Western Science

Department of Chemistry

# Chemistry 3372G
# Instrumental Analytical Chemistry

Course Outline

(January – April 2024)

Updated: December 20, 2023

## 1. Course Information

Course name: Chemistry 3372G Instrumental Analytical Chemistry
Lecture: [redacted]
Laboratory: [redacted]

**Prerequisites**
The prerequisite for Chemistry 3372G is Chemistry 2272F.

*Unless you have either the requisites for this course or written special permission from your Dean's Designate (Department/Program Counsellors and Science Academic Counselling) to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.*

## 2. Instructor Information


**Course Instructor:** Dr. Lijia Liu
[redacted]

**Lab Coordinator** Dr. Chris Levy
[redacted]

**Teaching Assistants**

Clement Lee
Han Nguyen
Samantha Cousineau
Nishtha Saxena


Students must use only their @uwo.ca email account for all inquiries related to this course. All emails coming from non-UWO servers will be ignored.

# 3. Course Syllabus, Schedule, Delivery Mode

**Course Description**
This course deals with the principles and fundamentals of modern instrumentation in chemical analysis. The content involves quantitative analytical separation and spectroscopy, theoretical and practical aspects of instrumental techniques, and determination of metals and small molecules.

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

- gain an in-depth knowledge of the functionality of modern instrumentation that is at the heart of chemical-analytical methods.
- Understand the physical basis of chromatography-based separation techniques, such as gas chromatography and liquid chromatography, and understand how the instruments perform these tasks.
- understand the physical basis of mass spectrometry and then understand how the instruments perform these tasks.
- gain knowledge on several modern morphological characterization techniques for examining microscale object
- realize the important of surface analysis and the difference between surface and bulk chemistry structure
- provide preliminary assessment on the choice of analytical techniques upon given an analytical task
- become aware of the fundamental importance of integrity and ethics in analytical chemistry.

By a combination of classroom learning reinforced with hands-on experiential learning using modern instrumentation in the laboratory and preparation of professional analytical reports students will become well equipped for technical employment in a commercial or industrial analytical laboratory.

**Course Topics**
The following chapters are intended to be covered (subject to minor revision) in this course. The chapter numbers are based on the textbook by Skoog et al, 7$^{th}$ Edition (See Sec 4 for Course materials).

**Chromatographic Separations (Chapters 26-30)**
- Introduction to analytical separations
- Gas Chromatography
- Liquid chromatography
- Other separation techniques

**High vacuum technology**

**Mass spectrometry (Chapters 11, 20)**
- Introduction of mass spectrometry
- Mass spectrometry for element speciation (ICP-MS)
- Mass spectrometry for structure determination

**Surface analysis techniques (Chapter 21)**

- X-ray photoelectron spectroscopy
- Auger electron spectroscopy
- Scanning electron microscopy
- Scanning probe microscopy

**Key Sessional Dates**

First day of lecture: January 9, 2024
Reading week: February 17-25, 2024
Poster Day (tentative): April 4, 1:00 pm – 4:00 pm
Last day of lecture: April 4, 2024
Exam period: April 11 – 30, 2024

**Contingency plan**

Although the intent is for this course to be delivered in person, should any university-declared emergency require some or all of the course to be delivered online, either synchronously or asynchronously, the course will adapt accordingly. The grading scheme will **not** change. Any assessments affected will be conducted online as determined by the course instructor

# 4. Course Materials

**Textbooks for lectures**

- Recommended

**Principles of Instrumental Analysis, 7th Ed.**
**Skoog, Holler, and Crouch**
**Cengage Learning**

This book is heavily referenced throughout the course. An online version of this textbook is available to view through Western Library.

- Suggested

**Quantitative Chemical Analysis, 10th Ed.**
**Harries and Lucy**
**Macmillan Learning**

Some of the content in the course took reference from this book (required textbook for Chem2272).

**Textbooks for laboratories**

- Required

Lab Manual (absolutely required): 2024 Chemistry 3372G Laboratory Manual (**the 2023 edition or earlier versions will not be acceptable**) .
Lab Notebook: Hayden-McNeil Organic Chemistry Laboratory Notebook with carbonless copy pages. This book (available at the Bookstore and used for other Chemistry courses as well) has removable pages which will be submitted for grading with your lab reports.

**Computer Software**:

- Microsoft Excel for data analysis

**Learning materials**
Lecture notes, additional learning resources (where applicable) will be posted on the OWL (http://owl.uwo.ca) course website.
**Please note that the lectures and labs run on separate OWL sites.**
Students are responsible for checking the course OWL site (http://owl.uwo.ca) on a regular basis for news and updates. This is the primary method by which information will be disseminated to all students in the class.

