Chemistry
UNIVERSITY OF TORONTO

CHM317S: Introduction to Instrumental Methods of Analysis

Course Syllabus – Winter 2025

I TEACHING TEAM

LECTURE INSTRUCTOR

Name: Prof. Rebecca Jockusch
Email: Rebecca.jockusch@utoronto.ca
Office: Lash Miller 253
Student hours (provisional – see course website for links and any updates): Mondays 12:45-1:45 & Wednesdays directly after class until 4:00 pm in LM253, or online by appointment.

LABORATORY INSTRUCTOR

Name: Prof. David Stone
Email: david.stone@utoronto.ca
Office: LM218
Student hours: During labs M–R 10-noon or by appointment

II COURSE OVERVIEW

COURSE DESCRIPTION:
CHM317 is designed to familiarize upper-level undergraduate students with important aspects of instrumental analysis. It is the second in a series of courses covering the science of chemical detection, identification, and measurement. It builds on principles and practices discussed in CHM217. Course topics include optical spectroscopies (absorbance, scattering, emission), mass spectrometry and chemical separations.

STUDENT LEARNING OUTCOMES:
At the end of this course, students will be able to:

- understand how the instrumental techniques discussed in the course (several optical spectroscopies, mass spectrometry and separations) exploit fundamental chemical and physical properties for chemical analyses
- understand, describe and apply the operating principals of the instruments discussed in this course (instruments for measuring UV/visible absorption, IR absorption, fluorescence, tandem mass spectra and separations based on liquid- and gas-chromatography).
- evaluate and use data obtained using the instrumental methods and techniques discussed.
- account for sources of error and noise in instrumental analyses.

- understand the advantages and limitations of the various instrumental techniques discussed, and through this knowledge be able to choose appropriate analytical method(s) to address analytical challenges

PREREQUISITE COURSE(S):
Prerequisites for this course include CHM217(Introduction to Analytical Chemistry), as well as Calculus I and II (e.g., MAT 135 & MAT 136).

READINGS:
Principles of Instrumental Analysis, Skoog, Holler and Crouch 6th Edition (Thomson & Brooks/Cole) or 7th Edition (CENGAGE Learning)

COURSE WEBSITE:
The most detailed and up-to-date information about the course is posted on the course website, which can be found by logging in to your Quercus account at https://q.utoronto.ca. You are advised to check the course website often, as content (summarized below) will be updated regularly.

- Syllabus and Course Schedule
- Announcements
- Lecture Notes
- Problem Sets and Keys
- Tests and Exams from Previous Years
- Laboratory Materials

III COURSE ORGANIZATION

LECTURES:
Lectures are held on Mondays and Wednesdays from 2:00 – 3:00 PM Eastern Time Zone beginning on Jan. 6th. Lecture recordings will NOT routinely be made available.

A tentative schedule of lecture topics (with readings) is posted on the course website, as well as an essentially complete set of lecture notes. We strongly recommend "pre-reading" the text before the associated class periods. This will enable deeper discussion of topics.

Lectures are divided into the following units: (I) introduction to instrumental analysis and optical spectroscopy (Jan), (II) a brief interlude on signals and noise, (III) optical spectroscopy methods (Feb), (IV) mass spectrometry (March) and (V) separations (Mar-Apr).

Notes for lecture will be posted to the course website before class. In past years, many students have found that they learn best by taking their own notes, and only use the posted notes as backups.

Problem Sets will be posted on the Quercus website as the course progresses. The problem sets will not be collected or graded; however, completing the problem sets is *the single best method to prepare* for the two midterms and the final assessment. Answers will also be posted, but the instructors urge you not to look at the answer keys until you are certain that you have the correct answers. If you are uncertain how to solve a problem, it is much better to discuss the problem with you peers, TAs

or course instructors before turning to the posted answers. Old tests and exams will also be posted, but without answers. Working these old tests and exams is also recommended preparation for this year's assessments.

LABORATORIES:
The laboratory component of the course begins with an orientation session (Jan 6, 7, 8 or 9, 10 AM - noon Eastern Time Zone) in the laboratory in Lash Miller (80 St. George St.) Room 6, followed by weekly meetings throughout the semester – see the course website for details for your particular lab group and schedule. The goal of the laboratory component is to provide you with practical experience in using instrumental methods for chemical analysis. You will, in addition, have opportunities to develop and demonstrate key transferrable skills such as: collaboration, communication (primarily written), data analysis and interpretation, and safe working practices. Finally, you will gain experience with techniques, including: reflectance FTIR, fluorescence, and atomic spectroscopy; and both gas and liquid chromatography.

