Chemistry 3372G
Instrumental Analytical Chemistry
Course Outline
(January – April 2022)

This document provides you with important information regarding this course.
Please refer to this document throughout the term.

Updated: December 20, 2021

1. Course Information

Course Information

Course name: Chemistry 3372G Instrumental Analytical Chemistry
Lecture: Tuesday 9:30 am – 11:30 am, Thursday 9:30 am – 10:30 am, ChB-9*
Laboratory: Monday-Friday, 1:30 – 5:20 pm, ChB-094

First week of the lectures: January 10, 2022
*Please note all lectures in January will be conducted synchronously over Zoom.*

First week of the labs: January 31, 2021 (in-person)
Reading week: February 19-27, 2022
Poster Day (tentative, see sec. 5): April 7, 1:30 pm

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 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
Office: ChB 066
Email: Lijia.liu@uwo.ca
Office Hours: By appointment (in-person or Zoom) scheduled via Email.
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.
**Anticipated 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, 7th 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

**Special seminars (if time permits)**
- Instrumental analysis for industry: process and quality control
- Synchrotron radiation and X-ray absorption spectroscopy

**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 (requested textbook for Chem2272).
Textbooks for laboratories
- Required
Lab Manual (absolutely required): 2022 Chemistry 3372G Laboratory Manual (the 2021 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
- MATLAB (version 2019 or higher) for running the simulation program (absolutely required):
  Western provides site license for downloading and activating MATLAB at https://wts.uwo.ca/sitelicense/matlab/index.html.

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 should check OWL 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. Students are responsible for checking OWL on a regular basis.

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. To pass the course, you must achieve a grade greater than 50% in BOTH (i.e. 50% or greater of the lab component, and 50% or greater of the lecture component).

Summary of components and weights

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
<th>Weight (missed mid-term)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Laboratory</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lab reports</td>
<td>24%</td>
<td>24%</td>
</tr>
<tr>
<td>Analysis of unknown</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Driver’s test</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td><strong>Laboratory total</strong></td>
<td>35%</td>
<td>35%</td>
</tr>
<tr>
<td><strong>Lecture</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poster presentation</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>Mid-term test</td>
<td>15%</td>
<td>-</td>
</tr>
<tr>
<td>Final exam</td>
<td>30%</td>
<td>45%</td>
</tr>
<tr>
<td><strong>Lecture Total</strong></td>
<td>65%</td>
<td>65%</td>
</tr>
</tbody>
</table>
There is a **minimum attendance** requirement, regardless of any academic accommodation. Students must attend and complete at least FOUR laboratory sessions AND the Driver’s test in order to receive a passing grade in the course.

Students must receive a passing grade* for the poster presentation activity. Students much also receive a passing grade on at least one of the exams to pass the course. Students are required to attend all the lab sessions. Except in exceptional circumstances (as determined by the Dean’s office), there are no make-up labs, and it is not possible to reschedule them. Unless the Academic Counselling Office explicitly states an academic accommodation is granted, absence from a lab session will result in a grade of zero for the missed lab.

* Definition of passing grade: 50% or greater of the weight of the item. For example: if one evaluation item weighs 20% of the course total, a passing grade means 10% or greater of the course total.

- **Laboratory (35%)**

You will need 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. Students must pass the laboratory component (reports, analyses of unknowns, the driver’s test, combined score greater than 50% of the lab component) in order to pass the course.

In mid-February, (well before the drop deadline for the course on March 7th 2020), 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 day (20%)**
  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 7, details will be announced in a separate document posted on OWL). In the unlikely event that social gathering is restricted due to uncertainty of the COVID situation, the poster day might be conducted online virtually. 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 Test (15%)**
  Mid-term test will be scheduled first weekend after the reading week (Tentatively March 5). It will be an in-person exam, and in a mixed format (i.e. multiple choices and short answers). Students with accommodated education will be given extra time.

- **Final Exam (30%)**
  Date/Time scheduled by Office of Registrar. The Final Exam will be cumulative, but more weight is placed on the content taught after the mid-term. 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

**Academic Consideration for Student Absence**
Students will have up to two (2) opportunities during the regular academic year to use an on-line portal to self-report an absence during the semester, provided the following conditions are met: the absence
is no more than 48 hours in duration, and the assessment for which consideration is being sought is worth 30% or less of the student’s final grade. Students are expected to contact their instructors within 24 hours of the end of the period of the self-reported absence, unless noted on the syllabus. Students are not able to use the self-reporting option in the following circumstances:

- for exams scheduled by the Office of the Registrar (e.g., December and April exams)
- absence of a duration greater than 48 hours,
- assessments worth more than 30% of the student’s final grade,
- if a student has already used the self-reporting portal twice during the academic year

If the conditions for a Self-Reported Absence are not met, students will need to provide a Student Medical Certificate if the absence is medical, or provide appropriate documentation if there are compassionate grounds for the absence in question. Students are encouraged to contact their Faculty academic counselling office to obtain more information about the relevant documentation.

Students should also note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. **All documentation required for absences that are not covered by the Self-Reported Absence Policy must be submitted to the Academic Counselling office of a student’s Home Faculty.**

For policy on Academic Consideration for Student Absences - Undergraduate Students in First Entry Programs, see: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Consideration_for_absences.pdf and for the Student Medical Certificate (SMC), see: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf

**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:


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).

[optional] 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).

## 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.

**Contingency plan for an in-person class pivoting to 100% online learning**

In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, all remaining course content will be delivered entirely online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will **not** change. Any remaining assessments will also be conducted online as determined by the course instructor.

**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.