CHEM 2303

Winter 2026

Instructor: Professor Jeff Smith
Office: Steacie 225
Phone: (613) 520-2600 ext.2408
E-mail: jeff.smith@carleton.ca

Lectures: Tuesdays and Thursdays, 11:35am-12:55pm
In person. Please check Carleton Central for location.

Textbook: Quantitative Chemical Analysis by
Daniel C. Harris, 10th Ed., Freeman, 2019.
$129.99 for 1 term of Achieve access and E-book
https://store.macmillanlearning.com/ca/product/Quantitative-Chemical-Analysis/p/1319164307

Course website: Brightspace will be used. Please visit https://brightspace.carleton.ca for course-related materials.

Office hours: By appointment – send me an email to set up

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Course description: Spectrophotometric analysis using Uv-Vis, fluorescence and FTIR instrumentation. Modern separation methods including CE, GC and LC. Recent techniques and applications using mass spectrometry. Applications of all of the above to real-world analysis including the advancement of environmental, biochemistry and health-related research.

Preclusion: Additional credit for CHEM 2300 and CHEM 2301

Prerequisites: CHEM 1006 with a minimum grade of B-, or CHEM 1002, or CHEM 1101, and (MATH 1007 or MATH 1004)

Lectures three hours a week, laboratory three hours a week

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Homework Management System:

This year a homework management platform will be bundled with the QCA10e textbook called Achieve. It will allow you to work through problems related to the material we are learning to solidify concepts in your mind and help you understand how to relate the theoretical knowledge you are learning to practical situations. The material on Achieve will resemble the types of questions that you will see on Midterms and the Final Exam.

5% of your final grade attributed to your interactions with the Achieve system. Each assignment will be pass/fail and a pass will be a grade of ≥70%.

You can access Achieve through this course in Brightspace.

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Homework Management System:

Please note that Achieve is a 3rd party tool that is integrated into Brightspace and has been vetted by Carleton University for privacy and security. It is not directly licensed or supported by the University. However, I have determined that it is the best tool to meet the learning outcomes in this course. If you have questions or need support with this tool, please contact me. If you have accessibility issues using this tool, please let me know and I will work with the Paul Menton Centre to find solutions for you.

Also note: when you purchase Achieve it comes with access to the e-book for QCA 10th Edition – this is the best deal that you can get on the textbook

Clickers: iClicker will be used for class polling every week for interactive and educational purposes. Cell phones, smart phones and WiFi connected laptops may be used to interact with these polls via text messaging and online answering. The use of iClicker is free with purchase of Achieve, class participation is encouraged, but not mandatory. You must link your iClicker account with this course within Achieve the first time you use it.

Laboratory: Section A1 – Friday 1:35-4:25pm – SC 305
Section A2 – Thursday 8:35-11:25am – SC 305
Section A4 – Thursday 1:35-4:25pm – SC 305
Section A6 – Tuesday 1:35-4:25pm – SC 305

WHMIS: All students registered in this course must successfully complete online training in the Workplace Hazardous Materials Information System (WHMIS) before being allowed to enter the laboratory. The training course takes about 2 hours to complete. If you have done the training before, there is no need to repeat it. If you have not completed the training, email the CHEM 2303 Laboratory Coordinator Graham Galway at grahamgalway@cunet.carleton.ca.

Laboratory Coordinator:

Graham Galway – GrahamGalway@cunet.carleton.ca

Teaching assistants:

Sarah Larose - SarahLarose3@cmail.carleton.ca
Nika Rezaei shad - NikaRezaeishad@cmail.carleton.ca
Noah Lepinsky - NOAHLEPINSKY@cmail.carleton.ca,
Jocelyn Menard - JocelynMenard@cmail.carleton.ca
Grace Tseng - gracetseng@cmail.carleton.ca

Laboratory details:

(a) Laboratories are scheduled to begin in the week of January 5th. The first lab will be an introductory session that is **mandatory to attend** to learn about the format of labs in CHEM 2303 as well as be trained on basic lab skills that will pertain to the rest of the labs in this course – please make sure you attend!

