratory Component of CHMA11H3

*****You must receive a passing grade in the laboratory section to pass the course*****

The goals of the lab program are to train you on safe laboratory practices and help you understand the fundamental chemistry laboratory techniques. The laboratory modules are designed to navigate you through safety training and experiments. The experiments are designed to teach fundamental lab techniques that lay a strong foundational knowledge for students to apply the techniques in upper-level chemistry courses.

The theory required to understand the experiments are directly or indirectly connected to the first-year chemistry content. Therefore, as part of the pre-lab work, **you may be expected to read a recommended section from the textbook**. It is **mandatory** to pass the lab component of the course to be eligible to pass the course. The lab component is worth 25% of your course grade.

Lab Schedule

The first experiment will be done online. The Synchronous Online Laboratory periods are three hours in length and run every other week. Updates on the lab format (in-person or online) of the remaining experiments will be announced at a later date.

Rotation 1: ODD numbered practicals (Week 1 students) have their first lab during **week of January 17th**.

Rotation 2: EVEN numbered practicals (Week 2 students) will have their first lab the **week of January 24th**.

Lab Coordinators

Prof. N. Thavarajah for **Monday** and **Tuesday** lab Sections

Email: nirusha.thavarajah@utoronto.ca

Office Hours: Monday and Tuesday 11:10-12:00 (will be via Zoom until in-person labs resume)

Office Hours Zoom Link:

<https://utoronto.zoom.us/j/86891476936>

Meeting ID: 868 9147 6936

Passcode: 610032

Prof. M. Zimmer-De luliis **Wednesday** and **Thursday** lab Sections

Email: m.zimmer.deiuliis@utoronto.ca

Office Hours: TBA

Structure of the Synchronous Online Lab Sessions (From January 17th- January 28th)

The synchronous session of the virtual lab will commence 10 min past the hour of the scheduled time for your practical on a Zoom link (the list of Zoom links with PRA section number will be available posted under the lab introductory module). You are encouraged to arrive on time for your assigned session. The synchronous laboratory periods are **3 Hrs. in length** and run every other week. If you are unable to attend the synchronous lab session during the scheduled hours, you can watch the recorded sessions after every lab to follow up with the instructions and complete the assigned tasks.

The **first 50 minutes** of each lab period will be spent on discussing theory, procedure, and calculations pertaining to the lab. In the **second hour of the labs**, the students will be asked to work on their experiment in the virtual lab environment **Ladderane**. While working in the Ladderane virtual lab environment, if students have any questions, the Teaching Assistants (TAs) will be available to help on the Zoom Link during the synchronous lab hours. It is advisable that students open the Ladderane by opening a second browser. This way students can remain logged into the lab Zoom link with their TAs presence while working on the Ladderane platform. The Ladderane virtual environment will be opened to students during the 3.0 Hr synchronous **lab**

time on the day of the registered practical session. Students must finish their Ladderane virtual lab during their given time slot to obtain their lab results and record them in their notebook report template. These results will be used to complete the post-lab report sheet.

The last hour of the lab session will be used for Teaching Assistants' office hours. Students are encouraged to attend the office hours to have all their questions pertaining to the virtual labs answered. If they don't have any questions, they can continue completing their Ladderane virtual lab assignment. Students who cannot attend the synchronous TA office hours due to time zone differences are encouraged to post their questions on the lab discussion board for the TAs to be answered during the official contact hours.

Structure of Lab Modules Organization on Quercus

The CHMA11H3 lab content is organized as the following modules on Quercus:

Lab Module 1 introduces the students to the organization of the labs, schedule, Zoom link list for the practical sections, preparation instructions, assignment description, assessment criteria and lab policies.

Lab Module 2 is dedicated to explaining safety policies and practices in first-year undergraduate labs.

Lab Module 3 contains the list of zoom links for all the practical sections and session recordings

Lab Module 4 is designed to introduce **Ladderane Virtual Lab Platform**, and practice Ladderane experiments for students to try out before their first official Ladderane experiment.

Lab Modules 5-8 will be dedicated to the individual experiments.

