

Faculty of Science Course Syllabus**Department of Chemistry***Chemistry 2201A**Introductory Analytical Chemistry**Fall, 2022*

Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq.

We are all Treaty people.

Lecturer: Dr. Alan Doucette Chemistry, Room 509 e-mail: alan.doucette@dal.ca
Lab instructor: Dr. Rory Chisholm Chemistry, Room 109 e-mail: roderick.chisholm@dal.ca

Teaching Assistants: Jessica Nickerson, Hammam Said, Teresa McMillen, Berna Macin, Ziheng Dang,
Patrick Giesbrecht

Lectures: MWF 10:35-11:25, Chemistry Room 226.

Laboratories: Weekly 4-hour labs, starting September 12, Chemistry Rooms 111-114P.

Tutorials/Help: Lecture help: Tues/Thurs 1:00 – 2:00 pm, (in Chem Room 223 & Online via Teams)
Lab help: M 11:30 am -12:30 pm, Th 2:00-3:00 pm (in Chem Room 111-114p)

Course Delivery: Lectures: Blended (in person or online). Labs will exclusively be delivered in-person

Course Description (from calendar)

The basic principles of analytical chemistry are presented, including chemical and instrumental methods of analysis. Instrumental techniques covered include chromatography, spectroscopy, and electrochemistry. Laboratory experiments explore all of these topics, and illustrate the techniques with practical examples.

Course Prerequisites

CHEM 1011/1012 or equivalent with a grade of C- or better.

Learning Objectives

- To acquire an understanding of the scope and practice of analytical chemistry.
- To develop skills for the treatment and interpretation of chemical measurements, including statistical analysis, error propagation, graphical representation, and linear regression.
- To become proficient in operational skills and calculations associated with volumetric, gravimetric, and instrumental procedures in the laboratory, including titrations and instrument calibration.
- To be able to carry out calculations involving chemical equilibria and appreciate their implications for analytical chemistry.
- To develop an understanding of the principles and application of key instrumental methods that include spectrophotometry, potentiometry and chromatography.
- To appreciate safe working practices within a chemistry laboratory.

Course Materials

Textbook: "An Introduction to Analytical Chemistry", Edition 8.1 by Ramaley, Wentzell, Doucette and Guy (required). Available as (free) downloadable pdf file from course website (Brightspace).

Laboratory Manual: Available from lab course space (Brightspace) as a free downloadable pdf file.

Laboratory Notebook: For recording details and data during labs (hardcover required).

Technology: Laptop/desktop computer with webcam/microphone if online course participation is intended; memory drive for saving laboratory data.

PPE: Approved safety glasses and lab coat are required to work in the lab. Bring a sharpie marker to lab

Web Site

The lecture and lab portions of the course are separately presented on Brightspace sites. Please consult each site on a regular basis. There is also a site for the Laboratory Safety Module.

Office Hours

Tutorial/Help sessions will double as Office Hours. See the information at the top of page 1 for lecture (A. Doucette) and lab (R. Chisholm) help.

Individual appointments can also be arranged on request (in-person or by e-mail).

Course Assessment ^A

<u>Component</u>	<u>Weight</u>	<u>Date(s)</u>
Term Test #1	12% ^B	Monday, October 3, in class
Term Test #2	12% ^B	Wednesday, November 2, in class
Term Test #3	12% ^B	Wednesday, November 30, in class
Self Reflection	4% ^C	Twice, following Term Test 1 & term Test #2
Lab Reports	20% ^D	~Weekly (8 total @ 2.5% per)
Prelab	3% ^E	Weekly, at beginning of your scheduled lab
Notebook	2% ^F	Twice throughout term (unannounced)
Lab Skills Test	5% ^G	During your scheduled lab, week of Oct 31-Nov 4th
Final exam	30% ^H	Scheduled by Registrar

Notes and Policies on Course Assessments:

^(A) **Assessment components** (dates, weight, and delivery) are subject to change should the course be affected by partial or temporary school closures or cancellations. For example, if a university closure or employee strike prevents access to laboratories, resulting in a missed week of experiments that cannot be rescheduled, the associated lab report (normally worth 2.5%) will be excluded from the grade total. The remaining assessment components (now totalling 97.5 points) will be scaled to 100%.

Please note that the total weight of lab assessments adds to 30% of this course. This large value reflects the importance of analytical lab techniques in this discipline. However, there is no assumed policy that a student must pass the lab to pass this course (or any other specific assessment component). However, the student must pass each of the 5 lab skills tests to pass the course (see 'G' for details).

