

Introductory Chemistry II – CHMA11 Winter 2023

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.

Lecture Professors:

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.

Lab Professor:

Prof. Nirusha Thavarajah, SW155

Email: nirusha.thavarajah@utoronto.ca

Office Hours: Tuesdays 12-2 pm and by appointment

Lab Coordinator:

Ms. Veronica Cavallari, SW 155A

email: veronica.cavallari@utoronto.ca

Lecture Schedule

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

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

Required Textbook

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

Course Schedule

Week	Dates	Topic(s)	Suggested Reading
1	Jan 9–13	Solutions	12.1–12.7
2	Jan 16–20	Chemical Equilibrium	14.1–14.8
3	Jan 23–27	Acids and Bases	15.1–15.6
4	Jan 30–Feb 3	Acids and Bases cont.	15.7–15.11
5	Feb 6–10	Aqueous Ionic Equilibria	16.1–16.4
6	Feb 13–17	Aqueous Ionic Equilibria cont.	16.5–16.8
7	Feb 20–24	Reading Week	N/A
8	Feb 27–Mar 3	Gibbs Energy and Thermodynamics	17.1–17.5
9	Mar 6–10	Gibbs Energy and Thermodynamics cont.	17.6–17.9
10	Mar 13–17	Electrochemistry	18.1–18.4
11	Mar 20–24	Electrochemistry cont.	18.5–18.8
12	Mar 27–Mar 31	Chemical Kinetics	13.1–13.4
13	Apr 3–Apr 7	Chemical Kinetics	13.5–13.7
14	Apr 10–14	Study Break	
15	Apr 17–21	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

The primary goal of the CHMA11H3 laboratory program is to teach the applications of knowledge from the lecture component of the course. Therefore, the experiments are carefully designed to reflect the lecture content, and pre-lab readings are assigned to relate the relevant theory to each experiment.

The first-year chemistry laboratories are located in the basement level of the Science Wing in Rooms SW153 and SW159. The **laboratory check-ins** will begin on the hour for the first 10 minutes, and the lab demonstration talk will take place 10 minutes past the hour. Therefore, please arrive on time to have your pre-lab work checked.

The laboratory periods are three hours in length and run every other week. The lab component of the course is **compulsory**, and students must obtain a passing grade in the lab section to be eligible to pass the course. The lab component is **worth 25%** of your course grade. A more detailed explanation of the evaluation scheme can be found on page 9 of this manual.

LABORATORY SECTION SCHEDULE

Week 1 lab students

Students assigned to practical sections ending in **odd numbers (i.e., P0001, P0003, P0005, P0007)** have their first lab during the **week of January 16th**.

Week 2 lab students

Students assigned to practical sections ending in **even numbers (i.e., P0002, P0004, P0006, P0008)** have their first lab during the **week of January 23rd**.

LABORATORY SCHEDULE

Week of	Week #	Experiment
January 16 th	1	EXP 1: Expression of Solution Concentrations
January 23 rd	2	
January 30 th	1	EXP 2: Chemical Equilibrium - Application of Le Châtelier's Principle
February 6 th	2	
February 13 th	1	EXP 3: Determination of the Acid Ionization Constant of Acetylsalicylic Acid
February 18th- 24th Reading Week		
February 27 th	2	EXP 3: Determination of the Acid Ionization Constant of Acetylsalicylic Acid
March 6 th	1	EXP 4: Determining the Buffer Effectiveness
March 13 th	2	
March 20 th	1	EXP 5: A Common Ion Effect on Solubility
March 27 th	2	

LAB SKILLS SEMINARS

Recorded lab skills seminars by Professor Nirusha Thavarajah for each lab will be posted on Quercus under the lab modules. Watching the recorded lab skills sessions is a **mandated** component of preparing well for your **pre-lab quizzes** and experiments. The lab skills sessions will cover the **pre-lab work expectations, procedures, techniques, and post-lab work requirements** for each lab.