IV EVALUATION/GRADING SCHEME

MARKING SCHEME & DATES/TIMES:
Your final mark in this course comes from two term tests and a final exam (together, 60%) and the collective mark from your laboratory exercises (including lab reports and other assessments) (40%). ***Record the term test dates/times in your calendar now.*** Please inform Prof. Jockusch as early as possible if you are unavailable during a scheduled assessment time. Alternate test sittings or an oral test may be pre-arranged to make up for missed tests.

Assignment (weight)	Date and Time (all times Eastern)
Term Test 1 (12%)	Monday February 10, 6:30 – 8:00 PM, SF 3202
Term Test 2 (23%)	Wednesday March 19, 6:10 – 8:00 PM, MS 2170
Final Exam (25%)	Date (after final lecture) TBD, Time TBD, Place TBD
Laboratory (40%)	See course website

TERM TESTS AND EXAM:
The term tests and exam will be given in person. These exercises will be "closed book," but relevant equations and constants will be provided. The best way to prepare for these exercises is to work the posted problem-sets and/or the copies of old tests/exams and to be sure that you understand the answers. Failure to participate in the term tests or the exam will result in a grade of 'zero'; the only acceptable excuse is an illness or other medical emergency, as addressed below. In such cases, the instructor will work with you to determine a fair reapportionment of the other marked materials.

V COURSE POLICIES

GENERAL:
The University of Toronto is committed to equity, human rights and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. The course instructor will neither condone nor tolerate behaviour that undermines the dignity or self-esteem of any individual in this course and wishes to be alerted to any attempt to create an intimidating or hostile environment. It is our collective responsibility to create a space that is inclusive and welcomes discussion. Discrimination, harassment and hate speech will not be tolerated. If you have any questions, comments, or concerns, you are encouraged to reach out to the staff in the university's Equity Offices.

EXPECTATIONS:
Each member of this course is expected to maintain a:

- professional and respectful attitude during all course activities, including lectures, tests/exams, laboratory exercises, and online activities
- personal calendar/schedule/organizer to ensure that all course activities are completed, and due dates are met
- collection of notes recorded independently based on concepts covered in course activities (students registered with Accessibility Services requiring a class note-taker will have access to this accommodation)
- familiarity with the university policy on Academic Integrity

LABORATORY POLICIES
Laboratory procedures and policies are described in detail in the lab manual, which is available on the course website. Please note in-particular the following policies:

Absences from the Lab:

- In the event of illness, students should notify the lab coordinator and their demo group partners as soon as possible. Students should obtain a completed VOI form from a licenced medical doctor at the time of illness; students may also use the absence declaration feature on ACORN subject to the limitations imposed by Faculty policy. For prolonged absence or complex personal situations, students should ask their college registrar for a Registrar's Letter.
- Make-up labs may be requested, but will be limited by the lab schedule – other courses and researchers use the lab and equipment as well, so make-up labs can only take place during one of the other regularly scheduled lab sections.

Report submission and extensions:

- Reports are due **no later than** end-of-day **before** your next scheduled lab **with the exception** of the 5th report, which is due during the last week of classes (see assignment details for specific dates by lab group)
- Students may make reasonable requests for extensions on an individual basis; such requests should be submitted by email to the lab coordinator

(david.stone@utoronto.ca) as soon as possible but generally **no later than the day before the due date.**

- Students registered with Accessibility Services should bring the lab schedule and report due dates to the attention of their advisor so that they can plan accordingly (advisors may not have access to this information otherwise).
- A lateness penalty of 5% of the maximum possible mark per day past the deadline will be assessed unless an extension has been granted or there is a valid reason (such as a medical emergency) for the delay

ARTIFICIAL INTELLIGENCE

You should write your laboratory report yourself without the assistance of Large Language Model (LLM) tools ("AI") such as ChatGPT. You may use such tools to refine your writing for clarity, spelling, and grammar. If you do so, you must declare this on the front page of your report, and check the resulting text for accuracy and completeness. Remember that these tools do not actually know or understand anything; they simply perform statistical likelihood calculations to generate strings of related words – they certainly did not perform the experiment alongside you!

