

# **Instrumental Analysis CHEM 314-01W/02W/03W – Spring Semester 2024**

**4 Credit hours; Pre-requisites CHEM 212, 214 and CHEM 222 or CHEM 224 and 226**

## **Instructor:**

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## **Course Materials:**

This course is a writing intensive course and will draw from a variety of sources such as books, peer reviewed manuscripts and personal notes. Sakai will serve as the main platform of communication and all materials will be posted there. Additionally, you should have an internet capable device as the majority of the course will be held in the laboratory and we will occasionally view and download materials from the internet.

## **Course Description:**

Analysis of major, minor and trace components in materials is essential in many fields. The lower the concentration of a compound the more sensitive the instrumentation needs to be. In this course we will explore different instrumental techniques to identify traces of a variety of chemicals. The techniques covered are atomic absorption spectrometry (AAS), capillary electrophoresis (CE), fluorometry, gas chromatography coupled with mass spectrometry (GC-MS), ion chromatography (IC), scanning electron microscopy (SEM), UV-Vis spectrometry, and voltammetry. You will learn the capabilities of each instrumentation and how to prepare and analyze your samples with it. After completing the laboratory section, you will write a report about each experiment. The reports will become progressively more elaborate throughout the semester, initially only focusing on the experimental and data aspect of the experiment, and subsequently also including description of the method, data discussion and placing the experiment in the scientific context along with citing references. Each report will be graded, and feedback given about whether it is in-line with the convention in analytical chemistry regarding structure, format, and terminology. You will be able to address the comments and re-submit an improved version of your initial report for re-grading. The final product of the course will be a culmination of the material you learned throughout the semester and will be in the form of a paper resembling a scientific manuscript about an assigned project.

## **Class Procedures and Schedules:**

The course is analysis focused and therefore the majority of the semester will be dedicated to learning and using instrumentation. No Laboratories are scheduled for week 1 (Jan. 17, 19) and week 2 (Jan. 22, 24, 26). All students will meet in FH 7 for the allotted lecture times (12:35-1:25PM). In these first two weeks you will be introduced to the scientific writing process. We will discuss what is needed to compose a peer reviewed manuscript in the field of analytical chemistry, which will include how to structure and format a manuscript and how to use the correct terminology and what is considered plagiarism. We will also look at examples of well written and poorly written manuscripts.

After that, each week will feature a different experiment specific for instrumentation commonly found in the analytical laboratory. Therefore, starting from week 3 (Jan 29) lab and lecture will be combined and only students in section CHEM 314-02W will attend Monday's lab and lecture and only students in section CHEM 313-03W will attend Wednesday's lab and lecture. All students will attend Friday's lecture which will be an introduction to the following week's laboratory experiment. We will be covering eight different instrumental methods throughout the semester. After a brief introduction, you will be able to use the instrumentation and analyze standards and real-life samples. Make sure to take plenty of notes for the subsequent report. There will also be time to ask questions and discuss the data along with looking at other studies.

Reports are due one week after completion of the lab and will be graded and returned with comments of how to improve. All reports need to include a description of the experiment and show your data along with whatever statistical evaluations are appropriate. The reports will get progressively more complex and will eventually also include a detailed description of the method used (Lab 4 and 5), a discussion of the data (Lab 6) and placing the experiment in the wider scientific context (Lab 7 and 8) as well as citations (Lab 4-8).

The grading will be based on the following criteria:

- Clearly structured and organized
- terminology correctly used
- written in understandable language
- figures and tables labeled appropriately
- statistical evaluation performed
- references cited in text and at the end

You will have one week to address the comments and submit an improved version of the report for regrading.

The first report will be graded, but the grade will not count towards the final grade. This assignment is intended as practice and to introduce you into the process of scientific writing. After that each report will count for 10% of the total grade. Therefore, all reports combined will make up 70% of your final grade.

The final two weeks of the semester (April 15-26) will be dedicated to your own project, which will consist of the analysis of a specific analyte in a predetermined sample. You will be able to

design your own analysis protocol independently and use suitable instrumentation with minor supervision. After you completed the experiments, you will summarize your data in form of a scientific manuscript applying what you have learned throughout the semester about scientific writing. The final manuscript should be between 8 and 10 pages double spaced and must include:

Title Page

Abstract

Introduction

Experimental Section

Results and Discussion

Conclusion

References

You are encouraged to use figures and tables to summarize the data and highlight certain aspects of the project.