ABSENCE FROM THE LABORATORY

Accommodations for Illness or Emergency, Religious Conflicts

For missed labs and lab submissions due to ILLNESS, EMERGENCY, or RELIGIOUS CONFLICTS, please complete the following process:

1. Complete the **Request for Missed Term Work Form**_(Link is posted under the lab introductory module on course Quercus website)
2. **Declare your absence** on **ACORN** (Profile & Settings > Absence Declaration)

If you provide appropriate reasoning for missing your scheduled lab session, you may be eligible to join a make-up lab session, pending available lab space. If you fail to notify the day of your absence, you will **NOT** be eligible for consideration for accommodation.

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 penalty of 10% per day 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.

If a student misses a lab and provides no reasonable explanation or supporting documentation, a mark of zero will be assigned.

Students must attend at least 3 out of the 5 scheduled experiments in order to be eligible to pass the course.

- If a student misses one experiment, and provides appropriate documentation, they will be considered for a make-up lab for that experiment.
- If a student misses a second experiment, and provides appropriate documentation, they will be considered for a make-up lab for that experiment.
- **If a student misses a third experiment, even if they provide appropriate supporting documentation, they will automatically fail the course.**
- If you miss a lab when you are required to hand in material for marking (i.e., Report Sheets), the original report sheet or a scanned copy must be submitted to the Lab Coordinator (Ms. Veronica Cavallari) within 48 hours of the missed lab. Standard late penalties (**i.e. 10% per day up to 5 days - material submitted after 5 days will be assessed a grade of zero**) will be applied to material submitted after the 48 hr. deadline.

LATE POLICY

- If you are late to your lab, but the pre-lab discussion is still underway, you will be allowed to participate, given that you have complete all the pre-lab work.
- If you are more than 30 minutes late for your lab you **WILL NOT BE ALLOWED TO PERFORM THE EXPERIMENT AND A MARK OF ZERO WILL BE ASSIGNED FOR ALL OF THE COMPONENTS ASSOCIATED WITH THAT LAB SESSION.**
- If you show up to the lab without completing your pre-lab work in your notebook, you **WILL NOT BE ALLOWED TO PERFORM THE EXPERIMENT AND A MARK OF ZERO WILL BE ASSIGNED FOR ALL OF THE COMPONENTS ASSOCIATED WITH THAT LAB SESSION.**

LATE PENALTIES

- Report Sheets
 - 10% of the total (not your grade) per day for 5 days (weekends count as two days unless you email a scanned copy of it to the lab coordinator).
 - After 5 days a grade of zero will be assigned
- Notebooks

- Your notebook will be graded on a regular basis during lab time; your assessment will include prelab preparation and in-lab performance. Refer pages 10-12 for details on lab notebook preparation and assessments.

LABORATORY MARKING SCHEME

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

Assessment Methods	% Of final grade	Marks
Quiz (available online 3 days before your lab):	7.5%	6 marks (x 5)
Report Sheets/Graphs/Products:	12.5%	10 marks (x 5)
Lab Notebooks	5.0%	4 marks (x 5)
Total Marks:	25%	100

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

Ancillary Fees: You will be assessed a \$20.00 ancillary fee which will cover the cost of chemicals, filter paper, Pasteur pipettes and other items consumed over the course of the lab. For more information regarding ancillary fees students are encouraged to visit the following website: <http://www.planningandbudget.utoronto.ca/tuition.htm>

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 2***	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!)

**5% for your Feedback to your peers and 10% for the Final Essay

***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 2022. 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 16 @ 9:00 am EST – April 4th @ 9:00 am EST	Online modules available for your reference
January 16 @ 9:00 am EST – February 13 @ 2:00 pm EST	Draft Essay Submission is Available
February 13 @ 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 15 – 22	Time for providing peer feedback
February 27 @ 2:00 PM EST	Deadline (DUE DATE) for submitting peer feedback (on peerScholar)
March 1 @ 9:00 EST – March 8	Revise essay
March 8 @ 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.

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 Chatelier'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