

**Introduction to Chemical Analysis**  
**CHEM/ENCH 213**  
*Fall 2024*

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**Questions?** Open door policy.

**LECTURES:** [REDACTED]

**TUTORIALS:** [REDACTED]

**onQ:** This electronic tool can only be accessed by students registered in CHEM/ENCH 213 by going to <https://onq.queensu.ca/d2l/home>. It contains:

- the course material (i.e. syllabus, slides and practice problems)
- a week-by-week calendar of the topics/tests,
- your grades
- tips to further help you
- a discussion board where questions can be asked about the course material.

**Required Textbook:**

**Quantitative Chemical Analysis**, 10<sup>th</sup> Ed., *Daniel C. Harris and Charles A. Lucy*, Freeman & Company (for those on a tight budget, an earlier Edition can also be used). This textbook is a good investment, as it is also used for CHEM/ENCH 321 and CHEM/ENCH 411.

**LABS**

**Lab Coordinator:** Kristen Harrington  
**Office:** Chernoff 124  
**Phone:** 533-6000 x. 74665      **E-mail:** [kvh4@queensu.ca](mailto:kvh4@queensu.ca)

**Lab Room:** [REDACTED]

**Lab Timetable:** Regular 3-hr lab sessions will be held [REDACTED] as assigned.

**Week 1** (Sept. 3-9): **Introductory Labs (~ 1.5 hrs) - assignment to lab teams and in-lab exercise/quiz – attendance mandatory.**

**Weeks 2-11**, students rotate between the following five experiments:

1. *Direct Spectrophotometric Analysis of Energy Drinks*
2. *UV-VIS Absorbance Spectrophotometry with Multi-wavelength Detection*
3. *Analytical Techniques based on Fluorescence Spectrophotometry*
4. *Microwave Plasma Atomic Emission Spectrometry for the Analysis of a Sports Drink*
5. *Elemental Analysis using Advanced Techniques of Atomic Spectrophotometry*

**Recommended software:** Lab data processing will require *Microsoft Excel*.

## SUMMARY OF ASSESSMENT

Lab reports (5):	30%
Individual in-tutorial tests* (10):	27%
Group in-class tests* (10):	13%
Final exam:	30%

### Lecture component assessment (all open-book) timing and weight

Assessment	Material covered	When (open period when online)	Weight
Individual test* 1 (in tutorial)	Week 1	Wednesday, September 11 <sup>th</sup>	2.7%
Group test* 1 (in class)	Week 1	Thursday, September 12 <sup>th</sup>	1.3%
Individual test 2 (in tutorial)	Week 2	Wednesday, September 18 <sup>th</sup>	2.7%
Group test 2 (in class)	Week 2	Thursday, September 19 <sup>th</sup>	1.3%
Individual test 3 (in tutorial)	Week 3	Wednesday, September 25 <sup>th</sup>	2.7%
Group test 3 (in class)	Week 3	Thursday, September 26 <sup>th</sup>	1.3%
Individual test 4 (in tutorial)	Week 4	Wednesday, October 2 <sup>nd</sup>	2.7%
Group test 4 (in class)	Week 4	Thursday, October 3 <sup>rd</sup>	1.3%
Individual test 5 (in tutorial)	Week 5	Wednesday, October 9 <sup>th</sup>	2.7%
Group test 5 (in class)	Week 5	Thursday, October 10 <sup>th</sup>	1.3%
Individual test 6 (in tutorial)	Week 6	Wednesday, October 23 <sup>rd</sup>	2.7%
Group test 6 (in class)	Week 6	Thursday, October 24 <sup>th</sup>	1.3%
Individual test 7 (in tutorial)	Week 7	Wednesday, October 30 <sup>th</sup>	2.7%
Group test 7 (in class)	Week 7	Thursday, October 31 <sup>st</sup>	1.3%
Individual test 8 (in tutorial)	Week 8	Wednesday, November 6 <sup>th</sup>	2.7%
Group test 8 (in class)	Week 8	Thursday, November 7 <sup>th</sup>	1.3%
Individual test 9 (in tutorial)	Week 9	Wednesday, November 13 <sup>th</sup>	2.7%
Group test 9 (in class)	Week 9	Thursday, November 14 <sup>th</sup>	1.3%
Individual test 10 (in tutorial)	Week 10	Wednesday, November 20 <sup>th</sup>	2.7%
Group test 10 (in class)	Week 10	Thursday, September 21 <sup>st</sup>	1.3%
Final exam	Whole course	Date to be set by the Exams Office	30%