Please note that Easter falls within the second half of the semester and the Monday lab will not meet on April 1, 2024. To ensure a seamless schedule the Wednesday lab/lecture will also not meet on April 3, 2024. For other important dates please check the detailed spring semester calendar: [https://www.luc.edu/academics/schedules/spring/academic\\_calendar.shtml](https://www.luc.edu/academics/schedules/spring/academic_calendar.shtml)

### Detailed Schedule.

**Red: All students attend according to the sections listed in the table. Everything highlighted in Red will be held in FH7.**

**Blue: Only CHEM 314-02W (or CHEM 314-05W second half of semester) attend; dark blue: laboratory experiments and discussion are held in FH 314; light blue: laboratory assignment due dates.**

**Green: Only CHEM 314-03 (or CHEM 314-06W second half of semester) attend; dark green: laboratory experiments and discussion are held in FH314; light green: laboratory assignment due dates.**

Week	Monday	Wednesday	Friday
1	No class; MLK Day	Jan. 17, 2024- FH7 No Lab. Lecture: Introduction Scientific Writing All Students CHEM 314- 01/02/03W	Jan. 19, 2024- FH7 No Lab. Lecture: Introduction Scientific Writing All Students CHEM 314- 01/02/03W
2	Jan. 22, 2024 – FH7 No Lab. Lecture: Introduction Scientific Writing All Students CHEM 314- 01/02/03W.	Jan. 24, 2024-FH7 No Lab. Lecture: Introduction Scientific Writing All Students CHEM 314- 01/02/03W.	Jan. 26, 2024- FH7 No Lab. Lecture: UV- Vis Spectrometry Basics All Students CHEM 314- 01/02/03W
3	Jan. 29, 2024 -FH 314 Lab1 CHEM 314-02W: UV Vis Spectrometry Lecture CHEM 314-02W: UV Vis Spectrometry Discussion	Jan. 31, 2024- FH314 Lab 1 CHEM 314-03W: UV Vis Spectrometry Lecture CHEM 314-03W: UV Vis Spectrometry Discussion	Feb. 2, 2024 – FH7 No Lab. Lecture: Atomic Absorption Spectrometry Basics. All Students CHEM 314- 01/02/03W.
4	Feb. 5, 2024 – FH314 Lab 2 CHEM 314-02W: Atomic Absorption Spectrometry Lecture CHEM 314-02W: Atomic Absorption Spectrometry Discussion. Lab Assignment 1 Due CHEM 314-02W.	Feb.7, 2024 – FH314 Lab 2 CHEM 314-03W: Atomic Absorption Spectrometry Lecture CHEM 314-03W: Atomic Absorption Spectrometry Discussion. Lab Assignment 1 Due CHEM 314-03W	Feb. 9, 2024 – FH7 No Lab. Lecture: Gas Chromatography Basics All Students CHEM 314- 01/02/03W.
5	Feb. 12, 2024 – FH-314	Feb. 14, 2024 – FH314	Feb. 16, 2024 – FH7 No Lab.

	<p>Lab 3 CHEM 314-02W: Gas Chromatography Lecture CHEM 314-02W: Gas Chromatography Discussion Lab Assignment 2 Due CHEM 314-02W</p>	<p>Lab 3 CHEM 314-03W: Gas Chromatography Lecture CHEM 314-03W: Gas Chromatography Discussion Lab Assignment 2 Due CHEM 314-03W</p>	<p>Lecture: Scanning Electron Microscopy Basics All Students CHEM 314- 01/02/03W</p>
6	<p>Feb 19, 2024 – FH314 Lab 4 CHEM 314-02W: Scanning Electron Microscopy Lecture CHEM 314-02W: Scanning Electron Microscopy Discussion Lab Assignment 3 Due CHEM 314-02W</p>	<p>Feb. 21, 2024 – FH 314 Lab 4, CHEM 314-03W: Scanning Electron Microscopy Lecture CHEM 314-03W: Scanning Electron Microscopy Discussion Lab Assignment 3 Due CHEM 314-03W</p>	<p>Feb. 23, 2024 – FH7 No Lab. Lecture: Summary and Discussion Lab experiments 1 through 4 All students CHEM 314- 01/02/03W</p>
7	<p>Feb. 26, 2024 -FH314 No Lab. Lecture CHEM 314-02W: Feedback to lab reports Lab Assignment 4 Due CHEM 314-02W</p>	<p>Feb. 28, 2024 – FH314 No Lab. Lecture CHEM 314-03W: Feedback to lab reports Lab Assignment 4 Due CHEM 314-03W</p>	<p>March 1, 2024- FH7 No Lab. Lecture: CHEM 314 04W/05W06W students, UV Vis Spectrometry Basics.</p>
8	<p>March 11, 2024 – FH314 Lab1 CHEM 314-05W: UV Vis Spectrometry Lecture: UV Vis Spectrometry Discussion Group A.</p>	<p>March 13, 2024 – FH314 Lab 1 CHEM 314-06W: UV Vis Spectrometry Lecture CHEM 314-06W: UV Vis Spectrometry Discussion</p>	<p>March 15, 2024 -FH7 No Lab. Lecture: Atomic Absorption Spectrometry Basics. All Students. CHEM 314-04/05/06W</p>
9	<p>March 18, 2024 – FH314 Lab 2 CHEM 314-05W: Atomic Absorption Spectrometry Lecture CHEM 314-05W: Atomic Absorption Spectrometry Discussion. Lab Assignment 1 Due CHEM 314-05W.</p>	<p>March 20, 2024 – FH314 Lab 2 CHEM 314-06W: Atomic Absorption Spectrometry Lecture CHEM 314-06W: Atomic Absorption Spectrometry Discussion. Lab Assignment 1 Due CHEM 314-06W</p>	<p>March 22, 2024 -FH7 No Lab. Lecture: Gas Chromatography Basics All Students CHEM 314- 04/05/06W.</p>
10	<p>March 25, 2024 – FH314</p>	<p>March 27, 2024 – FH314</p>	<p>March 29, 2024 No Classes Easter Break</p>

