

***Chem 3201: Analytical Spectroscopy and Separations***  
**Winter, 2022**

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**Lectures:** (Monday: time-To be Determined) 1 hr weekly meetup via Microsoft Teams (recorded)

**Online Content:** 1 × 1-hour Remote Lab Assignment Meeting per week (M pm; T pm).  
1 × 1-hour Case Study Meeting per week (Wpm; TR pm).

*First lab = Jan 10 or 11 Meeting time as scheduled*

**Laboratory (in person):** M/W or T/Th 1:30-5:30pm (twice a week)

**Office Hours:** By appointment. To schedule a one-on-one meeting please email your instructor and book an appointment. Meetings will occur via Microsoft Teams

**Website:** Brightspace includes a complete class schedule, electronic copy of textbook readings, videos, supplementary notes and readings, practice problems, and grades.

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**Course Description:**

An introduction to the fundamentals of instrumental chemical analysis is presented in a laboratory environment, with emphasis on selection of appropriate analytical techniques, sample treatment, data handling, and communication of experimental results. Instrumental techniques include chromatography, spectrophotometry, mass spectrometry, and electrochemistry, with applications in biological, environmental, forensic and health-related areas.

**Course Prerequisites:**

Chem 2201 or equivalent. Grade of C- or better.

Exclusion: Chem 3201

**Objectives/ Learning Outcomes:**

The learning outcomes associated with each experiment are described in your lab manual. There are several overarching themes:

- Time management, including proper planning and scheduling of preparing presentations and assignments
- Team work, organizing and working closely with your Remote Lab Group. You will be scheduled for a weekly mandatory 1 hr Remote Lab Meeting (with a TA), however you will have to meet and work with your group outside this scheduled time.
- Communication (written, presentation and oral), Group case studies will be evaluated by the submission of a powerpoint presentation (including recorded and imbedded audio within the powerpoint file). You will also be evaluated via individual assignments. This will include data analysis, presentation and interpretation of results.
- Effective reporting of data in graphical and tabulated formats.
- Calculation of concentrations, and unit conversion, statistical analysis
- Problem solving, which first relates to recognizing that you are facing a problem, diagnosing the problem and researching solutions.
- Effective use of literature (literature searching and interpretation of literature related to theories described within the class).
- Critical assessment of the quality of your work as well as others (class members and literature)
- Creativity and independence
- Experimental design, through the use of literature and understanding of key concepts you will design experiments to test a hypothesis. (via a case study later in the term)
- Become familiar with the fundamental theory and practical application of the following analytical techniques: molecular absorbance and emission; Raman spectroscopy/ Surface enhanced Raman; Fluorescence theory/instrumentation and advanced applications; gas and liquid chromatography; mass spectrometry, tandem MS and different modes of ionization; electrophoresis; as well as analytical sample preparation, buffer preparation, analyte extraction, derivatization, purification and recovery, methods of calibration including direct standardization, internal standards and standard addition.

**Course Format:****Online (Jan 10 – February 18)**

This online course will be taught in two-week module sets. At the end of the module your Group case study presentation (Fridays) and individual assignment (Sundays) will be due. See the course calendar for due dates and content schedule. Assigned readings will be available via brightspace (no required textbook to purchase) and accompanying content videos will be available within each module. Weekly meetups will occur Mondays (time TBD) for 1 hour live via Microsoft Teams. These weekly meetups are not intended to substitute the readings and content videos, but rather provide an overview of the content, discussion of key or difficult concepts and provide the opportunity for student questions.

Remote Case Study meetings (mandatory) will occur on a weekly basis for 1 hour. At these meetings your TA will introduce the group case study, discuss via content and/or exercises related to the case study and provide feedback into your group case study presentation. It is expected that a draft of the group's presentation will be discussed at the second week's remote lab meeting. This is your opportunity to receive feedback, ask questions and make improvements on your presentations. Failure to do so will result in unfortunate reduction in grades as concepts may be missing or not discussed adequately.