- ^(B) **Term tests** are also offered at a makeup time, each scheduled for the following day, 3-4pm. Any student can request to write their test during this makeup time (for whatever reason). If the student cannot attend the makeup (nor the original test time) due to illness, it is at the instructor's discretion to prorate marks onto other assessment components, or to schedule another makeup test. Please consult the policies on illness in this syllabus.

Term tests and final exam emphasize both qualitative and quantitative information, including material not directly covered during lecture, but available from other course resources such as the textbook and/or videos. Analytical Chemistry emphasizes problem solving skills. As such, test questions may appear different than those problems provided in the course.

Note that all three test scores will be used to calculate the final grade. There is no 'drop your lowest score' associated with these tests.

- ^(C) **Self reflection** will consist of a short writing exercise, with feedback and group discussion provided by your peers. Details will follow later in the term.

- ^(D) **Lab reports** are due 1 week after completion of the lab, before 11:59pm. For example, if you are in the Monday lab, your reports are always due (on or before) the following Monday evening, 11:59pm. While students may potentially work within the lab in groups, each student must independently submit their own report. Reports are to be submitted as a single pdf file, uploaded through the lab course Brightspace Dropbox. Non-visible or multiple image submissions will not be evaluated.

Except under extenuating circumstances, late reports will not be accepted, and will receive a grade of zero. Students wishing to submit a late lab report must contact the instructor within 24 hours of their original submission deadline to explain their extenuating circumstance and request up to a 1-week extension. An extension may be granted at the instructor's discretion on a case-by-case basis.

There are 9 lab reports available in this class; only your top 8 report grades will be kept, meaning your lowest scoring lab will be dropped. Failing to complete a lab experiment, or to hand in a lab report has no effect on these rules. If you chose to attend only 4 labs, your grade will simply reflect a lower score. Please consult the policy on missed labs due to illness.

- ^(E) **Prelab questions** will be evaluated at the start of the lab; late arrivals will not be evaluated and will receive a grade of zero. Students should have written their answers to prelab questions in their notebook (showing all of your work). As with the reports, the best score from 8 of 9 prelab questions will be retained. Please consult policy on missed labs for illness.

- ^(F) **Lab Notebooks** and proper notetaking are critical components of any chemistry laboratory. Detailed instructions on expectations for maintaining lab notebooks are provided on the lab course Brightspace site. Student notebooks will be evaluated in lab by the instructor or TA two times throughout the term. You will not know what day your notebook will be evaluated, so you must be always prepared.

- ^(G) **Lab skills test** takes place over a 1-hour period during your normal lab, the week of Oct 31-Nov 4. Students are individually assessed on 5 independent activities: (1) quantitative transfer, (2) dilutions, (3) titrations, (4) buffers and (5) graphing. Each activity has a 10 min time limit and is graded as Pass/Fail (+1 mark / 0 marks), based on the student's competence in performing the activity

according to a predefined checklist (will be known to the student). A 'pass' means the student has completed all aspects of that assessment as described on the checklist. If the student does not initially pass a given activity, they will have another attempt (without penalty) at a later date (schedule begins the following week; reading week). If a given activity is not passed after that redo, the student will receive a grade of zero for that activity. At this time, the student will be required to meet the instructor for follow-up training and discussions to ensure these skills have been demonstrated before the end of term, and subsequently 'pass' the activity, although with a grade of zero for that activity. **Failure to demonstrate each of these skills will result in a failing grade for Chem 2201.** The final grade is based on the number of activities passed within 2 attempts.

Students should consult the Lab Skill's section posted on the lab Brightspace for details on these skills labs. Prior labs are designed to teach these skills and additional time has been built into each lab to allow students to repeatedly practice these techniques. For example, experiment 1 includes a quantitative transfer and dilution, being the subject of lab skills test #1 and #2.

^(H) **Final Exam:** The final examination (three hours) is scheduled by the Registrar and is comprehensive. There is no makeup exam date, however students should consult policies on illness in the event of a missed final exam.

Grade Scale

Conversion of numerical grades to final letter grades follows the Dalhousie Common Grade Scale.

A+	A	A-	B+	B	B-	C+	C	C-	D	F
90+	85+	80+	77+	73+	70+	65+	60+	55+	50+	<50

- A+, A, A-** Considerable evidence of original thinking; demonstrated outstanding capacity to analyze and synthesize; outstanding grasp of subject matter; evidence of extensive knowledge base.
- B+, B, B-** Evidence of grasp of subject matter, some evidence of critical capacity and analytical ability; reasonable understanding of relevant issues; evidence of familiarity with the literature.
- C+, C, C-** Evidence of some understanding of the subject matter; ability to develop solutions to simple problems; benefitting from his/her university experience.
- D** Evidence of minimally acceptable familiarity with subject matter, critical and analytical skills (except in programs where a minimum grade of 'C' or "C+" is required).

