SYLLABUS 2026 CHEM/ENCH 321:
Instrumental Chemical Analysis

Course instructor: Dr. Malek Hassan
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Course TA: Ms. Yangyang Wang (yw54@queensu.ca)

Lectures Room: [redacted]
Lectures Time: [redacted]

Office Hours: [redacted].
(If you have any questions or would like to discuss topics from lecture notes and textbook further, you are encouraged to stop by the office hours)

OnQ: This electronic tool can only be accessed by students registered in CHEM/ENCH 321 by going to https://onq.queensu.ca/d2l/home. It contains:

- the course lecture-related material (i.e., syllabus, slides and practice problems)
- a week-by-week calendar of the topics
- information on assessments
- tips to further help you
- a discussion board where course material related questions can be asked.

Learning Goals: (1) Understanding the fundamentals of analytical chemistry and study a range of instrumental techniques. (2) Review and deepen some of the knowledge acquired in first- and second-year chemistry. (3) Understanding analytical methods, tools and learning how to perform relevant calculations.

Learning Outcomes:
At the end of this course, students will be able to:

1. Describe the theoretical basis for chromatographic/electrophoretic methods and how band broadening mechanisms affect chemical separation performance.
2. Draw connections between molecular structure and properties that determine an appropriate chemical separation/detection method.
3. Critically evaluate recent analytical and physical chemistry reports to develop a concise literature review.
4. Examine detector signals to extract qualitative and quantitative information.
5. Identify/justify approaches to prepare samples for chemical analysis.

Assessment of Learning Outcomes:
Assignments will assess outcomes 1-2

Midterm exam will assess outcomes 1-2
Literature review report will assess outcome 1-3,5
Final Exam will assess outcomes 1,2,4,5

Assessment Timing and Weights:

Midterm	25%
Assignments (Two)	20% (i.e., 10% each)
Final Exam	55%

In-class Midterm will be hosted during the lecture time on [redacted]. Location and further details will be provided during the term on onQ.

Grading Method:
All components of this course will receive numerical percentage marks. The final grade you receive for the course will be derived by converting your numerical course average to a letter grade according to Queen's Official Grade Conversion Scale:

Queen's Official Grade Conversion Scale

Grade	Numerical Course Average (Range)
A+	90-100
A	85-89
A-	80-84
B+	77-79
B	73-76
B-	70-72
C+	67-69
C	63-66
C-	60-62
D+	57-59
D	53-56
D-	50-52
F	49 and below

Required textbook:
Quantitative Chemical Analysis, 11th or 10th Ed., *Daniel C. Harris,* Freeman & Company.

Note:
1. Quantitative Chemical Analysis, 9th Ed., *Daniel C. Harris,* Freeman & Company is also okay.
Reading assignment/Questions will be posted in OnQ each week

Course Outline

1.) Introduction to Chromatography Liquid-Liquid Extraction, Partition Coefficient TLC, Resolution, Van Deemter Equation, Sources of Band Broadening, Selectivity Factor, Capacity Factor, Theoretical plates, Qualitative and Quantitative Analysis.

2.) Gas Chromatography: Injectors, Split, Splitless and on-column injection, Silanization, Columns, Packed vs. Capillary, Common stationary phases, Classification of Stationary Phases, Kovats Retention Index, McReynolds Constants, Temperature Programming, Detectors, ECD, FID, TCD, Mass Spectrometry. GC sample Prep., Purge and Trap, Solid Phase Micro-extraction, Headspace sampling.

3.) HPLC: Instrument Components: injectors, high pressure pumps, solvent gradients, guard columns, analytical columns, common stationary phases (reversed and normal phase, bonded, coated, pellicular), elutropic series, detectors, UV-Vis, Fluorescence, Refractive Index, developing and optimizing an HPLC separation.

4.) Electrophoresis, Capillary Electrophoresis, size exclusion chromatography, chiral separation.

5.) Detection methods: Mass Spectrometry, Ionization Methods, Electrospray Ionization (ESI); Electrochemical Analysis: Coulometric Analysis, Voltammetry, Diffusion Current, Polarography, Anodic Stripping, electrochemical biosensors, microfluidics, surface based analysis.

Problem sets: End of chapter questions will be posted on the CHEM/ENCH 321 OnQ site.

Calculator Policy

As noted in Academic Regulation 9.2, "Calculators acceptable for use during quizzes, tests and examinations are intended to support the basic calculating functions required by most Arts and Science courses. For this purpose, the use of the **Casio 991 series calculator** is permitted and is the only approved calculator for Arts and Science students."

Technology

Students are encouraged when possible to work with the most recent versions of software including web browsers, Java, Flash and Adobe Reader.

Web Browsers (for online or blended courses)

onQ performs best when using the most recent version of the web browsers, Chrome or Firefox. Safari and Edge are strongly discouraged as these web browsers are known to cause issues with onQ.