Remote Lab Assignment Meetings (semi-weekly 1 hour) will include realistic data analysis and interpretation related to the various modules. See the course calendar for the various due dates. Lab Assignments are designed using individual data sets and are to be submitted individually. Students are encouraged to work and collaborate together however each individual is expected to complete and understand their own material. Remote Lab Assignment meetings will occur within your groups (as scheduled; see course calendar for various dates). At these meetings a Teaching Assistant will introduce the assignment and key concepts for success. It is advised that you attempt the assignment before the meeting to ensure maximum understanding of the discussion. These meetings are not to be used for the Teaching Assistant to walk you through each question, but rather they will aid in the understanding of the concepts. As each assignment is individual, the TA's will discuss the methods and interpretation of the data and cannot review everyone's individual numbers.

**Return to In-person Labs (February 21)**

Pending the return to in-person teaching at Dalhousie students will begin in-person labs Feb. 28. The lab experiments will consist of a series of experiments to build the hands-on skills and experimental design associated with the initial online content. Note: should in-person teaching not be approved Chem 3201 will continue the remainder of the term online. Details of the module content to be discussed at a later date. The remainder of the term there is no associated lecture component of the course, this class still places emphasis on fundamental understanding of the theoretical principles governing the analytical experiments being conducted in lab. Experiment 1 will be conducted during the first 4 lab periods. This experiment is a review of analytical concepts and laboratory techniques. Students are expected to know these concepts to ensure success with the remainder of the course. The practice labs include a series of

videos and practice problems as a review of basic analytical concepts. Students may wish to refer to their 2<sup>nd</sup> year analytical textbook if they are not fully comfortable with these concepts. Additionally this lab aids in students knowing/understanding the expectations of prelab preparation, inlab organization, hands on laboratory skills and the expectations of chem 3201 reports.

Experiment 2 consists of 4 experiments (broken down into two reports) and experiment 3 consists of two experiments (one report). Each experiment concludes with a written lab report (see 'Reports' for further information). Each of these experiments involve experimental and sample extraction/treatment in which students will use literature to design and propose experimental details which they will test within the lab. The intent is to expose you to a wide range of advanced Analytical techniques, extraction protocols and data analysis.

Midterms and final exam evaluation will include a combination of questions related to the theory discussed within the readings, content videos and case studies as well as data analysis and interpretation as conducted within the assignments.

### Course Assessment:

<u>Assessment</u>	<u>Weight</u>	<u>Date</u>
Group Case Study Presentations	15%	As scheduled <sup>1</sup>
Lab Assignments/reports	35%	As scheduled <sup>2</sup>
Midterm 1	12.5%	March 3 (6pm-7:30pm)
Midterm 2	12.5%	April 6 (6pm-7:30pm)
Final Exam*	25%	(Schedule by registrar)

<sup>1</sup>See 'Group Case Study Presentations' for information

<sup>2</sup>See 'Assignments' for information

\*Final exam is a cumulative written test covering all aspects of the course

\* Should the term remain online 10% of total grades will shift from Lab assignments to Group Case Studies

**Conversion to Final Letter Grades as per Dalhousie Common Grade Scale:**

A+ (90-100)	B+ (77-79)	C+ (65-69)	D	(50-54)
A (85-89)	B (73-76)	C (60-64)	F	(<50)
A- (80-84)	B- (70-72)	C- (55-59)		

**School Cancellations:**

Weather-related closure of the University or power/internet outage may impact submission of your Group Case Study Presentations or Assignments, in which case the due date will be moved to the next day that the University is open. Email your instructor as soon as possible if power or internet outage is impacting your submission.