Most importantly, do not use such tools as a substitute for a scientific search tool. LLMs are known to produce citations that look authentic but are entirely fabricated. You will find excellent guides to appropriate search engines through the Library Resources link on Quercus that have been specifically curated for you by the Chemistry Librarian.

ABSENCES FROM NON-LAB COURSE COMPONENTS:

In-person lectures will not be recorded. You are advised to attend them, but attendance is not required. If an absence is unavoidable, lecture notes and discussions with classmates and/or the instructor can help you catch up. Participation in laboratory exercises is mandatory and if an absence is unavoidable, may be made up upon consultation with the instructor. The only excusable absence from a term test or the final exam is an illness or other emergency. In such a case, ***as soon as possible (ideally before the test/exam***) you must (i) inform the instructor by email or other means, and (ii) declare the absence using the methods outlined by the faculty of arts & science: https://www.artsci.utoronto.ca/current/academics/student-absences (which can include the absence declaration tool in ACORN, a U of T VOI form, and others –see the website for details). In such cases, the instructor will work with you to determine whether to schedule an oral assessment, written assessment or workout a fair reapportionment of the other marked materials.

VI TECHNOLOGY REQUIREMENTS

This course requires the use of computers, and technical challenges are possible. When completing academic work, students are responsible for scheduling enough time to allow for reasonable delays due to technical difficulties to be overcome, so such issues will not be acceptable grounds for deadline extension. Particularly, maintaining an up-to-date independent backup copy of your work is strongly recommended to guard against hard-drive failures, corrupted files, lost computers, etc. Specific guidance from the U of T Vice-Provost, Students regarding student technology requirements is available here: https://www.viceprovoststudents.

utoronto.ca/covid-19/tech-requirements-online-learning/, and advice for students more broadly regarding online learning is available here: https://onlinelearning.utoronto.ca/getting-ready-for-online/.

VII INSTITUTIONAL POLICIES & SUPPORT

ACADEMIC INTEGRITY:
You are encouraged to discuss course content and to work problem-sets and old tests with your classmates. ***However, the lab reports, the two term tests and the final exam must be completed by you and you alone, according to the university's policies on academic integrity.*** Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. The University of Toronto's Code of Behaviour on Academic Matters (https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

- Using someone else's ideas or words without appropriate acknowledgement
- Submitting your own work in more than one course without the permission of the instructor
- Making up sources or facts
- Obtaining or providing unauthorized assistance on any report
- Using websites (such as Chegg.com) to post course material/questions/answers
- Looking at someone else's answers or collaborating/discussing during a test
- Misrepresenting your identity
- Falsifying institutional documents or grades
- Falsifying or altering any documentation required by the University

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from your instructor or from other institutional resources (see https://www.academicintegrity.utoronto.ca/).

COPYRIGHT:
If a student wishes to copy or reproduce course notes or other course materials (outside of standard use for course activities), he or she must obtain the instructor's written consent beforehand. Otherwise, all such reproduction is an infringement of copyright and is absolutely prohibited. More information regarding this is available here: https://library.utoronto.ca/copyright/remote-instruction-copyright-considerations.

ACCESSIBILITY NEEDS:
Students with diverse learning styles and needs are welcome in this course. The University of Toronto is committed to accessibility: if you require accommodations for a disability, or have any other accessibility concerns about the course, please contact the Accessibility Services department as soon as possible. But please be aware that the Accessibility Services department is by law prohibited to share specific details with course instructors. Thus, we strongly recommend that students also contact the laboratory instructor directly as soon as possible to discuss specific needs and what can be done to accommodate them.

ACCOMMODATIONS FOR RELIGIOUS OBSERVANCES:
Following the University's policies, reasonable accommodations will be made for students who observe religious holy days that coincide with the due date/time of an assignment. Students must inform the instructor ***well before the assignment date*** to arrange accommodations.

ADDITIONAL SERVICES & SUPPORT:
- Full library service through University of Toronto Libraries
- Resources on conducting online research through University Libraries Research
- Resources on academic support from the Academic Success Centre
- Learner support at the Writing Centre
- Information for Quercus Support

ACKNOWLEDGEMENT OF TRADITIONAL LANDS:
The Teaching Team acknowledges the land on which the University of Toronto operates. For thousands of years, it has been the traditional land of the Huron-Wendat, the Seneca and, most recently, the Mississaugas of the Credit River. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.