

Faculty of Science Course Syllabus
Department of Chemistry
Chemistry 2201
Introductory Analytical Chemistry
Fall, 2020

Instructor(s): Alan Doucette (lecture) **email:** alan.doucette@dal.ca
Roderick Chisholm (lab) **email:** Roderick.chisholm@dal.ca

Office Hours: **A. Doucette:** Wednesday, 10:30 – 11:30 am ¹
R. Chisholm: Monday, 1:00 – 2:00 pm
** Please request administrative appointments; conducted through Microsoft Teams*

Lectures: Asynchronous videos (links available through Brightspace).

Laboratories: Weekly, beginning week of Sept 14
7 labs total. Asynchronous videos, plus a 1 hour weekly meeting (as scheduled)

Tutorials: Optional. Synchronous delivery via Microsoft Teams
3 x 1 hr tutorials offered weekly by Doucette: Mon 10:30 am; Tues 2:30 pm; Fri 10:30 am
+ 1 hr weekly 'lab' tutorial by Chisholm: Tues 6:00 pm

¹ All times are listed in this syllabus are in Atlantic Standard Time (AST)

Course Description

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

Course Prerequisites

CHEM 1011.03 and CHEM 1012.03 or equivalent (grade of C- or better)

Course Exclusion

None

Textbook

"An Introduction to Analytical Chemistry", 8th Edition by Ramaley, Wentzell, Doucette and Guy (required). Freely available from Brightspace as an electronic book. Printed copies of the text can be obtained as print-on-demand from the Dalhousie Bookstore (~\$30)

Laboratory Manual

The lab manual will be distributed via Brightspace (lab course site) as a free electronic booklet.

Web Sites

Individual Brightspace sites have been established for both the lecture and the lab. There is also a site for the Laboratory Safety Module.

Office Hours

A. Doucette (lecture) will offer drop-in tutorials via Microsoft Teams, which also doubles as office hours for course related assistance (M 10:30-11:30 am, Tu 2:30-3:30 pm, F 10:30-11:30).

Administrative appointments can be scheduled with Doucette via Teams (W 10:30-11:30 am, or as arranged if this time is unsuitable to student's schedule)

R. Chisholm (lab) administrative appointments, Mon 1:00-2:00 pm via Microsoft Teams

Course Exclusion

None

Laboratories

Lab material is provided through Brightspace, and includes video-based activities (asynchronous) together with synchronous meetings held in Microsoft Teams. More details on the laboratory program is provided on the Brightspace lab course site.

Laboratory Teaching Assistants

Teaching assistants will be assigned to work with students in small groups through synchronous meetings in Teams. Contact information is provided on laboratory course site.

Communication

Announcements will be posted on the course website and/or by Dalhousie email.

Course Assessment

<u>Component</u>	<u>Weight (% of total)</u>	<u>Date(s)</u>
CAPA Quizzes ^(A)	12%	~Weekly, 1.5% each
Term Test #1 ^(B)	12%	Wed, September 30
Term Test #2	12%	Wed, October 1
Term Test #3	12%	Wed, November 25
Labs ^(C)	20%	~Weekly
Final exam ^(D)	32%	Scheduled by Registrar

(A) CAPA Quizzes: Quizzes will be delivered weekly using CAPA (8 in total), and will comprise a single question, based on the material covered in the videos and corresponding textbook sections provide that week. CAPA Quizzes can be completed at any point throughout the week, before closing (Sunday, 11:59 pm) at the end of the respective week. There will be a time limit to attempt a quiz. Students will have multiple attempts to answer the quiz, though only 1 attempt possible per day. Questions are randomized, and so subsequent quiz questions may vary from the student's prior attempts. A correct answer in any attempt earns full points for that quiz. Quizzes are open book, though they must be completed independently.

The final mark for the CAPA quizzes will be calculated by dropping the two lowest individual marks.

(B) Tests: Three term tests will be administered, each held on a Wednesday from 10:30 – 11:30 am. Additional time will be provided to download/ upload test material. These tests are open book, and must be completed individually. For those who cannot attend the scheduled time, a makeup test will be held the following day (ie Thursday), from 4:00 – 5:00 pm. No other makeup time will be offered.

(C) Labs: Weekly labs will involve activities delivered through asynchronous videos as well as synchronous (Teams) meetings in small groups. Lab reports will be due the following week, and are to be submitted individually. We highly encourage students to work together and collaborate on the weekly reports but all reports must be submitted individually. The lab material will closely follow the material provided in the weekly lecture videos and corresponding textbook sections.

(D) Final Exam: The final examination (three hours, with extra time to download/upload material) is scheduled by the Registrar and will be comprehensive (including lab material). The final exam will also be open book and must be completed individually.

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).

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** (e-mail). 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.

Further information on this policy, including the use of the Student Declaration of Absence can be found here: https://www.dal.ca/dept/university_secretariat/policies/academic/misled-or-late-academic-requirements-due-to-student-absence.html.