Lab Assessment Components

Each experiment module on Quercus has the following Assessment components:

- 1. Pre-Lab quiz:** The pre-lab quizzes are released 3 days before the labs and students have two 20 minutes attempts. The pre-lab quizzes have 3 questions, reflecting on the pre-lab reading and questions that students must do before the lab. **Do not wait until the last minute to do your quizzes.**
- 2. Ladderane:** Students will complete the Ladderane virtual experiment for the **instructed labs** on the link provided under the respective experimental module. The Ladderane virtual environment will be opened for all students during their 3.0 Hrs. scheduled lab period. Students must finish their Ladderane virtual lab during their lab slot to obtain their results and record them in their notebook report to do the calculations. These results will be used to complete the post-lab report sheet.
- 3. Notebook Report:** For the first four experiments students will have 2 weeks to complete their *notebook report template* from the day of their lab session. The last lab notebook report will be due within one week from the day of their last lab session. At the end of the term, the TAs will select one notebook report randomly out of 5 experiments to grade. All documents must be uploaded as a **PDF** file for grading purposes. ***Do not** wait until the last minute to submit your assignments.
- 4. Post Lab Report Sheet:** For the first four experiments students will have 2 weeks to complete their Post lab report sheet template from the day of their lab session. The last

post-lab report sheet will be due within one week from the day of their last lab session. All documents must be uploaded as a **PDF** file for grading purposes. ***Do not** wait until the last minute to submit.

Laboratory Marking Scheme

The laboratory component is worth 25% of your final grade. The laboratory component is marked out of 100 total marks.

	% of final grade	Marks
Pre-Lab Quizzes (5 in total)	7.5%	6 marks (× 5)
Post-Lab Report Sheet (5 in total)	12.5%	10 marks (× 5)
Lab Notebook Report (5 in total)	5%	20 Marks
Total Marks:	25%	100

*****You must receive a passing grade in the laboratory section to pass the course***

Lab Safety

Safety in the laboratory is an extremely important element in the chemistry program at UTSC. Failure to follow safe practices can cause laboratory accidents which may result in personal injury, injury to others, the loss of time, and damage to property. By following suitable precautions, you can anticipate and prevent situations that would otherwise lead to accidents.

Even though, you are not attending the first lab practical in person this academic term, it is mandatory that you understand the safety lab practices to apply them in future chemistry labs. Students registered in CHMA11H3S will be automatically enrolled in the WHMIS Training course. Once the WHMIS course is made available, an email announcement will be sent and a link to the course will appear in your Quercus home page. As part of this course, you will be expected to watch a couple of safety videos (approximately 90 minutes long in total) and take a multiple-choice quiz on the information covered in the videos. You must obtain 80% on the quiz to pass the WHMIS course. **In addition, you will be required to print off a PDF copy of your quiz results and upload it into the "WHMIS Results Submission" folder under the Lab Module 2.**

Absence from the Synchronous Lab Session

If you are unable to attend the synchronous lab session online due to time zone difference or for any other valid reason you must give ahead notice to the Lab Coordinators: Prof. N. Thavarajah (nirusha.thavarajah@utorontoca) for students who are enrolled in Monday and Tuesday lab sections & Prof. M. Zimmer-De luliis (m.zimmer.deiuliis@utoronto.ca) for students who are enrolled in Wednesday and Thursday lab sections.

*You are responsible for watching the recorded lab sessions and completing the experimental modules on time to meet the due dates in **Eastern Standard Time (EST)**. There are no make-up lab sessions.

Accommodations for Illness or Emergency, Religious Conflicts

For missed lab submissions 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 to be considered as a late submission.

If a post lab assignment is missed and no reasonable explanation or supporting documentation are provided, there is a penalty of 10% per day which will be applied.

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. Failure to adhere to any aspect of this policy may result in a denial of your request for accommodation.

Students must complete all components of **at least 3 out of the 5 lab modules** in order to be eligible to pass the course.

- If a student misses one experiment module assessment (pre & post), and provides appropriate documentation, late submission will be considered.
- If a student misses two experimental modules assessments (pre & post), and provides appropriate documentation, late submission will be considered.
- **If a student misses a third experimental lab module, even if they provide appropriate supporting documentation, they will automatically fail the lab component and therefore will automatically fail the course.**

Peer Facilitator Program: Facilitated Study Group (FSG) is being run through the Centre for Teaching and Learning. These weekly sessions are open to all students taking this course who want to improve their understanding of course material, improve their study techniques, and improve their grade. Attendance is voluntary. In these sessions you will compare notes, discuss important concepts, develop study strategies, and prepare for exams and assignments on course material. Course material is NOT re-lectured. The FSG's are led by a trained facilitator who has previously taken the course. A survey will be taken during the first week of class to determine the best days and times for most students, and they will begin probably the 2nd or 3rd week of class. Please be sure to fill out the survey in the first week of class to help ensure the study groups are scheduled at optimal times. If you have any questions, please ask your facilitator, or visit the FSG website at <http://ctl.utoronto.ca/home/fsg>.

Please note that FSGs will NOT give out answers to any lab assignments.

Evaluation

Your final grade in the course will be calculated according to the grading scheme below:

Course Component	Percentage
Laboratory*	25%
Writing Assignment	15%
Problem Set Homework	5%
Mid-Term Test 1**	8%
Mid-Term Test 1**	12%
Final Exam	35%

*To pass the course, **you must pass the laboratory and either the term test or the final exam** (and receive a final grade of 50+, of course!)

