

**Faculty of Science Course Syllabus**

Department of Chemistry

*Chemistry 4311/5311: Fundamentals of Applied Electrochemistry**Fall 2020***Professor:** Dr. Heather Andreas, e-mail: [heather.andreas@dal.ca](mailto:heather.andreas@dal.ca)**Contact:** If you have questions please email me. I will endeavor to answer your email within 24 hours, although emails sent in the evening or on weekends may not be seen until the next business day. In addition, there are three hours per week of office hours:

Tuesdays 12:00-1:00      Thursdays 11:00-12:00      Friday 9:00-10:00

These office hours will be held on Microsoft Teams. **To book time** during one of these office hours, please email me a request with an estimate of the time you think the question will require (up to a maximum of 20 min). I will then book a slot and send you a Teams invitation.**Lectures:** asynchronous delivery – videos available through the course Brightspace page**Prerequisites:** CHEM 2301.03 and CHEM 2304.03 (grade of C- or better)**Course:** This is a fourth year/graduate level, 3 credit hour course in physical chemistry, focussing on electrochemistry.**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).**Web Site:** There will be a Brightspace website for this class. I will convey relevant information through the course website. It is your responsibility to regularly consult the course website.**Text:** There is no formal text for this course. Class notes will be made available through the course website, and various reference books will be highlighted for further reading**Lecture Component Objectives/Learning Outcomes:**

- Examine the most common types of electrochemical cells and experiments
- Examine 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.
- See how electrochemistry is applied in real-world applications.

**List of (approximate) course material:**

- Different types of electrochemical cells
- 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

**Grade Conversions:**Undergraduate:

The usual Faculty of Science scheme for converting numerical grades to letters will be used:

90-100 A+	85-89 A	80-84 A-	77-79 B+	73-76 B	
70-72 B-	65-69 C+	60-64 C	55-59 C-	50-54 D	0-49 F

Graduate:

The usual Faculty of Graduate Studies scheme for converting numerical grades to letters will be used in this class:

90-100 A+	85-89 A	80-84 A-	77-79 B+	73-76 B	70-72 B-	<70 F
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**Grading Scheme:**Undergraduate students:

*Homework:* 20%

*Quizzes:* Nine quizzes, dates given below, lowest quiz grade will be dropped 80%

The final grade will be composed of the eight top quiz grades (each quiz worth 10%).

Graduate students

*Homework:* 16%

*Quizzes:* Nine quizzes, dates given below, lowest quiz grade will be dropped 64%

The final grade will be composed of the eight top quiz grades (each quiz worth 8%).

*Seminar:* (due Nov. 19) 20 %

More information on the seminar is provided below.

**Homework:**

Homework will be composed of multiple self-evaluated questions. They are designed to help you evaluate whether you understand and can articulate the course material. Each quiz (see below) will have a homework assignment associated with it. The homework will open on the Saturday before the quiz (or earlier) and will be **due at 11:59am Halifax time on the Wednesday before the quiz**. *The exception is the last homework assignment, which will open 12:00 Wednesday Dec. 4 and close 11:59am Saturday Dec. 5.*

While you will be submitting your answers to me, I will not mark the assignment for content, but rather for effort; an honest attempt to answer the question gains you the mark for the question, whether or not the answer is correct. I will release the answers on Wednesday afternoon – I then expect you to carefully and critically compare your answer to the correct one and evaluate for yourself whether you are sufficiently well prepared for the quiz.

**You are welcome – and encouraged – to discuss homework questions with other members of the class.** Discussion is one of the easiest ways to learn a concept and to practice articulating the concept. You may also use the class lecture materials and seek out other resources (though the homework will be based on lecture material, so this is not necessary).

The mark for homework will be based on the percentage of homework questions attempted (if 70% of questions are attempted, you earn 70% of the grade associated with homework). There will be no deadline extensions or make-up homework assignments. “Student Declaration of Absence” forms can be applied to one homework assignment, meaning that assignment will not be part of the evaluation for the homework grade.

**Quizzes:**

Nine quizzes will be given, and the lowest quiz grade will be dropped when calculating the final mark. **The quiz will be released at 10:00am Friday and will close 11:59am Saturday.** *The exception is the last quiz, which will open 10:00am Monday Dec. 7 and close 11:59am Tuesday Dec. 8.*

I will not answer emails about quiz material during this period.

The quizzes will be based solely on the material presented in class (including the material presented in the seminars). Quizzes will open at **10:00am Halifax time** on these dates, and close **11:59am Halifax time**. The exact dates of each quiz are listed below.

Quizzes are **individual assessments**; therefore, collaboration of any sort is prohibited and would be considered academic misconduct. This includes, but is not limited to, discussing the quiz with your friends/peers/classmates, TAs/instructors, siblings/family members, and on discussion boards. You are permitted to use the lecture material provided to help you answer the quizzes (i.e., quizzes are “open book”); however, the knowledge must be put into your own words when answering the quiz questions. The use of any other external source of information (such as other books and webpages) is prohibited and would be considered academic misconduct.