**\* There is no make-up test if you miss one.** The best 8 tests out of 10 will be used to calculate the overall test mark for each of the in-tutorial and in-class tests. If you write all the tests and perform better in the final exam than in the tests, the weight of the latter will be shifted to the final.

**Students must pass BOTH the lecture and the laboratory components to pass the course.** Otherwise, the lowest of 47% or the student's actual mark will be allocated. Students who do not attend all lab sessions may be assigned a grade of incomplete (IN) and be required to attend and pass the missed lab(s) the following year before the IN is cleared from their transcript.

## **Learning objectives**

### **The instructor will:**

- ◆ Explain the fundamentals of analytical chemistry in a down-to-earth, relevant way.
- ◆ Review and deepen some of the knowledge acquired in first year chemistry.
- ◆ Teach new material using in-class learning activities involving student participation to deepen student learning.
- ◆ Entice students to think critically by deliberately making mistakes for students to find.
- ◆ Give feedback to students within a week of each test.
- ◆ Inasmuch as possible, answer questions on onQ by the next workday.
- ◆ Give lots of examples both in class and on onQ.

## **Learning expectations and outputs**

### **Students will:**

- ◆ Come prepared to every lab.
- ◆ Submit lab reports on time.
- ◆ Attend every lecture and participate in the learning activities.
- ◆ Do the (unmarked) assignments and the (marked) weekly in-tutorial and in-class tests.
- ◆ Be valued members of their team during weekly group tests.
- ◆ Ask questions on onQ so that everybody may benefit from the answers.

## **Learning outcomes**

### **At the end of this course, students will be able to:**

- ◆ Demonstrate the proper use of the balance, pipets, burets and volumetric flask.
- ◆ Assess the quality of a result and the validity of a method.
- ◆ Accurately analyse samples by UV-visible spectrophotometry, fluorescence spectrophotometry and atomic spectrometry techniques.
- ◆ Calculate the concentrations of different species of a compound in solution.
- ◆ Prepare buffers in various ways.
- ◆ Perform titrations successfully and interpret the results.

## **Topics covered**

### **Analytical Process**

1. The Analytical Chemist's Job, General Steps in a Chemical Analysis, SI Units, Chemical Concentrations, Preparing Solutions and Stoichiometry Calculations. (*Chapters 0-1*)

### **Tools**

2. Proper use of the analytical balance, burette, volumetric flask and pipets (*Chapter 2*)

### **Measurements**

3. Types of Error, Gaussian Distribution, Mean, Standard Deviation, Significant Figures, Propagation of Uncertainty. (*Chapters 3-4*)
4. Confidence Intervals, Comparison of Means with Student's t, Grubbs Test for an Outlier. (*Chapter 4*)

5. Calibration curves, Linear Regression and Least Squares, Standard Addition, Internal Standards, Quality Assurance and Method Validation (*Chapters 4-5*)

### **Atomic spectrometry**

6. Atomic spectrometry with flame, graphite furnace and plasma: fundamentals, instrumentation and applications (*Chapter 21*)

### **Spectrophotometry**

7. Spectrophotometry: fundamentals, instrumentation and applications (*Chapters 18-20*)
8. Fluorescence and phosphorescence in chemical analysis (luminescence) (*Section 18-7*)

### **Chemical Equilibrium**

9. Equilibrium constant, solubility product, complex formation, protic acids and bases, pH, systematic treatment of equilibrium (*Chapters 6, 8, 13*)
10. Monoprotic and polyprotic acids, bases and buffers (*Chapters 9-10*)

### **Titrations**

11. Titrations: Calculations, Potentiometric, Spectrophotometric, Precipitation and complexometric Titrations, Titration of a Mixture, End-Point Detection (*Chapters 7, 11-12*).

