DALHOUSIE UNIVERSITY

Faculty of Science Course Syllabus
Department of Chemistry
Chem 6299: Special Topics in Analytical Chemistry: PROTEOMICS
WINTER, 2022

Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq. We are all Treaty people.

Instructor: Dr. Alan Doucette alan.doucette@dal.ca

Office Hours: I am available for in-person appointments MWF (Chemistry, room 506). *You can also reach me online (Microsoft Teams). Feel free to request a specific appointment time. I check emails 7 days a week.*

Lectures: Combined in person/ online: Wednesday, 2:35 pm – 5:00 pm[1,2] (CHEM 540)

ONLINE DELIVERY: Remote participation in all lectures will be provided through Microsoft Teams.[3] Lectures be livestreamed and recorded and later accessible through Microsoft Teams.

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

[2] *In the event of campus closure, lectures will continue to be offered remotely at times scheduled*

[3] *A laptop with video camera & microphone is recommended for remote classroom participation*

Course Description

Proteomics describes the systematic characterization of proteins in order to understand a biological system. This relatively new field has progress through technology developments in bioanalytical chemistry, particularly involving separations and mass spectrometry. A thorough treatment of the motivation, methods and implications of proteomics is presented.

Course Prerequisites

CHEM 4206 or 5206 or working knowledge of mass spectrometry

Course Materials

- Weekly readings will be distributed, directing you to published articles, websites, or video resources.

Communication

Please check your Dalhousie email regularly for course related communications.

DALHOUSIE UNIVERSITY

Course Assessment

The following grading scheme will be used for this course:

Component	Weight (% of final grade)	Date
Written report	**30%**	**last day of exam period**
presentation	**25%**	**last day of class**
weekly 'assignments'	**25%**	***weekly (x6)***
lab demo	**20%**	**before week 4**

**** All assessment components in this class must be completed individually.***

- Students will be required to attend two ~2-hr "labs", outside of normal class times. These labs will allow students to gain familiarity in (1) protein sample preparation (2) mass spectrometry (3) data manipulation and analysis. The techniques will directly complement the readings and classroom instructions.
- In addition to an in-class presentation, students will also prepare a lab-based demonstration, which outlines a particular aspect of proteome analysis. The remaining students must attend at least one of these presentations.
- Grading rubrics for the in-class presentation, written report, and lab demo are attached.

Other course requirements

All students will be required to meet with the instructor (in person or Microsoft Teams), approximately 1 week prior to their in-class presentation (max 1.5 hours) to provide and receive feedback on your in-class presentations.

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

A+ (90-100)	**B+** (77-79.9)	**C+** (65-69.9)	**D** (50-54.9)
A (85-89.9)	**B** (73-76.9)	**C** (60-64.9)	**F** (<50)
A- (80-84.9)	**B-** (70-72.9)	**C-** (55-59.9)	

DALHOUSIE UNIVERSITY

Course Objectives/Learning Outcomes

Upon completion of this course, students should be able to:

Weight the merits of various instrumental platforms for characterization of proteome samples

Recognize the limitations of mass spectrometry to identify components of a complex mixture, including an appreciation of the merits of separations coupled to mass spectrometry.

Apply various approaches to quantitative proteomics analysis

Perform protein sample manipulations in a practical lab setting, including protein extraction, isolation, separation, derivatization and digestion.

Optimize an MS platform for proteome analysis, with regards to maximizing instrument sensitivity and throughput.

Perform data manipulations using online software platforms to decipher MS raw data files.

Independently research and communicate a topic related to proteome analysis (written/ oral) to his or her peers.

Missed or Late Academic Requirements due to Student Absence

We remain in a pandemic, with several restrictions and recommendations described by Nova Scotia Public Health and by Dalhousie University. This includes policies on mask wearing, vaccination, testing, and physical distancing. All students are required to comply with health and safety requirements on campus and should be considerate of others' health concerns. Non-compliance may be reported under the Code of Student Conduct.

As recommended by public health, if you are feeling ill or displaying flu-like symptoms, ***stay home!*** It is for this precise reason that all lectures will be available in person as well as remotely. You may also prefer to meet with me online rather than in person. This will also be accommodated. If, due to illness, you are unable to attend a scheduled meeting, presentation, lab, , you must contact the instructor **prior to** the missed event. Presentations/ labs will be rescheduled to the next available opportunity.

Information on regular policy, including the use of the Student Declaration of Absence can be found here: **https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academicrequirements-due-to-student-absence.html.**

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

DALHOUSIE UNIVERSITY

Course Content

Week 1: Intro to proteomics

- What is a proteome?
- Basic protein structure
- How big is the proteome?
- Proteome dynamics and impact of abundance change
- What can proteomics answer?
- Mass spectrometry basics: high res and tandem MS
- Classical proteomics techniques
- Fingerprinting & sequencing

Week 2: Modern Instrumental improvements

- New Ionization sources
- New mass analyzers – Orbitraps
- SWATH – data independent scans
- Ion Mobility
- Fragmentation sources (ETD, EDC, UVPD…)
- ESI mechanisms