Internet Speed (for online or blended courses)

While wired internet connection is encouraged, we recognize that students may be relying on a wireless connection. A minimum download speed of 10 Mbps and up to 20 Mbps for multimedia is recommended. To test your internet speed, https://www.speedtest.net/

Support (for online or blended courses)
For technology support ranging from setting up your device, issues with onQ to installing software, contact ITS Support Centre https://www.queensu.ca/its/itsc

Academic Integrity
Queen's students, faculty, administrators and staff all have responsibilities for upholding the fundamental values of academic integrity; honesty, trust, fairness, respect, responsibility and courage (see www.academicintegrity.org). These values 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 (see the Senate Report on Principles and Priorities http://www.queensu.ca/secretariat/policies/senate/report-principles-and-priorities).

Students are responsible for familiarizing themselves with the regulations concerning academic integrity and for ensuring that their assignments and their behaviour conform to the principles of academic integrity. Information on academic integrity is available in the Arts and Science Calendar (see Academic Regulation 1 http://www.queensu.ca/artsci/academic-calendars/regulations/academic-regulations/regulation-1), on the Arts and Science website (see https://www.queensu.ca/artsci/students-at-queens/academic-integrity), and from the instructor of this course. Departures from academic integrity include plagiarism, use of unauthorized materials, facilitation, forgery and falsification, and are antithetical to the development of an academic community at Queen's. Given the seriousness of these matters, actions which contravene the regulation on academic integrity carry sanctions that can range from a warning or the loss of grades on an assignment to the failure of a course to a requirement to withdraw from the university.

Copyright of Course Materials
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.

Accommodations for Disabilities
Queen's University is committed to achieving full accessibility for people with disabilities. Part of this commitment includes arranging academic accommodations for students with disabilities to ensure they have an equitable opportunity to participate in all of their academic activities. The Senate Policy for Accommodations for Students with Disabilities was approved at Senate in November 2016 (see https://www.queensu.ca/secretariat/sites/webpublish.queensu.ca.uslcwww/files/files/policies/senateandtrustees/ACADACCOMMPOLICY2016.pdf). If you are a student with a disability and think you may need academic accommodations, you are strongly encouraged to contact

the Queen's Student Accessibility Services (QSAS) and register as early as possible. For more information, including important deadlines, please visit the QSAS website at: http://www.queensu.ca/studentwellness/accessibility-services/

Academic Considerations 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 health issues (e.g., stomach flu, pneumonia, COVID diagnosis, vaccination, etc.)
- Responses to traumatic events (e.g., Death of a loved one, divorce, sexual assault, social injustice, etc.)
- Requirements by law or public health authorities (e.g., court date, isolation due to COVID exposure, etc.)

Queen's University is committed to providing academic consideration to students experiencing extenuating circumstances that are beyond their control and are interfering with their ability to complete academic requirements related to a course for a short period of time. The Senate Policy on Academic Consideration for Students in Extenuating Circumstances is available at http://www.queensu.ca/secretariat/sites/webpublish.queensu.ca.uslcwww/files/files/policies/senateandtrustees/Academic%20Considerations%20for%20Extenuating%20Circumstances%20Policy%20Final.pdf

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. Arts and Science undergraduate students can find the Faculty of Arts and Science protocol and the portal where a request can be submitted. Students in other Faculties and Schools who are enrolled in this course should refer to the protocol for their home Faculty.

For guidance on **submitting requests**, please see refer to the Resource Guides available on the Academic Consideration website under "Applying for Academic Consideration."

N.B: The COVID-19 pandemic is an evolving situation. If you have symptoms or are deemed a close contact of someone with COVID, please access our **COVID-Related Absence Reference Guide** on the Academic Consideration website. This guide will provide you with information on applying for consideration, the types of documentation (including non-medical documentation) you can use to support your request, as well as insight into how the Faculty office will assess these requests.

If you need to request academic consideration for this course, you will be required to provide the name and email address of the instructor/coordinator. Please use the following:
Instructor/Coordinator Name: Malek Hassan
Instructor/Coordinator email address: Hassan.m@queensu.ca

Timing of Final Examinations

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 via SOLUS immediately prior to the Thanksgiving holiday; they are posted on the Friday before Reading Week for the Winter Term and for the summer term, they are individually noted on the Arts and Science Online syllabi. **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.**

Discussion Guidelines

University is a place to share, question and challenge ideas. Each student brings a different lived experience from which to draw upon. To help one another learn the most we can from this experience please consider the following guidelines.

1. Make a personal commitment to learn about, understand, and support your peers.
2. Assume the best of others and expect the best of them.
3. Acknowledge the impact of oppression on the lives of other people and make sure your writing is respectful and inclusive.
4. Recognize and value the experiences, abilities, and knowledge each person brings.
5. Pay close attention to what your peers write before you respond. Think through and re-read your writings before you post or send them to others.
6. It's ok to disagree with ideas, but do not make personal attacks.
7. Be open to being challenged or confronted on your ideas and to challenging others with the intent of facilitating growth. Do not demean or embarrass others.
8. Encourage others to develop and share their ideas.