(b) The lab timetable is printed on p. 4 in the lab manual; *students should prepare accordingly*. The new lab manual will be available electronically (via Brightspace) and careful notes on each lab should be made by each student.

Laboratory details (cont.):

(c) The wearing of safety glasses and lab coat is MANDATORY at all times. They can be purchased from the Science Stores. Contact lenses should NOT be worn in the lab. Prescription glasses with safety lenses are permissible; if the glasses are small, goggles will have to be used. **See the safety rules on page 5 of the lab manual.**

(d) Due to the timing and equipment limitations, it is impossible to coordinate the labs and lectures. The lab manual contains some general information in the Introduction section of each experiment. Students may refer to the textbook for more theory of the technique and method.

(e) **Satisfactory completion of the lab is required to pass the course.** This includes performing all the experiments as scheduled, recording the output signals in the lab, analysing the data at home, and submitting your results on time in either an analysis report form (pages 16-18 in the lab manual) or a formal report (pages 19-20 of lab manual).

Late deductions: **10% per day** (formal report) **10% total** (analysis reports). See pages 16 and 20 of the lab manual for more details.

Laboratory details (cont.):

CHEM 2303 Laboratory Primer Videos!

These short (2-3 min) videos will give you an overview of what to expect in the labs for CHEM 2303 to help you prepare and manage your expectations going into each lab. **They are not a substitute for reading the lab manual!** They are to complement the lab manual and help you understand what you will be doing as you read through the lab manual (and do the pre-lab) prior to every lab. The goal of these videos is to help you hit the ground running for each lab to ensure success and efficient time management.

Experiment 1 – Microwave Digestion of a Vitamin Tablet for Iron Determination
* Experiment 2 – Determination of Copper by Complexation, Solvent-Extraction, and Spectrophotometry
Experiment 3 – Determination of Total Water Hardness by Colourimetric Titration
Experiment 4 – Gas Chromatography of Organic Compounds with Flame Ionization Detection
Experiment 5 – Analysis of Analgesic Tablet by High Performance Liquid Chromatography
Experiment 6 – Determination of Quinine in Tonic Water by Spectrofluorometry
* Experiment 7 – Determination of Total Organic Carbon in Water by Oxidative Combustion Infrared Analysis

https://www.youtube.com/playlist?list=PLABFzZMgnynHcyYjyI6IqQFdV7GMAyEgH

* - formal lab report required

Assignments: Questions and problems will be assigned through the Achieve Homework Platform to help solidify your understanding of the class material. **Interaction with Achieve will be graded.**

Grading:

The final grade for Chemistry 2303 will be based on the following:

Laboratory component:

1) Formal reports (2 @ 7%)	14%
2) Advanced analysis reports (5 @ 1.4%)	7.0%
3) Post-lab notebook pages	3.5%
4) Lab assignment	5.25%
5) TA evaluation	3.5%
6) Online pre-lab quizzes on Brightspace	1.75%
Laboratory subtotal:	**35%**

Achieve:	**5.0%**
Midterm #1:	**12.5%**
Midterm #2:	**12.5%**
Final Exam:	**35.0%**
Total:	**100%**

(Bell curving will not be used on laboratory, midterm, exam or final marks)

Academic Accommodations and Regulations

Carleton is committed to providing academic accessibility for all individuals. You may need special arrangements to meet your academic obligations during the term. The accommodation request processes are outlined on the Academic Accommodations website (https://students.carleton.ca/course-outline/).

Statement on Chat GPT/Generative AI usage

As our understanding of the uses of AI and its relationship to student work and academic integrity continue to evolve, the use of AI may become permissible in this course in the future. However, at the present moment the use of AI in CHEM 2303 is not allowed. Students who are suspected of using AI (Chat GPT/Generative AI) will have their work forwarded to the Office of the Dean of Science for an investigation into academic misconduct.

Statement on Academic Integrity

Students are expected to uphold the values of academic integrity, which include fairness, honesty, trust, and responsibility. Examples of actions that that compromise these values include but are not limited to plagiarism, accessing unauthorized sites for assignments or tests, unauthorized collaboration on assignments or exams, and using artificial intelligence tools such as ChatGPT when your assessment instructions say it is not permitted.