If students need assistance, they can seek support on the OWL Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

# 5. Methods of Evaluation

Students are evaluated based on their performances both in lab and in lecture.

Summary of components and weights

| | **Component** | **Weight** |
|---|---|---|
| Laboratory | Lab reports | 24% |
| | Analysis of unknown | 5% |
| | Driver's test | 6% |
| Lecture | Poster presentation | 11% |
| | Mid-term Test (1) | 12% |
| | Mid-term Test (2) | 12% |
| | Final exam | 30% |
| Course Total | | 100% |

**Requirements to pass the course:**
Students must attend and complete at least FOUR laboratory sessions, complete the Driver's test, and obtain a combined mark of at least 50% on the laboratory component of the course.
Students who fail to meet any of these requirements will receive a course grade of not greater than 40%, even if the calculated grade is higher. For students with valid excuses, the only remedy against an F in such cases would be to apply for an INC grade through the Dean's Office and complete the missed work the next time the course is offered.

- **Laboratory (35%)**

You will need to submit all the required lab reports to earn your mark for the corresponding components.

***Laboratory reports are to be submitted electronically via LAB SECTION OWL site using Turnitin.***

Submit lab report as MS Word (.doc, .docx) or Portable Document Format (.pdf) file. You are also required to submit the files that were used when completing the lab report as supporting documents, i.e. the Excel (.xlsx) file and, if applicable, the raw chromatogram data (.pdf)."

The Driver's test: Students will be evaluated based on their knowledge on the instrumental analysis experiments they have performed in lab. The **Driver's test is mandatory.** Failed to show up at the Driver's test will result a fail in the lab component.
Detailed instructions will appear as a separate document.

The laboratory component of this course is of particular importance. Performance in your lab work will be monitored closely by the teaching assistants, instructor, and laboratory coordinator. In mid-February, you will receive an interim progress notation on your laboratory competency (related only to your experimental techniques and the safe operation of equipment. Your lab reports are not considered as part of this evaluation). You will receive one of the following evaluations:

**Satisfactory**: you are performing your experiments in a safe and appropriate manner

**Caution**: you have some serious defects in your lab performance and you are in danger of not performing to your best potential. Some of your actions may potentially damage equipment or impede the performance of your lab partner. Remedial action is required, and you should discuss this matter with your teaching assistant.

**Unsatisfactory**: Your lab performance is very poor. You will be asked to meet with the instructor to discuss ways to improve the situation.

Students whose performance in the laboratory is consistently unsafe or destructive, in the opinion of the instructor, will be removed from the laboratory for the remainder of the lab session and reported to the Associate Chair of Chemistry. A zero mark will be assigned to the corresponding lab report. Continued unsafe or destructive performance will, on recommendation of the Department, and with the permission of the Dean of the Faculty, result in the student being excluded from further laboratory sessions in the course and the student will not be entitled to further evaluation in the course.

- **Lecture (65%)**

**Poster presentation (11%)**
You will work in a group of two, to prepare a poster on one analytical technique learnt in this course. The poster should cover the working mechanism, instrumentation, and one or two examples of how this analytical technique is used to solve a scientific question (use current literature as references). You as a group, will present your poster to multiple internal and/or external examiners on a designated poster day (tentatively set on April 4, details will be announced in a separate document posted on OWL).
Your poster will be evaluated by three examiners following an established rubric. An average of the three marks will be your final mark for this item.

**Mid-term Tests (24%)**

There are two Mid-term Tests in this course, each is worth 12% of the total course mark. Both tests will be held in class, and the test questions are in a mixed format (i.e. multiple choices and short answers). Students with accommodated education will be given extra time.
Test 1: February 8, 9:30 am – 10:20 am
Test 2: March 7, 9:30 am – 10:20 am

**Final Exam (30%)**
Date/Time scheduled by Office of Registrar.
The Final Exam will be cumulative. The format of the final exam will be a mixture of multiple choice and short answer questions.

# 6. Accommodation and Accessibility

**Accommodation Policies**
Students with disabilities work with Accessible Education (formerly SSD) which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The Academic Accommodation for Students with Disabilities policy can be found at: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic Accommodation_disabilities.pdf

**Student Absences and Missed Course Components**

Students who are unable to meet their academic responsibilities due to medical or compassionate reasons may submit a request for academic consideration. For each missed piece of work, *regardless of its weight in the total course grade*, you must apply for such consideration by providing valid medical or supporting documentation to the Academic Counselling Office of your Faculty of Registration.