### **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. Queen's students, faculty, administrators and staff therefore all have responsibilities for supporting and upholding the fundamental values of academic integrity. Academic integrity is constituted by the five core fundamental values of honesty, trust, fairness, respect and responsibility and by the quality of courage. These values and qualities are central to the building, nurturing and sustaining of an academic community in which all members of the community will thrive. Adherence to the values expressed through academic integrity forms a foundation for the "freedom of inquiry and exchange of ideas" essential to the intellectual life of the University.

The following statements from "The Fundamental Values of Academic Integrity" (2nd edition), developed by the International Center for Academic Integrity (ICAI), contextualize these values and qualities:

1. **Honesty** Academic communities of integrity advance the quest for truth and knowledge through intellectual and personal honesty in learning, teaching, research, and service.
2. **Trust** Academic communities of integrity both foster and rely upon climates of mutual trust. Climates of trust encourage and support the free exchange of ideas which in turn allows scholarly inquiry to reach its fullest potential.
3. **Fairness** Academic communities of integrity establish clear and transparent expectations, standards, and practices to support fairness in the interactions of students, faculty, and administrators.

4. **Respect** Academic communities of integrity value the interactive, cooperative, participatory nature of learning. They honor, value, and consider diverse opinions and ideas.
5. **Responsibility** Academic communities of integrity rest upon foundations of personal accountability coupled with the willingness of individuals and groups to lead by example, uphold mutually agreed-upon standards, and take action when they encounter wrongdoing.
6. **Courage** To develop and sustain communities of integrity, it takes more than simply believing in the fundamental values. Translating the values from talking points into action -- standing up for them in the face of pressure and adversity — requires determination, commitment, and courage.

Students are responsible for familiarizing themselves with and adhering to the Senate [regulations](#) concerning academic integrity, along with [Faculty or School](#) specific information. Departures from academic integrity include, but are not limited to, plagiarism, use of unauthorized materials, facilitation, forgery and falsification. Actions which contravene the regulation on academic integrity carry sanctions that can range from a warning, to loss of grades on an assignment, to failure of a course, to requirement to withdraw from the university. 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.

### **Copyright of Course Materials**

Course materials created by the course instructor, including all slides, presentations, handouts, tests, exams, postings on the CHEM/ENCH 213 onQ website, 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.

### **Timing of Proctored 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.**

## 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.

## 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,

- Short term Physical or Mental Illness or Injury (stomach flu, anxiety/depression, mononucleosis, concussion, broken bones, surgery, medical treatments, etc.)
- Traumatic Event/Confidential (Bereavement, serious injury, illness or required treatment for a significant other/family member or a traumatic event such as divorce, sexual assault, social injustice, etc.)
- Requirements by Law or Public Health Authorities (court dates, jury duty, requirements to isolate, etc.)
- Significant Event (varsity athletic event, distinguished event, serving in the Reserve Forces, etc.)

Queen's University is committed to providing academic consideration to students experiencing extenuating circumstances. For more information, please see the [Senate Policy on Academic Consideration for Students in Extenuating Circumstances](#).

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.

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](#).

## **Turnitin Statement**

This course makes use of Turnitin, a third-party application that helps maintain standards of excellence in academic integrity. Normally, students will be required to submit their course assignments through onQ to Turnitin. In doing so, students' work will be included as source documents in the Turnitin reference database, where they will be used solely for the purpose of detecting plagiarized text in this course. Data from submissions is also collected and analyzed by Turnitin for detecting Artificial Intelligence ([AI-generated text](#)). These results are not reported to your instructor at this time but could be in the future.

Turnitin is a suite of tools that provide instructors with information about the authenticity of submitted work and facilitates the process of grading. The similarity report generated after an assignment file is submitted produces a similarity score for each assignment. A similarity score is the percentage of writing that is similar to content found on the internet or the Turnitin extensive database of content. Turnitin does not determine if an instance of plagiarism has occurred. Instead, it gives

instructors the information they need to determine the authenticity of work as a part of a larger process.

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