**The test with the higher mark will be taken for 12%

Calculators: Only non-programmable, non-communicating calculators are allowed in tests and exams for this course (both lecture and lab). Invigilators have the authority to check calculators and to confiscate illegal models. Students who have illegal calculators confiscated during a test/exam will be supplied with an allowed calculator but an immediate penalty of 10% will be imposed for that test/exam. Students without a calculator will also be allowed to borrow an allowed model, but at the cost 10% off their mark on that test/exam.

WRITING ASSIGNMENT: Peer Reviewed Mock Journal using PeerScholar

Not only do we want everyone to be comfortable with communicating through emails, but we also want to support your writing skills in the context of chemistry. You will be asked to write an essay with the goal of exploring modern topics in chemistry. You will learn how to utilize both UofT Library resources and Web of Science while also training your writing skills. You will convey your research and learning on your topic in the form of a peer-reviewed 500-word essay.

Several of you may have completed a similar assignment during CHMA10 in the fall of 2021. For this assignment, the expectations have changed. In CHMA12, we ask that you follow an **analytical approach**. This will be slightly different from what you have experienced in CHMA10, where you wrote a *descriptive style* essay. For an **analytical essay** you will be focusing on one chemistry-related challenge in a topic/field of interest and describing one solution found in recent literature. You will find this style of writing in the introduction or discussion section of peer-reviewed journal articles that you are using to support your essay. Please note you **MUST** submit a draft essay to participate in the feedback process of this assignment. Failure to do so will result in you forfeiting 4% of the overall course grade.

****Please note that the topics in this essay are different from CHMA10 so please do not submit the same essay from CHMA10. It is an academic offense to re-submit work from other courses, so please take this as an opportunity to explore another topic that may be of interest to you. ****

The peer-review process is the cornerstone of writing and communicating new results and ideas in the sciences. A part of this process heavily depends on you! You will be asked to apply critical thinking skills to give and receive feedback to fellow colleagues. You will experience this process while doing this assignment by using PeerScholar and online learning modules that will guide you throughout the various components of the assignment. The online learning modules are available throughout the course and are not for marks but rather are made available for your reference. The assignment will be worth 12% of your final grade. Below are the due dates and breakdown of those marks:

January 17 @ 9:00 am EST - April 5th @ 9:00 am EST	Online modules available for your reference
January 17 @ 9:00 am EST - February 14 @ 2:00 pm EST	Draft Essay Submission is Available
February 14 @ 2:00 pm EST	Deadline (DUE DATE) for submitting first draft of your essay (on peerScholar) NOTE: You MUST submit a draft to be able to complete the peer feedback component.
February 16 - 23	Time for providing peer feedback
February 28 @ 2:00 PM EST	Deadline (DUE DATE) for submitting peer feedback (on peerScholar)
March 2 @ 9:00 EST - March 9	Revise essay
March 9 @ 2:00 PM EST)	Deadline (DUE DATE) for submitting final draft of your essay (on peerScholar and Ouriginal)
Essay and Feedback	
	Weight (%)
Final essay	10
Quality and participation in the peer-feedback process	5
	Total = 15%

You can find more details about the writing assignment on the CHMA11 Quercus page.

Cell Phones: During lectures and labs please put your cell phones in silent mode to avoid disruption. If circumstances warrant use of your cell phone and you must receive an emergency call, please inform the Course Instructor at the beginning of the session in advance and then excuse yourself from the session to respond to the call outside the lecture hall or laboratory.

Academic Calendar: Further information about academic regulations and course withdrawal deadlines can be found in the UTSC Calendar. You are encouraged to read this material.

Centre for Teaching and Learning: If you need assistance with effective writing skills, study skills, exam preparation, note taking, or time management, free workshops and advice are available from the Centre for Teaching and Learning, which can be reached at:

<https://www.utsc.utoronto.ca/ctl/student-support>

Math & Statistics Learning Centre is now offering help with any sort of questions you may have related to mathematics and statistics. The CHMA11 course involve advanced math skills. If you are having difficulties or need some refresher, you are encouraged to drop in at AC312 and use the available general help hours. The schedule can be viewed at the link: <http://ctl.utsc.utoronto.ca/mslc/>

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 us and/or the AccessAbility Services Office as soon as possible, <https://www.utsc.utoronto.ca/~ability/>. We will work with you and AccessAbility Services to ensure you can achieve your learning goals in this course. Enquiries are confidential. The UTSC AccessAbility Services staff (located in AA142) 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 important to maintain our community which honours the values of honesty, trust, respect, fairness and responsibility and to protect you and the value of the degree towards which you are all working so diligently.

