1. General Course Information

Course:	CHEM 221
Course title:	Materials, Solutions, and Interfaces
Pre-requisites:	(CHEM 109/3.0 and CHEM 110/3.0) or CHEM 112/6.0 and MATH 120/6.0 or MATH 121/6.0 or (MATH 123/3.0 and MATH 124/3.0)
Semester and year:	Winter 2026
Number of credits:	3.0
Learning hours:	126
Modality:	On Campus
Classroom accessibility:	Front Row is Accessible
Course Instructor:	Dr. Paul Duchesne
Contact Information:	paul.duchesne@queensu.ca
Office Hours & Location:	[redacted]

Teaching Assistants: Steven Ganescu and Amiraria Latifzadeh
Contact Information: steven.ganescu@queensu.ca and latifzadeh.a@queensu.ca
Office Hours & Location: TBA

2. Course Description

A survey of the thermodynamic properties of gases and liquids, including phase and chemical equilibria and electrochemistry. An introduction to the properties of materials, interfaces, surfaces and aqueous solutions. The laboratory allows students to use modern software to facilitate equilibrium calculations, illustrate measurement techniques, and develop laboratory skills.

3. Topics

Week	Module	Topic
1	Thermodynamics I	First Law of Thermodynamics
2	Thermodynamics II	Second and Third Laws of Thermodynamics
3	Simple Mixtures I	Simple Mixtures and Phase Diagrams
4	Simple Mixtures II	Fundamental Properties of Solutions
5	Equilibrium Electrochemistry I	Chemical Activities and Binary Phase Diagrams
6	Equilibrium Electrochemistry II	Half-reactions and Cell Potentials
7	Solid Materials I	Structure and Physical Properties
8	Solid Materials II	Crystallography and Diffraction Methods
9	Solid Materials III	Surface Activity & Catalysis
10	Real Materials: Metal Corrosion	Phenomena and Application of Theory
11	Real Materials: Li-ion Batteries	Theory and Fundamentals
12	Review	Pre-exam Review of Challenging Topics

4. Course Learning Outcomes

On successful completion of this course, students will be able to:

1. Understand and apply thermodynamic laws to chemical systems
2. Interpret phase diagrams and utilize the information they contain
3. Understand and apply thermodynamic principles regarding phase changes of matter
4. Calculate activity and equilibria in chemical and electrochemical systems
5. Describe and apply common properties of solids/liquids/gases
6. Describe and interpret data from common interface-characterization techniques

5. Important University Dates

Please visit the Faculty of Arts and Sciences Sessional Dates website for all academic deadlines.

Inclusion

6. Land Acknowledgement

I acknowledge that Queen's University occupies traditional Anishinaabe and Haudenosaunee territory. To acknowledge this traditional territory is to recognize its longer history, one predating the establishment of the earliest European colonies. It is also to acknowledge this territory's significance for the Indigenous Peoples who have lived, and continue to live, upon it and whose practices and spiritualties are tied to the land and continue to develop in relationship to the territory and its other inhabitants today. Indigenous communities in Kingston/Katarokwi continue to reflect the area's Anishinaabe and Haudenosaunee roots. There is also a significant Métis community and First Peoples from other Nations across Turtle Island are present here today. To read more about the history of the land, see the Queen's Encyclopedia and to learn more about land acknowledgements, see the Office of Indigenous Initiatives

7. Equity, Diversity, and Inclusivity Statement

Queen's University recognizes that the values of equity and diversity are vital to and in harmony with its educational mission and standards of excellence. It acknowledges that direct, indirect, and systemic discrimination exists within our institutional structures, policies, and practices and in our community. These take many forms and work to differentially advantage and disadvantage persons across social identities such as race, ethnicity, disability, gender identity, sexual orientation, faith, and socioeconomic status, among other examples. In this class I will work to promote an anti-discriminatory, anti-racist and accountable environment where everyone feels welcome. Every member of this class is asked to show respect for every other member.