**Group Case Study Presentations:**

Group case studies involve understanding the module content and expanding this theory to think outside the box in approaching the case study situation. Each case study directly related to the module content, however these require you to work as a group to communicate your ideas via a short (no more than 10 min) powerpoint presentation pre-recorded. The case study will be introduced by your TA in the first week of the module. There the TA will discuss key concepts and related activities for your group to thoroughly understand the task. Your group will have to self organize, direct tasks, and prepare the presentation, outside regular class time. The second week of the module you will share your presentation, and receive feedback from your TA. Additionally, this is an opportunity for you as a group to ask for clarification and ask questions related to the case study. One powerpoint file per group (with embedded audio) is to be submitted Friday by 11:59pm via brightspace. It is expected that all students will participate equally within the organization and preparation of the case study. In addition to the presentation submission, the group will submit a list of duties indicating everyone's involvement.

The first week of class, you will meet your group and TA at your scheduled time and discuss the organization of the remote lab meetings and the case studies. At this initial meeting, you as a group will detail a group contract (signed by all group members) outlining procedures for the group to follow. This will include, when to meet outside regular class times, how/when to organize individual tasks, and importantly detail processes to follow should issues arise within the group. Should a group member not fully participate or neglect their duties, the group is to consult their group contract (written during week 1) and follow the guidelines and procedures they detailed. The case study presentation is to be evaluated as a group and all group members will receive the same grade. Refer to the course calendar for case study submission dates.

**Lab Assignments (individual):**

Assignments as intended to provide the student with the opportunity to process and interpret real data related to the course module. Assignments are individualized and therefore are to be submitted individually. Despite the individual aspects of the assignments, we realize the benefits of working together and therefore we encourage students to work together and collaborate in the understanding of the data analysis and interpretation. But you cannot just copy from each other as understanding these methods will be key to succeed on the midterms and final exam. Your methods and numeric values for your individual assignment will be evaluated. Assignments are to be submitted via brightspace the end of second week of the module by Sunday 11:59pm (see calendar for details). Refer to the course calendar for assignment submission dates.

**Reports:**

Experiments 1 through 3 are graded through written lab reports. Reports are due on the listed due dates (by 1:30pm). If completed before the due date, reports may be submitted earlier. Only hard copies of the report will be accepted (with exception of illness, see below for details).

Experiments 1 through 3 are to be graded out of 10 marks. 9 marks are included in the evaluation of the experiment reports. 1 mark for each experiment is included as the prelab questions. Prelab questions must be completed prior to conducting the experiment and will be checked at the start of each lab period. Over the course of the experiment you will be required to complete multiple prelab questions. The sum of all of the prelab questions (per experiment) will total 1 mark. The percent total for each report in relation to the calculation of the final grade is presented in the table to the right.

Lab Assignment/Report	Total % of Final Grade
Assignment 1	5
Assignment 2	5
Assignment 3	5
Exp 1	5
Exp 2a	5
Exp 2b	5
Exp 3	5

*It is encouraged to complete the prelab questions well in advance of the experiment and discuss your answers with your teaching assistants or instructor if you encounter any confusion.*

All data collected within a group for a given experiment must be fully shared among all members of the group, regardless of the workload shared in lab (this applies even if the student was absent from that lab – see ‘Missed Labs’ for further information).

Students are welcome (and encouraged) to collaborate with any other members of this class to complete their reports. However, the report must exclusively present the results collected within the student’s own group. Reports may be prepared individually, or alternatively a single copy of the report may be submitted from the group (all members will receive the same grade). The default is that reports are submitted individually. If students choose to submit a group report, it must be agreed upon by all members and communicated to the instructor (email) at least one week prior to the report due date.

**To pass the course student must submit 3 of the 4 reports** from experiments 1 through 3. Please note that all reports will be graded, and we will not drop the lowest report grade in determining the final grade (*ie* if you only complete 3 reports, you will receive a grade of zero for the 4<sup>th</sup> report. If you only hand in 2 reports, you will not be allowed to pass this course). See ‘Missed Labs/Illness’ for more information.