It is an offence for students 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
- Include false, misleading or concocted citations in their work.
- Obtain unauthorized assistance on any assignment
- 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.- eg: doctor's notes.
- To use or possess an unauthorized aid in any test or exam.

There are other offences under the Code, but these are the most common. Please respect these rules. Offences will be dealt with according to the procedures outlined in the Code of Behaviour on Academic Matters.

ClutchPrep homework:

Throughout the course, you will be assigned a set of questions through the Clutch Prep platform. Clutch Prep includes video lessons and video homework assignments. These problems are intended to help you practice the skills and concepts taught during lecture.

To sign up for our class and register your account, go to <https://www.clutchprep.com/join/VOZNY3> and enter the class code: **VOZNY3**. Then follow the prompts to enter your name, email address, and create a password. Guidelines for registering can also be found on the CHMA11 Quercus page. **For technical support, please DO NOT contact Ruby Sullan, Alex Voznyy, Marco Zimmer-De Iuliis, or Nirusha Thavarajah.** You should contact Clutch directly. These assignments are worth 5% of your final grade.

Our class will be using **Clutch Prep homework assignments** for graded homework. Every question on your homework assignments comes with a video solution. You will get credit based on answering the problems and watching the video solutions.

Clutch Prep Technical Difficulties or Account Questions: If you run into any technical issues or have questions about your Clutch Prep account, message the Clutch Prep Customer Service using the blue help chat button in the bottom right corner of the screen. This will be the fastest and most effective way to resolve your issues.

The help button looks like this:



11

Below is a list of topics that will be covered in this course, along with the corresponding chapters and learning outcomes.

- 1. Solutions Chemistry (Chapter 12):** through this section, we will...
 - Discuss the interplay between intermolecular forces (CHMA10) and solubility when preparing solutions
 - Consider the factors that affect solubility
 - Quantify the solubility of gases at different pressures (Henry's Law)
 - Compare the influence of colligative properties on physical properties
 - Distinguish the difference between solutions and colloids
- 2. Chemical Equilibrium (Chapter 14):** in this section, we will...
 - Be introduced to the concept of dynamic equilibrium and learn ways of quantitatively expressing equilibrium
 - Practice applying the equilibrium expressions to quantify the amounts of products and reactants in a reaction

- Practice predicting the direction in which a reaction will proceed by comparing the reaction quotients with equilibrium constants
 - Discuss how we can predict how a system at equilibrium will respond to disturbances (Le Chatlier's principle)
- 3. Acids and bases (Chapter 15):** in this section, we will...
- Define various ways of describing acids and bases (Arrhenius, Bronsted-Lowry, Lewis)
 - Quantify the strength of acids and bases through ionization constants (K_a)
 - Quantify the strength of acids and bases using pH and pOH
 - Relate pH for weak acids and bases with equilibrium constants
 - Consider pH and K_a for polyprotic acids
 - Relate the strength of acids to molecular composition and structure
- 4. Aqueous Ionic Equilibria (Chapter 16):** in this section, we will...
- Describe how buffers are prepared and understand how they function
 - Calculate the pH of buffers using the Henderson-Hasselbalch equation
 - Quantify the effectiveness of buffers
 - Introduce titration and applications with acids and bases
 - Practice how titrations can be monitored by calculating the pH during acid base titrations
- 5. Thermodynamics (Chapters 6 and 17):** in this section, we will...
- Describe and apply the First, Second, and Third Laws of Thermodynamics
 - Relate heat, work, and energy
 - Discuss enthalpy and application of Hess's Law
 - Introduce entropy, spontaneity, and consider the ways in which energy can be distributed
 - Relate entropy and enthalpy
 - Introduce Gibbs energy
 - Differentiate how entropy, enthalpy, and temperature contribute to Gibbs energy (under standard and non-standard conditions)
 - Apply Gibbs energy under equilibrium and non-equilibrium conditions
- 6. Electrochemistry (Chapter 18):** in this section, we will...
- Discuss how energy and electricity can be generated from spontaneous chemical reactions
 - Revisit redox reactions and applications in electrochemical cells
 - Practice calculating standard potentials for electrochemical cells
 - Relate spontaneity with cell potentials and predict spontaneous redox reactions
 - Relate cell potential to Gibbs energy and equilibrium constant
 - Calculate cell potential under nonspontaneous conditions (Nernst equation)
- 7. Chemical Kinetics (Chapter 13):** in this section, we will...
- Quantify reaction rates and relate to concentration of reactants using rate laws
 - Discuss zero, first, and second order reactions and derive integrated rate laws

- Practice applying rate laws
- Discuss how reactions can be depicted using energy diagrams and define relevant components
- Analyze kinetic data using Arrhenius plots
- Discuss the importance of elementary steps and relate to reaction mechanisms
- Discuss how catalysis relates to kinetics