8. Building a Classroom Community

University is a place to share, question, and challenge ideas. Each student brings a different set of lived experiences. You can help to create a safer, more respectful classroom community for learners by following these guidelines:

- Make a personal commitment to learn about, understand, and support your peers.
- Assume the best of others and expect the best of them.
- Recognize and value the experiences, abilities, and knowledge each person brings to the course.
- Acknowledge the impact of oppression on other people's lives and make sure your words and tone are respectful and inclusive.
- Encourage others to develop and share their ideas.
- Pay close attention to what your peers say/write before you respond. Think through and re-read what you have written before you post online or send your comments to others.
- Be open to having your ideas challenged and challenge others with the intent of facilitating growth.
- Look for opportunities to agree with one another, building on and intentionally referencing peers' thoughts and ideas; disagree with ideas without making personal attacks, demeaning, or embarrassing others.

9. Fostering Accessibility

All of us have a shared responsibility for reducing barriers to learning and fostering accessibility and promoting meaningful inclusion of those with disabilities. The Accessibility Hub at Queen's University's Human Rights & Equity Office offer a host of tutorials that provide us all with practical tips for:

- Creating accessible documents (e.g., to submit to your teaching team or share with peers in peer feedback activities/in a presentation),
- Emails (e.g., while communicating with group members or your teaching team), and
- Meeting practices (e.g., in tutorials/labs/seminars or virtual meetings).

10. Name/Pronoun

If, for whatever reason, you wish to change how your name appears in onQ and/or on class lists, please follow these steps. You may also use this process to add your pronouns to the appearance of your name.

1. Log into SOLUS.
2. Click on Personal Information tab.
3. Click on the Names tab
4. Click on the Add New Name tab
5. Choose Preferred from the Name Type drop down menu
6. Enter the name you would like to appear in onQ and/or on class lists.
7. Click Save.

Please allow 24 to 48 hours for your name to be registered within the system. If you have further questions or concerns, please contact ITS at Queen's University.

Course Materials & Technologies

11. Required Course Textbooks

Course Textbooks	Edition(s)	Publisher	For Purchase	Cost		At Queen's Library?
Physical Chemistry – Volume 1 (Atkins)	**12th** (or 11th, 10th, 9th)	Oxford University Press	180-day eBook Rental	78 CAD	+ Tax	Yes
			1-year eBook Rental	120 CAD		
			eBook Purchase	165 CAD		

12. Other Required Materials or technologies

Resource	Resource Type	Access	Cost	Further Information
Lecture Slides	Lecture Notes	onQ	Free	Uploaded prior to each lecture

13. Supplemental Materials

Resource	Resource Type	Access	Cost	Further Information
N/A	Select Type.	N/A	N/A	N/A

14. Educational Technologies, Help, Privacy, and Accessibility

This course makes use of the following website(s), program(s), and/or application(s) for specific educational use/purposes.

Privacy: Be aware that your independent use of the website(s), programs, and/or application(s) used in this course*, beyond what is required,* is subject to their terms of use and privacy policy. You are encouraged to review the applicable privacy statements before using the site. Please see below.

Accessibility: Queen's University is committed to developing courses that are accessible. For further information on accessibility compliance of the website(s), program(s) application(s) used in the course, please consult the links below.

15. Copyright of Course Material

Course materials created by the course instructor, including all slides, presentations, handouts, tests, exams, and other similar course materials, are the intellectual property of the instructor. It is a departure from academic integrity to distribute, publicly post, sell or otherwise disseminate an instructor's course materials or to provide an instructor's course materials to anyone else for distribution, posting, sale or other means of dissemination, without the instructor's express consent. A student who engages in such conduct may be subject to penalty for a departure from academic integrity and may also face adverse legal consequences for infringement of intellectual property rights.

Communication

16. Questions about the Course and Contacting the Teaching Team

Questions regarding lectures, practice problems, assignments, or exams should be addressed to Prof. Duchesne via email (paul.duchesne@queensu.ca).

Questions regarding tutorials should be addressed to a student's assigned TA, either Amiraria Latifzadeh (latifzadeh.a@queensu.ca) or Steven Ganescu (steven.ganescu@queensu.ca).

Questions regarding lab experiments and reports should be addressed to the Laboratory Coordinator (kvh4@queensu.ca).