**Feedback:**

Written reports/assignments can only be returned to the student once the entire class has completed and submitted the report for that particular experiments. Feedback will occur by Remote Lab Meetings with your TA, posted through the course website, and/or discussed during the course tutorials. Students are also encouraged to meet with the instructor to discuss their presentations/assignments.

**Late submission policy:**

Late submissions (anywhere from 5 minutes overdue to 1 week late) will receive a grade of zero. Email your instructor as soon as possible if power or internet outage is impacting your submission.

**Missed Remote Lab Meeting /Illness:**

All remote lab meetings are required and considered mandatory. Groups are expected to detail a process in which to follow should a group member miss a remote lab meeting. Missing a remote lab meeting does not excuse that member from participating within the case study.

In the event of a missed lab due to school cancelation, you will be required to make up this experiment. The next available Friday afternoon is the default time for lab makeups; if in conflict with this time your lab will be rescheduled at a mutually agreeable time.

**Missed Labs /Illness:**

All missed labs require a declaration of illness. For experiments 1 through 3, **if you miss a single lab day out of the 2-day experiments**, we ask that you contact the instructor (and also your partner) before the lab begins, as your absence will affect your partner's work (your partner will complete the lab individually). The student who missed the lab will not be given opportunity to make up that lab. The data collected by the group will still be shared with the absent partner, and the absent student is still required to submit a lab report on the normal due date (individually, or as a group).

To substitute for the missed lab, the absent student is also expected to **submit a 1000-1500 word essay** (due together with the report). The essay topic is chosen by the instructor and relates to the material covered in the given experiment. This essay will be graded on a scale of 0 to 3 (0 = not completed; 1 = partially complete, or poorly done, essentially a failing grade; 2 = a minimal effort, essentially a grade of C- or below; 3 = acceptable). The corresponding percentage will be multiplied by the report grade.

**If you miss both lab days for a given experiment**, the data collected by the group will no longer be shared with the absent partner (the remaining partner will be offered assistance in lab to complete the experiment). The absent student will not be asked to submit a normal report. The associated 6% grade for the report will be transferred to the final exam.

To substitute for missing the entire experiment, the absent student will be required to write **three 1000-1500 word essays** (due at the start of the final exam) covering topics related to the missed lab experiment as chosen by the instructor. The essays will again be graded on a scale of 0 to 3, and the percentage will be multiplied by the final exam grade to determine the grade for the report (out of 6).

Another reminder that students must complete a minimum 3 of 4 reports. The three essays do not substitute for a report. Thus, students cannot miss more than one 2-day experiment.

Should a midterm be missed due to illness, a student declaration of absence must be submitted (via the brightspace dropbox) within 24 hours. The weighted grade value of the midterm will be moved to the final exam. No make up tests will be provided.

**Midterms and final exam:**

Midterms and final exams will include a combination of questions related to the module theory as well as the data analysis/interpretation skills from the assignments. Both midterms and final exam are to occur individually. These evaluations will be timed (midterms 1.5 hours, final 3 hours). The midterms and final exam are intended to be in person, however should campus be closed to in person testing details will be provided into the online evaluation format.

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**Accommodation Policy For Students:**

Students may request accommodation as a result of barriers related to disability, religious obligation, or any characteristic protected under Canadian Human Rights legislation. **Student Accommodation Policy:** [http://www.dal.ca/campus\\_life/student\\_services/academic-support/accessibility.html](http://www.dal.ca/campus_life/student_services/academic-support/accessibility.html)

Students who require accommodation for classroom participation or the writing of tests and exams should make their request to the **Advising and Access Services Centre (AASC)** prior to or at the outset of the regular academic year. More information and the **Request for Accommodation** form are available at [www.dal.ca/access](http://www.dal.ca/access).

**Academic Integrity:**

Academic integrity, with its embodied values, is seen as a foundation of Dalhousie University. It is the responsibility of all students to be familiar with behaviours and practices associated with academic integrity. Instructors are required to forward any suspected cases of plagiarism or other forms of academic cheating to the Academic Integrity Officer for their Faculty.