Misconduct in scholarly activity will not be tolerated and will result in consequences as outlined in Carleton University's Academic Integrity Policy. A list of standard sanctions in the Faculty of Science can be found here.

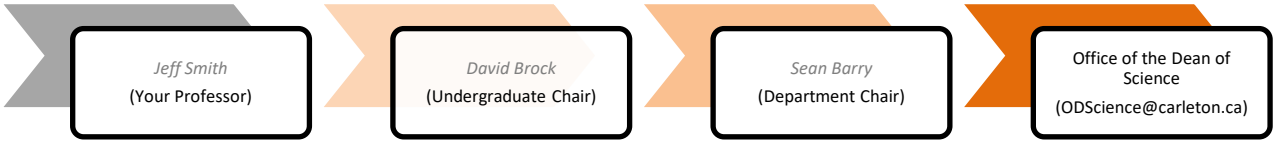
Additional details about this process can be found on the Faculty of Science Academic Integrity website.

Students are expected to familiarize themselves with and abide by Carleton University's Academic Integrity Policy.

Student Rights & Responsibilities
Students are expected to act responsibly and engage respectfully with other students and members of the Carleton and the broader community. See the 7 Rights and Responsibilities Policy for details regarding the expectations of non-academic behaviour of students. Those who participate with another student in the commission of an infraction of this Policy will also be held liable for their actions.

Mental Health and Wellness:
As a student you may experience a range of mental health challenges that significantly impact your academic success and overall well-being. If you need help, please speak to someone. There are numerous resources available both on- and off-campus to support you. For more information, please consult https://wellness.carleton.ca/.

Student Concerns
If a concern arises regarding this course, **your first point of contact is me**: Email me or visit my office and I will do my best to address your concern. If I am unable to address your concern, the next points of contact are (in this order):



Note: You can also bring your concerns to Ombuds services.

Assistance for Students
Writing and Learning Support: https://carleton.ca/csas/support/
Peer Assisted Study Sessions (PASS): https://carleton.ca/csas/pass/
Math Tutorial Centre: https://carleton.ca/math/math-tutorial-centre/
Science Student Success Centre: https://sssc.carleton.ca/

Academic Accommodation for Students with Religious Obligations:
Carleton University accommodates students who, due to religious obligation, must miss an examination, test, assignment deadline, laboratory, or other compulsory event. The University has a Senate-approved policy on religious accommodation that forms part of its Human Rights Policy, available at: www.carleton.ca/equity. Students requesting academic accommodation on the basis of religious observance should make a formal, written request to their instructors for alternate dates and/or means of satisfying academic requirements. Such requests should be made during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist, but no later than two weeks before the compulsory academic event. Accommodation is to be worked out directly and on an individual basis between the student and the instructor(s) involved. Instructors will make accommodations in a way that avoids academic disadvantage to the student. Students or instructors who have questions or want to confirm accommodation eligibility of a religious event or practice may refer to the Equity Services website for a list of holy days and Carleton's Academic Accommodation policies, or may contact an Equity Services Advisor in the Equity Services Department for assistance. Students unable to reach a satisfactory arrangement with their instructor(s) should contact the Director of Equity Services. Instructors who have questions or wish to verify the nature of the religious event or practice involved should also contact this officer. For more details visit the Equity Services website
http://www.carleton.ca/equity/accommodation/student_guide.htm
http://interfaith-calendar.org/

Academic Accommodation for Pregnant Students:
Pregnant students requiring academic accommodations are encouraged to contact an Equity Advisor in Equity Services to complete a letter of accommodation. The student must then make an appointment to discuss her needs with the instructor at least two weeks prior to the first academic event in which it is anticipated the accommodation will be required. For more details visit the Equity Services website http://www.carleton.ca/equity/accommodation/student_guide.htm.