17. Queen's Email

The university communicates with students via Queen's email. Please check your email regularly to ensure you do not miss important information related to your course.

18. Course Feedback

At various points during the course, you may be asked to take part in a variety of feedback activities, such as surveys and questionnaires. This feedback enables the teaching team to improve the course. All surveys are anonymous and are directly related to activities, assessments, and other course material.

Assessments

19. Weighting and Alignment with Course Learning Outcomes (CLOs)

Assessment		**Alignment with CLOs**	**Weighting**
Lab Reports		1,2,3,4	25%
Assignments (5)		1,2,3,4,5,6	15%
In-class Test #1	[redacted]	1,2	10%
In-class Test #2	[redacted]	3,4	10%
Final Exam	TBA	1,2,3,4,5,6	40%
Total			100%

20. Assessment Flexibility

Assignments are designed to provide you with important practice in applying course concepts and feedback regarding your understanding; it is thus critical that you complete and submit each Assignment prior to its indicated deadline. However, to build-in flexibility for all students, only your best 4 Assignments (out of 5) will count towards your grade.

21. Descriptions of Learning Activities and Assessments

Lab Reports
Students will engage in laboratory experiments demonstrating principles and techniques relevant to the material covered in lectures. Following each experiment, they will submit Lab Reports summarizing their findings and allowing them to develop their scientific writing ability.

Assignments
Students will complete Assignments that test their understanding of physical chemistry principles and ability to apply physical laws in solving relevant problems. These Assignments are designed to help students develop their skills and identify areas in which they require further practice before they undertake the more heavily weighted Assessments in this course.

In-class Tests
In-class tests will assess each student's understanding and proficiency in the topics presented during the first 6 Weeks of this course. In-class test questions will be similar in form and content to those presented in weekly Assignments, but will challenge students to use their critical thinking and understanding of the material to a greater extent.

Final Exam
The Final Exam will cover content presented throughout the entirety of this course, but emphasize materials not covered during the preceding Midterm Exam. As was the case for the Midterm Exam, the Final Exam will challenge students to extend their understanding beyond the calculations featured in assignments.

Classroom Component Due Dates:

Assignments: (5 total, lowest grade dropped from average)

Assignment #1 [redacted]
Assignment #2 [redacted]
Assignment #3 [redacted]
Assignment #4 [redacted]
Assignment #5 [redacted]

In-class Tests:

50 min – [redacted] – Covers Weeks 1 through 4 (inclusive)
50 min – [redacted] – Covers Weeks 5 through 8 (inclusive)

Final Exam:

3 h – April (Date/Time TBD) – Covers all lecture content, emphasis on Weeks 9 through 12 (inclusive)

22. Proctored Exams

Timing of Final Examinations

Once the exam schedule has been finalized, the exam date will be posted on your SOLUS account. The exam dates for each term are listed on the Faculty of Arts and Science webpage under "Important Dates." Student exam schedules for the Fall Term are posted on SOLUS immediately prior to Thanksgiving and on the Friday before Reading Week for the Winter Term. Students should **delay finalizing any travel plans until after the examination schedule has been posted**. Exams will **not be moved or deferred** to accommodate employment, travel/holiday plans or flight reservations. For information regarding what is considered extenuating circumstances and qualifications for Academic Consideration, please visit the Faculty of Arts and Science's Academic Consideration webpage.

If you are unable to attend an exam and receive approval for a deferred proctored exam, a further deferral of that exam will not be accommodated.

23. Assignment Submission Policy

Late Policy

5% shall be deducted from an assignment for each day, or portion thereof, that it is late (including weekends). **The absolute last day to submit a late assignment in this course is 7 days after the due date.** Anything that arrives after this will not be accepted without permission of the instructor.

Students with letters of accommodation should confirm the implementation of their accommodations prior to the listed due date. Please see the "Accommodations for Disabilities" section of this syllabus for more information.

Students experiencing short-term extenuating circumstances that are beyond their control and may affect their academic work should submit a request to their faculty office for academic consideration. Please see the "Academic Considerations for Students in Extenuating Circumstances" section of this syllabus for more details.