**Policy on Intellectual Honesty and Faculty Discipline Process:**

[https://www.dal.ca/dept/university\\_secretariat/academic-integrity.html](https://www.dal.ca/dept/university_secretariat/academic-integrity.html)

**Student Code of Conduct:**

Dalhousie University has a student code of conduct, and it is expected that students will adhere to the code during their participation in lectures and other activities associated with this course. [http://www.dal.ca/dept/university\\_secretariat/policies/student-life/code-of-student-conduct.html](http://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html)

**Copyright:**

All members of the Dalhousie community are expected to comply with their obligations under Canadian copyright law. Dalhousie copyright policies and guidelines, including our Fair Dealing Guidelines, are available at <http://www.dal.ca/dept/copyrightoffice.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](mailto:elders@dal.ca)).

**Information:** [https://www.dal.ca/campus\\_life/communities/indigenous.html](https://www.dal.ca/campus_life/communities/indigenous.html)

**Services Available to Students:**

The following campus services are available to all Dalhousie students. Unless noted otherwise, the services are free.

Service	Support Provided	Location	Contact
<b>General Academic Advising</b>	Help with <ul style="list-style-type: none"> <li>- understanding degree requirements and academic regulations</li> <li>- choosing your major</li> <li>- achieving your educational or career goals</li> <li>- dealing with academic or other difficulties</li> </ul>	<b>Killam Library Ground floor Rm G28 Bissett Centre for Academic Success</b>	In person: Killam Library Rm G28 By appointment: <ul style="list-style-type: none"> <li>- e-mail: <a href="mailto:advising@dal.ca">advising@dal.ca</a></li> <li>- Phone: (902) 494-3077</li> <li>- Book online through MyDal</li> </ul>
<b>Dalhousie Libraries</b>	Help to find books and articles for assignments Help with citing sources in the text of your paper and preparation of bibliography	<b>Killam Library Ground floor</b>  Librarian offices	In person: Service Point (Ground floor) By appointment: Identify your subject librarian (URL below) and contact by email or phone to arrange a time: <a href="http://dal.beta.libguides.com/sb.php?subject_id=34328">http://dal.beta.libguides.com/sb.php?subject_id=34328</a>
<b>Studying for Success (SFS)</b>	Help to develop essential study skills through small group workshops or one-on-one coaching sessions Match to a tutor for help in course-specific content (for a reasonable fee)	<b>Killam Library 3<sup>rd</sup> floor</b>  Coordinator Rm 3104  Study Coaches Rm 3103	To make an appointment: <ul style="list-style-type: none"> <li>- Visit main office (Killam Library main floor, Rm G28)</li> <li>- Call (902) 494-3077</li> <li>- e-mail Coordinator at: <a href="mailto:sfs@dal.ca">sfs@dal.ca</a> or</li> <li>- Drop in to see us during posted office hours</li> </ul> <b>All information can be found on our website: <a href="http://www.dal.ca/sfs">www.dal.ca/sfs</a></b>
<b>Writing Centre</b>	Meet with a tutor to discuss writing assignments (lab report, research paper, thesis, poster) <ul style="list-style-type: none"> <li>- Learn to integrate source material into your own work appropriately</li> <li>- Learn about disciplinary writing from a peer or staff member in your field</li> </ul>	<b>Killam Library Ground floor</b> Learning Commons & Rm G25	To make an appointment: <ul style="list-style-type: none"> <li>- Visit the Writing Centre in the Killam Learning Commons (Rm G40) and book an appointment</li> <li>- Call (902) 494-1963</li> <li>- e-mail <a href="mailto:writingcentre@dal.ca">writingcentre@dal.ca</a></li> <li>- Book online through MyDal</li> </ul> We are open six days a week <b>See our website: <a href="http://writingcentre.dal.ca">writingcentre.dal.ca</a></b>