Plagiarism:

Plagiarism is presenting, whether intentional or not, the ideas, expression of ideas or work of others as one's own. Plagiarism includes reproducing or paraphrasing portions of someone else's published or unpublished material, regardless of the source, and presenting these as one's own without proper citation or reference to the original source. Examples of sources from which the ideas, expressions of ideas or works of others may be drawn from include but are not limited to: books, articles, papers, literary compositions and phrases, performance compositions, chemical compounds, art works, laboratory reports, research results, calculations and the results of calculations, diagrams, constructions, computer reports, computer code/software, and material on the Internet.

Examples of plagiarism include, but are not limited to:

- submitting a take-home examination, essay, laboratory report or other assignment written, in whole or in part, by someone else;
- using ideas or direct, verbatim quotations, paraphrased material, algorithms, formulae, scientific or mathematical concepts, or ideas without appropriate acknowledgment in any academic assignment;
- using another's data or research findings;
- submitting a computer program developed in whole or in part by someone else, with or without modifications, as one's own;
- failing to acknowledge sources through the use of proper citations when using another‘s works and/or failing to use quotation marks.

For more information, see: http://science.carleton.ca/students/academic-integrity/

Academic Integrity: Consequences of Academic Misconduct

In the Faculty of Science, sanctions for misconduct under the Academic Integrity Policy of Carleton University will normally be applied as follows:

•A first offence will result in a grade of zero on the work(s) associated with the misconduct, and a deduction of up to three (3) grade points from the final course grade (e.g. a grade of B could be reduced to a C).

•Any subsequent offences will result in increasingly severe sanctions ranging from:

- A final grade of F in the course.
- Suspension from studies for up to three (3) semesters.
- Expulsion of enrollment from the University.

Note: These sanctions are provided here as guidelines only; more severe sanctions may be applied as appropriate (e.g., in the case of cheating on an examination).

CHEM 2303 Midterm and Final Exam Details

Here is how the midterm and final exam component of CHEM 2303 is going to work:

- There will be 2 midterm exams, one on January 29th, 2026, and one on March 12th, 2026
  - *These midterms will be designed to take 60 minutes to complete but you will have the whole class time (80 minutes) to finish*
  - *The midterms will be held in person during normal class time (or in the MEC if you have approved accommodation(s) through the PMC)*
  - *Make up midterms will not be offered, if a midterm is missed, the weight of the other midterm and final exam will be adjusted to compensate for the removal of the midterm. If both midterms are missed, your final exam will be worth 60% (not recommended!!)*

- There will be a 3 hour formally scheduled final exam that will take place in April 2026
  - *The exam will be designed to take 120 minutes to complete but you will have 180 minutes to finish*
  - *The exam will be in person and administered by exam services (e.g. in the field house, or in the MEC if you have approved accommodation(s) through the PMC)*

CHEM 2303 Learning Outcomes:

1. Gain an appreciation of the challenges associated with conducting analyses

2. Learn about, understand, and be able to describe several cutting edge technologies that can be used for chemical analysis of complex samples

3. Gain practical skills in the use of several cutting edge technologies that can be used for chemical analysis of complex samples

4. Learn how to collect, record and manipulate data based on measurements to test a hypothesis

5. Gain skills in reporting and discussing the results of analyses

6. Be able to strategize what you would do when presented with an analytical challenge in the real world

Tentative Lecture Schedule**

#	Lecture	Topics	Chapters (N = notes)
1	Jan 6th, 2026	• Presentation / discussion of syllabus	N/A
		• Tips for success	N/A
		• Introduction to the analytical process	Ch. 0
		• Sample preparation	Ch. 28-2
		• Measurement, tools, error and statistics	Ch. 1,2,3, 4-1,-3
		• Error calculations with calibration curves	Ch. 4-8
2	Jan 8th, 2026	• Spectrophotometry	Ch. 18
		• Properties of light	Ch. 18-1
		• Absorption of light	Ch. 18-2
		• Excited states	Ch. 18-6
		• Luminescence	Ch. 18-7
3	Jan 13th, 2026	• Applications of spectrophotometry	Ch. 19, 20
		• UV-Vis spectroscopy	Ch. 20-1,-2,-3, N
4	Jan 15th, 2026	• Fluorimetry	Ch. 18-7, N
		• Fluorescent staining, green fluorescent protein	N
		• Immmunoassays	Ch. 19-5, N