Lecture Format

Lectures for this course will be delivered in-person (Chem 226) and simultaneously made available to all students through Teams (Chem 2201 group) for online live streaming. These lectures will also be recorded. In general, Friday's classes will be devoted to problem solving activities, conducted in groups. Weekly problem sets will be made available ahead of time, together with other activities designed to actively engage the class in learning this course material. Note that each student has the option to access the lectures in person (assuming space is available in the classroom), as well as through online delivery (teams), regardless of section they have registered for.

Lectures will closely follow the order delivered in the textbook – some sections may not be covered directly in class. The instructor will always make clear which sections you will still be responsible for vs those that can be skipped. Just because a given topic is not covered in class, it does not mean it cannot be tested. An approximate schedule of lecture material is provided separately.

Online Components

Currently the course is expected to have the following components available online:

- (1) **Live-stream and recorded lectures.** Every lecture can be accessed 'live' through Teams. Students can post questions in the chat section or use raise hand feature to participate remotely. Friday lectures will assume group work through smaller breakout rooms. Students attending class in person can also use Teams to post questions into the chat or participate in group activities during Friday class.
- (2) **Prerecorded lectures.** Online video lectures have been recorded by Dr Peter Wentzell, retired Dalhousie Chemistry Professor, who taught this course for many years. These videos are available through the course Brightspace as a supplemental resource. Additional lecture videos are posted on YouTube (ShortChemistry), with more videos intended to be posted later in the term.
- (3) **Exercise Solutions.** Video solutions are available for each **in-chapter** exercises, along with PDF versions of the solutions.
- (4) **Online Help Sessions.** To facilitate greater scheduling flexibility and accessibility, lecture Tutorial/Help Sessions (Tues/Thurs 1-2pm) can be accessed online, or in person in Chem 223. Individual online meetings for administrative support or for additional help with the material can also be scheduled. These will use Microsoft Teams.

Course Policies

Absences. If students are unable to complete a graded requirement (test, exam, laboratory) at the scheduled time due to illness or other valid reasons, they are responsible for notifying the Professor or Laboratory Instructor **as soon as possible** (phone, e-mail or in person).

For missed tests due to short-term circumstances (<3 days), students should complete the **Student Declaration of Absence Form** (in Brightspace) within three days following the last day of absence. Note that any student is permitted on request to write each of their tests during the scheduled makeup time, regardless of reason. However, if the student does not write the test, the grade for that test will default to zero until they have contacted the instructor to provide a valid reason.

Should a student miss a laboratory experiment, the student must again complete the Student Declaration of Absence Form and contact the instructor within 24 hours of the missed lab, explaining the extenuating circumstances for their absence. The student has the option to complete a makeup experiment but only within 1 week of the originally scheduled experiment, scheduled by the instructor (attempting to accommodate scheduling). If an experiment is not conducted by the student, then no report shall be

submitted and the student shall receive a grade of zero for that particular lab report as well as the prelab. Students are not required to make up a missed experiment, noting that the lowest score from 9 experiments is automatically dropped.

In general, lab reports will not be accepted after the respective due date. Time is available during the lab itself to complete much of the lab report, and it is strongly recommended to finish and submit the lab report as soon as possible following completion of the experiment. An extended illness may constitute an exception to this. The student should notify the instructor if they feel they have a valid reason to request an extension to their lab report.

E-mail. Use e-mail for issues related to administrative matters or short queries related to content. AAD will not reply to e-mails asking how to solve problems or to repeat information from the lecture. Such questions are best asked in class, or during help sessions.

Electronics. Cell phones should be turned off while in lecture and lab.

Academic Integrity. A large component of this course is related to problem solving and students are permitted to work on textbook exercises together if that enhances their learning. All other aspects of assessed classwork, including tests, and exams, are expected to be completed independently. Suspected violations of academic integrity will be treated in accordance with university policy.

Lab Exemptions. Lab exemptions may be granted to those who have already completed CHEM 2201 (with a letter grade of A-F) and a lab grade of 15/30 or better on the lab component of the course. You must contact roderick.chisholm@dal.ca to apply for a lab exemption. Lab exemptions will not automatically be granted. No lab exemptions will be granted from completion of the remote version of the lab, offered because of the pandemic.