Because one quiz grade is already being dropped, there are no make-up quizzes or deadline extensions. However, a “Student Declaration of Absence” forms can be applied to a quiz.

**Quiz dates and Topics**

*The topics covered by each quiz will be posted on Brightspace.*

*Note!* Quizzes may incorporate earlier topics, particularly any topic that students struggled with on earlier quizzes. If there is a topic on which students perform poorly, I will announce it to the class and students should then recognize that it is likely this topic will appear on a later quiz.

Opens Sept. 18 – Closes Sept. 19

Opens Oct. 2 – Closes Oct. 3

Opens Oct. 9 – Closes Oct. 10

Opens Oct. 16 – Closes Oct. 17

Opens Oct. 23 – Closes Oct. 24

Opens Oct. 30 – Closes Oct. 31

Opens Nov. 20 – Closes Nov. 21

Opens Nov. 27 – Closes Nov. 28

Opens Dec. 7 – Closes Dec. 8

**Seminar:**

Each graduate student is required to present a seminar; these seminars will be recorded and uploaded to Brightspace. **The information provided during these seminars is testable material**, so a concise set of handouts covering the material to be presented in the seminar must also be prepared. These handouts can simply be comprised of copies of PowerPoint or other presentation materials. Students will be graded on the seminar presentation and the handouts (e.g. the information contained, the clarity, etc.).

**Important Dates:** **Prior to October 8**, the seminar topic must be discussed and agreed upon with Heather – failure to meet this deadline will result in a loss of 3 of the 20 percentage points assigned to the seminar (see grading scheme, above).

**Thursday, Nov. 19** – The video and handout for seminar is due to Heather by 11:59am. Failure to meet this deadline will result in a loss of 5 of the 20 percentage points assigned to the seminar (note: this is above and beyond any other deductions).

**Length:** *Graduate students* will present a ~20 minute seminar.

**Topics:** The seminar topic must be discussed and agreed upon with Heather the Oct. 8 deadline, see “Important Dates” above. The topic may be related to the student’s research, or may be on an application (e.g., corrosion, energy production/storage, or sensors). Approximately half of the seminar should focus on a fundamental and detailed discussion of the topic. For example, a student studying biosensors would include in their seminar an introduction to biosensors, and how they work, and should include a small survey of the state-of-the-art biosensors. The second half of the seminar should include a discussion of the specifics of the student’s research, and particularly regarding the electrochemical techniques used in the student’s project. Topics should include (but not be limited to):

- How the technique(s) work for the student’s specific system.
- Why that technique was chosen.
- What information is gained from that technique.
- What are the difficulties involved in using that technique.
- What types of electrodes can be used? And what are the electrode requirements? (Size, reversibility, stability)
- What errors are associated with the values from the systems studied?

*Please note that even though some of these topics have likely been presented previously by the student or by fellow graduate students or group members (particularly the fundamentals about the particular topics), it is expected that the material presented in these seminars should be the student’s own original work prepared particularly for this class (no slide materials should be taken from previous presentations).*

**Missed graded components:**

If you cannot complete a homework assignment or quiz because of illness or other extenuating circumstances, you must complete a “Student Declaration of Absence” form within 72 hours of the due date for the missed component. *No due date extensions or make-up quizzes will be provided.*

**Cancellations:**

In the event that any course activity is interrupted due to snow, power outage, or any other event/circumstance in Halifax or at Dalhousie University, please pay close attention to your Dalhousie Email Account and the Announcements made on the Brightspace Course Site for the most up to date information.

***No additional assessments (extra credit assignments or supplementary homework/quiz retakes) will be given. Final grades will be calculated based on the assessments laid out in this syllabus only.***

***Under emergency circumstances that have a serious impact on the delivery of this class, there may be a need to alter the syllabus.***

**Copyright:** The lecture and any other materials provided for this course are subject to the copyright of the course instructor and may not be reproduced or copied in whole or in part without the consent of the instructor. Students who are enrolled in the course who have received this lecture or any other material may reproduce it in order to view it at a more convenient time but must destroy the reproduction within 30 days of receiving the final course evaluation. The course instructor retains copyright for the material, and any use by the Board of Dalhousie or its administration are governed by Section 23.06 of the Collective Agreement.

## 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](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](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](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](mailto:elders@dal.ca)).

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

### Missed or Late Academic Requirements due to Student Absence (policy)

[https://www.dal.ca/dept/university\\_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html](https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html)

## Student Resources and Support

### Advising

**General Advising** [https://www.dal.ca/campus\\_life/academic-support/advising.html](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](https://www.dal.ca/campus_life/communities/indigenous.html)

**Black Students Advising Centre:** [https://www.dal.ca/campus\\_life/communities/black-student-advising.html](https://www.dal.ca/campus_life/communities/black-student-advising.html)

**International Centre:** [https://www.dal.ca/campus\\_life/international-centre/current-students.html](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](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](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](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](https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html)

### Safety

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

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