These sections will help you in the lab component of the course and will not be explicitly tested on Midterms

** – Lecture and midterm schedule is subject to change at the discretion of Professor Smith

Tentative Lecture Schedule**

#	Lecture	Topics	Chapters (N = notes)
5	Jan 20th, 2026	• Fourier Transform Infrared Spectroscopy	Ch. 20-5, N
6	Jan 22nd, 2026	• Atomic spectroscopy • Flame and furnace atomization • Inductively coupled plasma (ICP)	Ch. 21 Ch. 21-2 Ch. 21-2, 21-4, N
	Jan 27th, 2026	• *Buffer time to review material for Midterm #1*	*N/A*
	Jan 29th, 2026	• **Midterm #1 on material covered until Jan 23rd** *(Test will be designed to take 60 minutes to complete; however, 80 minutes will be allocated)*	Ch. 0, 1, 18, 19, 20, 21 and N
7	Feb 3rd, 2026	• Electrophoresis • Polyacrylamide gel electrophoresis (PAGE) • Two-dimensional PAGE	Ch. 26-6, N N N
8	Feb 5th, 2026	• Capillary electrophoresis	Ch. 26-6, 26-7

** – Lecture and midterm schedule is subject to change at the discretion of Professor Smith

Tentative Lecture Schedule**

#	Lecture	Topics	Chapters (N = notes)
9	Feb 10th, 2026	• Solvent extraction • Chromatography	Ch. 23-1 Ch. 23-2, 3
10	Feb 12th, 2026	• Separation efficiency • Why bands spread (van Deemter)	Ch. 23-4 Ch. 23-5
	Feb 17th, 2026 Feb 19th, 2026	• *READING BREAK* • *READING BREAK*	
11	Feb 24th, 2026	• Gas chromatography Part 1	Ch. 24
12	Feb 26th, 2026	• Gas chromatography Part 2	Ch. 24
13	Mar 3rd, 2026	• High-performance liquid chromatography (HPLC)	Ch. 25, N
14	Mar 5th, 2026	• Liquid chromatography methods	Ch. 26-1,2,3,4,5

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Tentative Lecture Schedule**

#	Lecture	Topics	Chapters (N = notes)
	Mar 10th, 2026	• *Buffer time to review material for Midterm #2*	*N/A*
	Mar 12th, 2026	• **Midterm #2 on material covered Feb 6th to Mar 7th** *(Test will be designed to take 60 minutes to complete; however, 80 minutes will be allocated)*	Ch. 23, 24, 25, 26 and N
15	Mar 17th, 2026	• Mass spectral interpretation and resolution	Ch. 22-1, 22-2, N
16	Mar 19th, 2026	• Mass spectrometry – methods of ionization • Electron impact (EI) and chemical ionization (CI) • Atmospheric pressure chemical ionization (APCI) • Electrospray ionization (ESI) • Matrix-assisted laser desorption ionization (MALDI)	N Ch. 22-1, N Ch. 22-4, N Ch. 22-4, N Bx. 22-4, N

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Tentative Lecture Schedule**

#	Lecture	Topics	Chapters (N = notes)
17 & 18	Mar 24th, 2026 & Mar 26th, 2026	• Mass spectrometry – methods of separation • Magnetic and electrostatic sector instruments • Quadrupole ion guides • Time-of-flight (TOF)	Ch. 22-3 Ch. 22-1, 22-3, N Ch. 22-3, N Ch. 22-3, N
19	Mar 31st, 2026	• Applications in mass spectrometry • ICP-MS • Proteomics	Ch. 22-4, N Ch. 21-7, N N
	Apr 2nd, 2026	• *Buffer time to review material for Final Exam*	*N/A*
	Apr 7th, 2026	• No Class	N/A
	Apr 2026 ***Time: TBD*** ***Location: TBD***	• ***FINAL EXAM*** • **The exam will cover all of the material covered in this course** • **3 hours in duration**	**Ch. 0, 1, 18, 19, 20, 21, 22, 23, 24, 25, 26 and N**

** – Lecture and midterm schedule is subject to change at the discretion of Professor Smith