

Faculty of Science Course Syllabus (Section A) (revised April 2022)**Department of Chemistry**

Chemistry 4311/5311

Chemistry 4311/5311: Fundamentals of Applied Electrochemistry

Fall, 2022

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

We acknowledge the histories, contributions, and legacies of the African Nova Scotian people and communities who have been here for over 400 years.

Instructor(s): Heather Andreas, heather.andreas@dal.ca, Office hours: Tuesday 10:00-11:00 and Friday 3:00-4:00 (room: Chem 316).

Lectures: Tuesday & Thursday, 8:35-9:55, LSC C338

Laboratories: None

Tutorials: None

Course delivery: In-person, lectures will not be recorded

Course Description

A broad introduction to the fundamentals of electrochemistry, including electrochemical theory, double layer modelling and electrochemical methods. Additionally, important electrochemical applications will be discussed, including corrosion, energy production and storage (fuel cells, batteries and supercapacitors) and sensors (biosensors).

Course Prerequisites

CHEM 2301.03 and CHEM 2304.03 (grade of C- or better)

Course Exclusion

None

Learning Objectives

- *Learn about the most common types of electrochemical cells, including why and when a 2-electrode or 3-electrode system should be used.*
- *Learn about what happens at the electrode/electrolyte surface during double-layer charging and during Faradaic reactions.*
- *Identify and understand how thermodynamic and kinetic information can be gained from electrochemical measurements.*
- *Learn about the most common electrochemical techniques for identifying physical and chemical processes and deriving analytical data (especially cyclic voltammetry).*
- *See how electrochemistry is applied in real-world applications.*

Course Materials

- *No textbook is required; testing will be based solely on the material presented in class (including the material presented in the seminars). There will be a Course Brightspace page.*

Course Assessment

Undergraduate students:

<i>Experience Points: (described further below)</i>	22%
<i>Quizzes: (dates given below, lowest 2 quiz grades will be dropped)</i>	24 %
<i>Test 1: (in class, Thursday September 29)</i>	13%
<i>Test 2: (in class, Thursday October 27)</i>	13%
<i>Theory Mastery Exam: (in class, Tuesday November 15)</i>	20%
<i>Application Mastery Exam: (In class, Tuesday December 06)</i>	8%

Graduate students:

<i>Experience Points: (described further below)</i>	18%
<i>Quizzes: (dates given below, lowest 2 quiz grades will be dropped)</i>	18 %
<i>Seminar</i>	18%
<i>Test 1: (in class, Thursday September 29)</i>	10%
<i>Test 2: (in class, Thursday October 27)</i>	10%
<i>Theory Mastery Exam: (in class, Tuesday November 15)</i>	20%
<i>Application Mastery Exam: (In class, Tuesday December 06)</i>	6%

Quiz Dates

- Quiz 1 – September 8 (Covering Self-study material)*
- Quiz 2 – September 15 (Covering material up to the end of September 8’s lecture)*
- Quiz 3 – September 22 (Covering material up to the end of September 15’s lecture)*
- Quiz 4 – October 6 (Covering material up to the end of September 27’s lecture)*
- Quiz 5 – October 13 (Covering material up to the end of October 6’s lecture)*
- Quiz 6 – October 20 (Covering material up to the end of October 13’s lecture)*
- Quiz 7 – November 3 (Covering material up to the end of October 25’s lecture)*
- Quiz 8 – November 29 (Covering material up to the end of November 24’s lecture)*

Information on Experience Points (XP)

Experience points are designed to accommodate different ways of learning and demonstrating proficiency. They will essentially be a “choose your own” type of learning. Currently, there are > 40 possible XP available for the class but others will likely be added.

- *Complete the “Tell me about you” questionnaire – worth 1 XP*
- *Make and submit a schedule for the semester – worth 2 XP*
- *Participate in the group test (1.5 marks each time) – worth 3 XP total*
- *Homework assignments (can be completed online through MS Forms or in discussion with Heather during an Office Hour)*
 - Graded as*
 - 3XP – superior answer*
 - 2XP – demonstrated proficiency*
 - 1XP – made an honest attempt*
- *Ask a question during Grad student seminars – 1XP each (max one per seminar)*

Conversion of numerical grades to Final Letter Grades

Undergraduates: follows the 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)	

Graduate: follows the Faculty of Graduate Studies scheme

A+ (90-100)	B+ (77-79)	F (<70)
A (85-89)	B (73-76)	
A- (80-84)	B- (70-72)	

Course Policies on Missed or Late Academic Requirements

There will be no option for make-up quizzes in this class. Quizzes that are not completed will receive a mark of zero. Note that there are 8 scheduled quizzes, but only 6 count toward your grade, so any missed quizzes will be considered as one of the 2 that are dropped.

In case of illness on the date of a mid-term test, you should complete a Student Declaration of Absence form within 72 hours of the missed test. If you miss a mid-term test because of illness, you may be given a makeup exam (at the Dr. Andreas' discretion), alternately, the value of the test will be moved to the Theory Mastery Exam.*

In the case of illness on the date of the Theory Mastery exam, you must contact Dr. Andreas immediately and complete a Student Declaration of Absence form within 72 hours of the missed exam. You will be provided the opportunity for a make-up Theory Mastery Exam.*

In case of illness on the date of Application Mastery exam, you should complete a Student Declaration of Absence form within 72 hours of the missed exam and you will be provided the opportunity for a make-up Application Mastery Exam.*

**Students can use a maximum of two (2) Student Declarations of Absence (SDA) per course per term, based on the Dalhousie University policies surrounding the Student Declaration of Absence forms (https://www.dal.ca/campus_life/safety-respect/student-rights-andresponsibilities/academic-policies/Information%20for%20students/faqs-for-students.html).*

SDA forms will not cover you if you are out for a prolonged period of time due to illness or other reasons. In these situations, email Heather and let me know as soon as possible so I can assist you best. In the case of prolonged absences withdrawing from the class or requesting an ILL grade may be the best course of action.

Cancellations: Weather-related closure of the University implies the cancellation of all courses, including quizzes or tests, which will therefore be moved to the next immediate class date.

Course Policies related to Academic Integrity

This class will be highly collaborative in nature; however, no collaboration will be allowed during the two Midterm Tests or the two Mastery Exams.

Course Content

- *Different types of electrochemical cells (basic electrochemistry)*
- *2 vs. 3 electrode measurements*
- *Reference electrodes*
- *The origin of potential at the interface*
- *Double-layer models*
- *Hg capacitance and the pzc*
- *Electron transfer at the interface*
- *Transport control*
- *Electrochemistry at film covered electrodes*
- *Seminars on electrochemistry in real-world applications*

- **Faculty of Science Course Syllabus (Section B) (revised April-2022)**
 - **Fall/Winter 2022-23**
 - *Chemistry 4311/5311*

- Please ensure that the following information on University Policies is available to all students in your course. This document should be sent to students in your course along with your Course Syllabus, Section A, or may be copied into your **Course Syllabus (Section A)**.

- **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://academiccalendar.dal.ca/Catalog/ViewCatalog.aspx?pageid=viewcatalog&catalogid=117&chapterid=-1&topicgroupid=31821&loaduseredits=False>

- **University Grading Practices**

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

Faculty of Science Course Syllabus (Section C) (revised April-2022)**Fall/Winter 2022-23***Chemistry 4311/5311*

Please ensure that the following information on Student Resources is available to all students in your course. This document should be made available to students on the course Brightspace page, or elements may be copied into your **Course Syllabus**.

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/undergrad-students/degree-planning.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.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>

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