**Accommodation for students with disabilities**. Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. In cases where a student misses a piece of work for reasons related to the disability on file with Accessible Education, the student should request accommodation by contacting Accessible Education instead of the Academic Counselling Office.

**Missed Labs**
Students are required to attend all the lab sessions. There are no make-up labs, and it is not possible to reschedule them. Absence from a lab session will result in a grade of zero for the missed lab. If the missed lab is due to a reason that is approved by Academic Counselling or Accessible Education, the weight of the lab will be shifted to other labs.

**Late Submission (lab reports and poster abstract)**
Late submissions will be accepted if submitted within 48 hours after the due date. Late penalty is 10% mark deduction per 24 hours. Submission made after 48 hours after the due date will be rejected. Students with applicable accommodations recommended by Accessible Education can request a longer one-time deadline extension. To preserve the integrity of evaluation, this extension cannot exceed 7 days after the original due date. Students with disability accommodations who ask for a longer

extension will be excused.

**Missed Poster Day Presentation**
Since this is an activity performed by a team of two, at least one member in the team shall attend the Poster Day presentation. Both members shall receive the same grade. In the unlikely event that both members can't attend the presentation, and both members have obtained approval from Academic Counselling or Accessible Education, the students shall contact the course instructor as soon as possible to arrange alternative presentation method.

**Missed Midterm Tests or Final Exam**
If you are unable to write a midterm test and are granted accommodation, the weight of the missed midterm will be shifted to the other midterm test. If you miss both midterm tests and are excused as well, the weight of the midterm tests will be transferred to the Final exam.
If you are unable to write the Final Exam, contact the Academic Counselling office of your Faculty of Registration as soon as possible. They will assess your eligibility to write the Special Examination. You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation". (see http://www.registrar.uwo.ca/examinations/exam_schedule.html).

If a student fails to write a scheduled Special Examination, the date of the next Special Examination (if granted) normally will be the scheduled date for the final exam the next time this course is offered. The maximum course load for that term will be reduced by the credit of the course(s) for which the final examination has been deferred. See Academic Calendar for details (under Special Examinations).

**Religious Accommodation**
Students should consult the University's list of recognized religious holidays, and should give reasonable notice in writing, prior to the holiday, to the Instructor and an Academic Counsellor if their course requirements will be affected by a religious observance. Additional information is given in the Western Multicultural Calendar:
https://multiculturalcalendar.com/ecal/index.php?s=c-univwo

**Use of electronic devices**
Only basic scientific calculators are permitted on all test and exams. The use of all other electronic devices (cell phones, laptops, tablets, cameras, etc) in exams and tests are prohibited

# 7. Academic Policies

The website for Registrarial Services is http://www.registrar.uwo.ca.

In accordance with policy, http://www.uwo.ca/its/identity/activatenonstudent.html, the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner.

**Plagiarism and cheating are major academic offences.** Tests, exams, and lab reports may be checked with software that searches for unusual coincidences in answer patterns and/or copying that may indicate cheating. Do not copy information from old lab reports.

All lab reports will be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (http://www.turnitin.com ).

**Scholastic offences** are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.

**Laboratory Safety**

Students must seek approval from TAs whenever they leave the laboratory during experiments. They must return within a reasonably short period. Students leaving without approval will not be allowed to return to the lab, and will receive 0% on their lab mark.

# 8. Support Services

Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on add/drop courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters: https://www.uwo.ca/sci/counselling/

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Student Accessibility Services (SAS) at (519) 661-2147 if you have any questions regarding accommodations.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well-being: https://www.uwo.ca/se/digital/.

Learning-skills counsellors at the Student Development Centre (http://www.sdc.uwo.ca) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Students who are in emotional/mental distress should refer to Mental Health@Western (http://www.health.uwo.ca/mental_health) for a complete list of options about how to obtain help.

Additional student-run support services are offered by the USC, http://westernusc.ca/services.

This course is supported by the Science Student Donation Fund. If you are a BSc or BMSc student registered in the Faculty of Science or Schulich School of Medicine and Dentistry, you pay the Science

Student Donation Fee. This fee contributes to the Science Student Donation Fund, which is administered by the Science Students' Council (SSC). One or more grants from the Fund have allowed for the purchase of equipment integral to teaching this course. You may opt out of the Fee by the end of September of each academic year by completing the online form linked from the Faculty of Science's Academic Counselling site. For further information on the process of awarding grants from the Fund or how these grants have benefitted undergraduate education in this course, consult the chair of the department or email the Science Students' Council at ssc@uwo.ca.