Lecture Content

<u>Week # , Date</u>	<u>Assessment</u>	<u>Textbook</u>
Week 1: Sept 7-9 Summary: Course expectations; Introduction and overview, Statistics		Topic 1 & 2
Week 2: Sept 12-16 Measurement Error; Regression		Topic 3 & 4
Week 3: Sept 19-23 Volumetric calculations; Units; Dilutions; Titrations		Topic 5
Week 4: Sept 26-30	Midterm 1	Topic 6 & 7
Instrumental Methods; Calibration; Standard Addition; Internal Standards		
Week 5: Oct 3-7 Instrumental Methods; Calibration; Standard Addition; Internal Standards		Topic 6-7
Week 6: Oct 10-14 Acid-Base I: Ionic Equilibria; strong & weak acids		Topics 8, 9, 10
Week 7: Oct 17-21 Acid-Base II: Buffers; Titrations		Topic 11
Week 8: Oct 24-28	Midterm 2	Topic 12
Spectroscopy I: Light; Beer's Law; Absorbance & Emission; Instrumentation		
Week 9: Oct 31-Nov 4 Spectroscopy II: Atomic vs Molecular Instrument; 2 Colour absorbance; Spectrophotometric titrations		Topic 12
Week 10: Nov 7-11	STUDY BREAK	
Week 11: Nov 14-18 Electrochemistry: Redox; Electrochemical cell; Nernst Equation; Reference electrodes; Potentiometry		Topic 13
Week 12: Nov 21-25 Chromatography I: Instrumentation, Plate and Rate Theory		Topic 14
Week 13: Nov 28 – Dec 2	Midterm 3	Topic 14
Chromatography II: Types of chromatography; Resolution; Applications		
Week 14: Dec 5-7 Chromatography III; Review of material for final exam		Topic 1-14

Lab Content

Experiment 1 – Basic Analytical Techniques/Data Analysis

Experiment 2 – Redox Titration of Vitamin C in Orange Juice

Experiment 3 – Fluorescence Determination of Quinine Content Within Tonic Water

Experiment 4 – Determination of Iron in a Multivitamin by Standard Addition

Experiment 5 - Determining the Calcium Content within a TUMS Tablet by Back Titration

Experiment 6 – Buffers and Weak Acid/Base Equilibrium

Experiment 7 – Atomic Spectroscopy in Flames

Experiment 8 – Use of an Ion Selective Electrode to Determine Nitrate Content Within Bacon Bits

Experiment 9 – Extraction and Separation of Plant Pigments

Students will complete these experiments in consecutive order, with Experiment 1 beginning the week of Sept 7-9.

Additionally, all students are scheduled for their first attempt of the **5 Lab Skills Tests** the week of Oct 31-Nov 4, with the (optional) redo made available to students beginning the following week (ie during the fall term break).

For a detailed schedule of experiments according to your specific lab day, please consult the “CHEM2201 – 2022 Fall- Analytical Lab” Brightspace site.

University Policies and Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity.

Information: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).

Information: https://www.dal.ca/campus_life/academic-support/accessibility.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.

Code: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness **Statement:** <http://www.dal.ca/cultureofrespect.html>

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit or e-mail the Indigenous Student Centre (1321 Edward St) (elders@dal.ca). **Information:** https://www.dal.ca/campus_life/communities/indigenous.html

Important Dates in the Academic Year (including add/drop dates)

https://www.dal.ca/academics/important_dates.html

University Grading Practices

https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Student Resources and Support

Advising

General Advising https://www.dal.ca/campus_life/academic-support/advising.html

Science Program Advisors: <https://www.dal.ca/faculty/science/current-students/academic-advising.html>

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Black Students Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre/current-students.html

Academic supports

Library: <https://libraries.dal.ca/>

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Studying for Success: https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Copyright Office: <https://libraries.dal.ca/services/copyright-office.html>

Fair Dealing Guidelines <https://libraries.dal.ca/services/copyright-office/fair-dealing.html>

Other supports and services

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness/servicessupport/student-health-and-wellness.html

Student Advocacy: <https://dsu.ca/dsas>

Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-toget-help/ombudsperson.html

Safety

Biosafety: <https://www.dal.ca/dept/safety/programs-services/biosafety.html>

Chemical Safety: <https://www.dal.ca/dept/safety/programs-services/chemical-safety.html>

Radiation Safety: <https://www.dal.ca/dept/safety/programs-services/radiation-safety.html>

Scent-Free Program: <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>

Dalhousie COVID-19 information and updates: <https://www.dal.ca/covid-19-information-and-updates.html>