If the test (including makeup) is not written due to illness, marks will be prorated to other class assessment components at the discretion of the professor. For CAPA quizzes, which are administered online over a period of several days, there are no make-ups available – however, the lowest two marks will be dropped. Consult with the laboratory syllabus for more information on missed labs and/or late reports.

E-mail.

Use e-mail for issues related to administrative matters or short queries related to content. Dr. Doucette will not reply to e-mails asking for assistance on course material. Instead, please come to one of the designated tutorials, or post questions on Brightspace.

Collaboration.

We strongly encourage the formation of peer groups to assist learning the course material. This includes going through textbook material and completing practice problems. However, all quizzes, tests and the final exam must be conducted individually. Group work will form an integral component of the laboratory. Students will be permitted to collaborate when working on lab reports.

Course Content

<i>Week #, Date</i>	<i>Assessment</i>	<i>Textbook</i>
<i>Week 1: Sept 8-11</i> Summary: Course expectations; Introduction and overview of analytical chemistry	<i>(none)</i>	<i>Topic 1</i>
<i>Week 2: Sept 14-18</i> Statistics; Measurement Error	<i>CAPA Quiz 1 (Q1)</i>	<i>Topic 2 & 3</i>
<i>Week 3: Sept 21-25</i> Volumetric calculations; Units; Dilutions; Titrations	<i>(Q2)</i>	<i>Topic 5</i>
<i>Week 4: Sept 28-Oct 2</i> Instrumental Methods; Calibration; Standard Addition; Internal Standards	<i>Midterm 1 (M1)</i>	<i>Topic 6 & 7</i>
<i>Week 5: Oct 5-9</i> An alternate approach to problem solving (REVIEW)	<i>(Q3)</i>	<i>Topic 1-7</i>
<i>Week 6: Oct 12-16</i> Acid-Base I: Ionic Equilibria; strong & weak acids	<i>(Q4)</i>	<i>Topics 8, 9, 10</i>
<i>Week 7: Oct 19-23</i> Acid-Base II: Buffers; Titrations	<i>(Q5)</i>	<i>Topic 11</i>
<i>Week 8: Oct 26-30</i> Spectroscopy I: Light; Beer's Law; Absorbance & Emission; Instrumentation	<i>(M2)</i>	<i>Topic 12</i>
<i>Week 9: Nov 2-6</i> Spectroscopy II: Atomic vs Molecular Instrument; 2 Colour absorbance; Spectrophotometric titrations	<i>(Q6)</i>	<i>Topic 12</i>
<i>Week 10: Nov 9-13</i>	<i>STUDY BREAK</i>	
<i>Week 11: Nov 16-20</i> Electrochemistry: Redox; Electrochemical cell; Nernst Equation; Reference electrodes; Potentiometry	<i>(Q7)</i>	<i>Topic 13</i>
<i>Week 12: Nov 23-27</i> Chromatography I: Instrumentation, Plate and Rate Theory	<i>(M3)</i>	<i>Topic 14</i>
<i>Week 13: Nov 30 – Dec 4</i> Chromatography II: Types of chromatography; Resolution; Applications	<i>(Q8)</i>	<i>Topic 14</i>
<i>Week 14: Dec 7-8</i> Review of material for final exam	<i>(none)</i>	<i>Topic 1-14</i>

Course Objectives/Learning Outcomes

- Evaluate the quality of analytical results using statistical methods.
 - Calculate uncertainty in a result through the propagation of errors.
 - Apply linear regression for the purpose of calibration.
 - Transform between chemical quantities (mass, moles, concentrations, percentages).
 - Determine an analytical result on the basis of titration data.
 - Relate instrumental response to concentration in the determination of an analyte.
 - Apply the methods of standard addition and internal standards to analytical determinations.
 - Write and manipulate equilibrium constant expressions for chemical reactions.
 - Calculate quantities associated with chemical equilibria.
 - Distinguish between activity and concentration.
 - Classify aqueous solutions according to their acid-base properties.
 - Calculate the pH of different types of aqueous solutions.
 - Predict the reactions of acids and bases and the pH of the resulting solution.
 - Determine the quantities needed to prepare a buffer from different starting materials.
 - Distinguish the shapes of titration curves for different conditions.
 - Describe the components of different types of spectroscopic instrumentation.
 - Apply Beer's law to spectroscopic measurements.
 - Describe the applications and limitations of different spectroscopic techniques.
 - Identify the components of an electrochemical cell and represent it in shorthand notation.
 - Apply the Nernst Equation to calculate electrochemical cell potentials.
 - Calculate analytical concentrations from the potentials of redox and membrane electrodes.
 - Describe the components of a chromatograph for different types of chromatography.
 - Recognize the important features of a typical chromatogram.
 - Determine and interpret the parameters associated with the quality of a separation.
 - Describe and calculate the factors affecting a separation through rate theory.
 - Describe different types of chromatography and their applications.
 - Carry out quantitative and qualitative analysis on the basis of chromatographic data.
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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/services-support/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-to-get-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>