24. Policy Review of Graded Work

Requests for assignment regrading may be made to your TA a minimum of 48 hours after you have received the marked copy of your assignment, but no more than 10 days later. Be sure to read your TA's feedback carefully before you submit a review of graded work. To request that your assignment be reviewed, please include the following in your email:

- *Your name, student number, and TA's name.*
- *The original copy of your marked assignment, attached.*
- *Your reason for the request:*
    - *The specific aspects of your assignment that you believe were not sufficiently awarded, referring to the categories of the rubric.*
    - *Why you believe that your assignment meets the criteria for a higher mark for each of the categories of the rubric that you indicated above. Please make explicit reference to the detailed descriptions of each category provided in the rubric.*

If a review of graded work results in only a slightly different final grade, the original grade will stand. Should we find an error where marks were not assigned when they should have been or were missed in adding up the total score or were added up incorrectly resulting in a higher score than earned, the grade will be changed so that it is accurate. Grades would only increase or decrease if there was evidence of an error in marking, not simply because the regrader interprets or applies the rubric slightly differently than the original grader.

Policies

25. Class Attendance

Your presence and participation in class contributes to the knowledge and skills that you will develop throughout this course. I expect that you attend class regularly, participate in class conversations and learning activities. These types of activities provide active engagement, promote a deeper understanding of the course content, and contribute to your success in this course.

26. Academic Support

All undergraduate students face new learning and writing challenges as they progress through university: essays and reports become more complex; effectively incorporating research into writing becomes more important; the types of assignments become more diverse; managing

your time and developing the skills you need to read and think critically gets more challenging. I encourage students to contact Student Academic Success Services (SASS). SASS offers many different ways to receive support:

- Free online or in-person appointments to get personalized support on writing and academic skills from expert staff and trained peers.
- Workshops and drop-in programs. SASS' Events Calendar lists events coming soon.
- Online resources that provide strategies for academic skills and writing development at university.
- If English is not your first language, SASS has specific resources for English as Additional Language students, including weekly programs and EAL academic skills appointments. You can meet on an ongoing basis with an EAL consultant to work on your academic writing, speaking, listening, and reading skills.

27. Accommodations for Disabilities

Queen's University is committed to working with students with disabilities to remove barriers to their academic goals. Queen's Student Accessibility Services (QSAS), students with disabilities, instructors, and faculty staff work together to provide and implement academic accommodations designed to allow students with disabilities equitable access to all course material (including in-class as well as exams). If you are a student currently experiencing barriers to your academics due to disability related reasons, and you would like to understand whether academic accommodations could support the removal of those barriers, please visit the QSAS website to learn more about academic accommodations or start the registration process with QSAS by clicking ***Access Ventus*** button at **Ventus | Accessibility Services | Queen's (queensu.ca)**

VENTUS is an online portal that connects students, instructors, Queen's Student Accessibility Services, the Exam's Office and other support services in the process to request, assess, and implement academic accommodations.

To learn more go to: https://www.queensu.ca/ventus-support/students/visual-guide-ventus-students

Academic Consideration for Students in Extenuating Circumstances

Academic Consideration is a process for the University community to provide a compassionate response to assist students experiencing unforeseen, short-term extenuating circumstances that may impact or impede a student's ability to complete their academics. This may include but is not limited to any extenuating circumstance (illness, bereavement, traumatic event, injury, family emergency, etc.) which is short-lived, begins within the term, and will not last longer than 12 weeks - see Academic Consideration webpage for details (https://www.queensu.ca/artsci/undergraduate/student-services/academic-consideration)

Each Faculty has developed a protocol to provide a consistent and equitable approach in dealing with requests for academic consideration for students facing extenuating circumstances. For more information, undergraduate students in the Faculty of Arts and Sciences should consult the Faculty's webpage on Academic Consideration in Extenuating Circumstances and submit a request via the Academic Consideration Request Portal. Students in other Faculties and Schools who are enrolled in this course should refer to the protocol for their home Faculty.