Week 3: Quantitative analysis

- AQUA
- Spectral counting
- ITRAQ
- SILAC
- MRM

Week 4: Beyond identification

- PTM analysis & Proteoforms
- HDX
- Cross-linking
- Protein-protein interactions
- Molecular Dynamics
- Top Down
- Front end

Week 5: Bioinformatics

- Sequest
- XTandem
- Top down analysis
- False positive
- Biomarker ID
- Stats/ Volcano plots…

Week 6: To be determined…

- Recent advances

DALHOUSIE UNIVERSITY

University Policies and Statements

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

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-studentconduct.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

DALHOUSIE UNIVERSITY

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-andupdates.html

DALHOUSIE UNIVERSITY

A Presentation on Current Topics in Proteomics: WINTER 2022

Your presentation is intended to outline a *specific topic* in the field of proteome analysis. The suggested topic should complement those topics already being covered in class (see course syllabus). The presentation should take the form of a 'teaching presentation', and should be presented at the level of a senior undergraduate course in chemistry.

Presentation Format:

The presentation should be approximately 35 minutes in length, if delivered in an uninterrupted format (ie holding questions till the end). However, you may prefer to allow the class to ask questions during your presentation, which will naturally extend the time period. It is anticipated that you will receive up to 15 min in questions from the audience (including the instructor). The presentation must be conducted through PowerPoint though there will likely be points where you will add notes/ sketches to a chalkboard. Remember this is a teaching talk, so the pacing is slower than a research talk. Your PowerPoint slides will be shared with other students in this class.

Students are required to meet with the instructor on two separate occasions. The first meeting (~15 min) is intended to go over a 'rough outline' of your presentation. You should have a sense of the material you want to discuss on a slide-by-slide basis. I will provide suggestions to improve your presentation, and may ask that you cover additional material, or omit some. The second meeting (~one week later) can be thought of as a 'practice talk'. You are expected to have a completed slide deck, and to present a few of the slides, to get a sense of the pacing and level of detail. Again, I will give you suggestions to improve the talk prior to the final presentation in front of the class. The aim of these meetings is to ensure that everyone does the best possible job with their talks, and to ensure that appropriate material is presented for the benefit of the class.

Dates for meeting 1 & 2:

1st meeting: minimum 1 weeks before your presentation (in my office)
2nd meeting: minimum 3 days before your presentation.

Assessment:

The presentation constitutes 25 % of your total grade, with breakdown as follows:

a) 1st meeting to discuss topic/ review presentation	2 marks
b) 2nd meeting with a 'practice' talk	6 marks
c) Formal presentation	12 marks
Depth/ interest level of material	
Speaking style / slide quality	
Level of understanding of material	
d) Questions from audience	5 marks

DALHOUSIE UNIVERSITY

Lab demo (Chem 6299)

Proteome analysis involves multiple technique aspects, from biological sample handling, to trace sample manipulation, to instrumental analysis and computational work. The lab-based portion of the class will provide a quick overview of each of these techniques, however there will be insufficient time for the instructor to properly demonstrate (and for you in turn to exercise) each of these techniques. This lab demo is an opportunity to explore one specific aspect of proteome analysis, and to demonstrate this technique to the class.

The presentation should be ~15-20 min in length. Students should prepare ahead of time to ensure that they can present all aspects of their technique without forcing others to wait for lengthy steps (think of it like a cooking show!). Though not required, the student can prepare a written protocol as a guide for others to use in the future. While the focus is on technical skills, the student should be familiar with the fundamental theories guiding the aspects of their techniques.

Grading:

The following breakdown is used to assess your demonstration. The report itself is worth 30% of your total grade in this course.

PREPARATION (30%)

Is everything in place, are sample results available

PRESENTATION STYLE (20%)

Was it clear? Was it concise? Did the student consider time for others to see the work?

SCIENTIFIC ACCURACY (30%)

Was the technique presented correctly?

UNDERSTANDING (20%)

IAs judged through questions and discussion. Does the student appreciate why the techniques are performed as they are?

DALHOUSIE UNIVERSITY

Written Report (Chem 62XX)

You are asked to write a literature review of a specific topic in the area of proteome analysis. The report should be a direct complement to your in-class teaching presentation (ie it should cover essentially the same material). While the research that went into your topic might be the same, the format of a written report allows you to cover the material in a slightly different way. The writing style should be formal, using properly formatted paragraphs (ie do not write in point form!). The material you describe should be properly referenced (at end of report, in proper scientific format). You may source your background information from textbooks and the web, though you are also expected to include material from peer-reviewed scientific literature. This resource should not exceed 5 pages in length, double spaced (references, figures & tables extra).

Deadlines:

This report is due on the last day of the final exam period

Grading:

The following breakdown of the review article will be used to assess your report. The report itself is worth 30% of your total grade in this course.

STYLE (20%)

Basic format, referencing, figure/ table layout, font styles and grammar

STRUCTURE (20%)

The overall 'flow' of document, paragraph structure, conveying a clear message, easy to read…

SCIENTIFIC ACCURACY (20%)

Is the content correct?

DEPTH (40%)

Includes sufficient depth, with material relevant to the overall objectives of this class.