Students are encouraged to submit requests as soon as the need becomes apparent and to contact their instructor and/or course coordinator as soon as possible once academic consideration has been granted. Any delay in contact may limit the options available for academic consideration. While we encourage instructors to accommodate, each instructor has discretion in deciding whether or how to apply the Academic Consideration. For more information on the Academic Consideration process, what is and is not an extenuating circumstance, and to submit an Academic Consideration request, please see the Faculty of Arts and Science's Academic Consideration website. ASO courses include links to information on **Academic Consideration** on your **Course Homepage** in onQ.

Please see the Teaching Team page for contact information for your instructor and TA(s), where relevant.

For more information, please see the Senate Policy on Academic Consideration for Students in Extenuating Circumstances.

Queen's Policy Statement on Academic Integrity

Queen's University is dedicated to creating a scholarly community free to explore a range of ideas, to build and advance knowledge and to share the ideas and knowledge that emerge from a range of intellectual pursuits. Each core value of academic integrity, as defined in the Senate Academic Integrity Policy, gives rise to and supports the next.

Honesty appears in presenting one's own academic work, whether in the context of an examination, written assignment, laboratory or seminar presentation. It is in researching one's own work for course assignments, acknowledging dependence on the ideas or words of another and in distinguishing one's own ideas and thoughts from other sources. It is also present in faithfully reporting laboratory results even when they do not conform to an original hypothesis. Further, honesty is present in truthfully communicating in written and/or oral exchanges with instructors, peers and other individuals (e.g. teaching assistants, proctors, university staff and/or university administrators).

Trust exists in an environment in which one's own ideas can be expressed without fear of ridicule or fear that someone else will take credit for them.

Fairness appears in the proper and full acknowledgement of the contributions of collaborators in group projects and in the full participation of partners in collaborative projects.

Respect, in a general sense, is part of an intellectual community that recognizes the participatory nature of the learning process and honours and respects a wide range of opinions and ideas. However, "respect" appears in a very particular sense when students attend class, pay attention, contribute to discussion and submit papers on time; instructors "show respect by taking students' ideas seriously, by recognizing them as individuals, helping them develop their ideas, providing full and honest feedback on their work, and valuing their perspectives and their goals" ("The Fundamental Values of Academic Integrity", 3rd Edition, p. 8).

Ultimately, responsibility is both personal and collective and engages students, administrators, faculty and staff in creating and maintaining a learning environment supported by and supporting academic integrity.

Courage differs from the preceding values by being more a quality or capacity of character – "the capacity to act in accordance with one's values despite fear" ("The Fundamental Values of Academic Integrity", 3rd edition, p. 10). Courage is displayed by students who make choices and integrous decisions that are followed by action, even in the face of peer pressure to cheat, copy another's material, provide their own work to others to facilitate cheating, or otherwise represent themselves dishonestly. Students also display courage by acknowledging prior wrongdoing and taking proactive measures to rectify any associated negative impact.

All of these values are not merely abstract but are expressed in and reinforced by the University's policies and practices.

Syllabus statements for Generative Artificial Intelligence (AI) Tools (select one of the following)

Using generative AI writing tools such as ChatGPT in your submitted work is not permitted in this class. This type of use constitutes a Departure from Academic Integrity, as defined by Queen's University Academic Integrity procedures.

Queen's Student Academic Success Services (SASS) offers a self-directed, online academic integrity module which we encourage all students to take which will help with:

- Understanding the nature of the academic integrity departure
- Understanding the expectations of and role of sources in scholarly writing
- Integrating sources into your writing (paraphrasing, quoting, summarizing)
- Understanding when and how to cite your sources
- Managing your time effectively to avoid the need for shortcuts
- Taking effective notes to ensure accuracy of source material and correct attribution

28. Copy Rights Use Statement

Course materials created by the course instructor, including all slides, presentations, handouts, tests, exams, and other similar course materials, are the intellectual property of the instructor. It is a departure from academic integrity to distribute, publicly post, sell, or otherwise disseminate an instructor's course materials or to provide an instructor's course materials to anyone else for distribution, posting, sale or other means of dissemination, without the instructor's express consent. A student who engages in such conduct may be subject to penalty for a departure from academic integrity and may also face adverse legal consequences for infringement of intellectual property rights. For more information, please see: https://www.queensu.ca/secretariat/policies/administration-and-operations/copyright-compliance-and-administration-policy.