	Lab 3 CHEM 314-05W: Gas Chromatography Lecture CHEM 314-05W: Gas Chromatography Discussion Lab Assignment 2 Due CHEM 314-05W	Lab 3 CHEM 314-06W: Gas Chromatography Lecture CHEM 314-06W: Gas Chromatography Discussion Lab Assignment 2 Due CHEM 314-06W	
11	April 1, 2024 No Classes Easter Break	April 3, 2024 No Lab and Discussion	April 4, 2024 – FH7 No Lab. Lecture: Scanning Electron Microscopy Basics All Students CHEM 314- 04/05/06W
12	April 8, 2024 – FH 314 Lab 4 CHEM 314-05W: Scanning Electron Microscopy Lecture CHEM 314-05W: Scanning Electron Microscopy Discussion Lab Assignment 3 Due CHEM 314-05W	April 10, 2024 – FH314 Lab 4, CHEM 314-06W: Scanning Electron Microscopy Lecture CHEM 314-06W: Scanning Electron Microscopy Discussion Lab Assignment 3 Due CHEM 314-06W	April 12, 2024 – FH7 No Lab. Lecture: Final Project Assignment Details. All students CHEM 314- 01/02/03W
13	April 15, 2024 – FH314 Lab/Lecture CHEM 314-02W: Final Project Assignment Lab Assignment 4 Due CHEM 314-05W	April 17, 2024 – FH314 Lab/Lecture CHEM 314-03W: Final Assignment Lab Assignment 4 Due CHEM 314-06W	April 19, 2024 -FH7 No Lab. Lecture CHEM 314-01/02/03W: Q&A Final Assignment
14	April 22, 2024 – FH314 Lab/Lecture CHEM 314-02W: Final Project Assignment	April 24, 2024 -FH314 Lab/Lecture CHEM 314-03W: Final Assignment	April 26, 2024 – FH7 No Lab. Lecture CHEM 314-01/02/03W: Q&A Final Assignment
15	April 29, 2024 Final Assignment due in Sakai for all students of CHEM 314 at 11:59PM.		

### Assignments and Grading:

The course is writing intensive and therefore your grade will be solely based on written assignments in form of lab reports. You will have the opportunity to improve the grade of an assignment, except the final project, by addressing the suggestions and comments made for the initial version and re-submitting the improved version. Whatever grade (initial or re-submitted) is higher will count towards the final grade.

All assignment due dates are listed in the detailed schedule above.

The first report is due on February 5, 2024 for CHEM 314-02W and February 7 for CHEM 314-03W students and is intended as practice. It will be graded, but not count towards the final grade.

The **second report will be graded** and is due on February 12, 2024 for CHEM 213-02W students and February 14, 2024 for CHEM 314-03W students. It will count 10% of the final grade. Each subsequent report will count also 10% of the final grade hence there will be seven graded reports with 10% each making up 70% of the final grade.

The **final manuscript** is due on *Monday, April 29 at 11:59PM in Sakai* and will count 30% of the final grade. It is a course requirement.

If for any reason a student misses the final assignment, he/she must consult with Dean *Patricoski* (apatricoski@luc.edu).

### ***Grade Composition in %:***

Seven reports: 10% each

Final project: 30%

### ***Grading Scale in %***

100-94%	A
93-88%	A-
87-85%	B+
84-79%	B
78-75%	B-
74-71%	C+
70-64%	C
63-60%	C-
59-50%	D
<50%	F

### Office Hours:

Office hours are scheduled for *Fridays between 9:30AM to 10:30AM or by appointment.*

### Academic Integrity:

All students in this course are expected to have read and to abide by the demanding standard of personal honesty, drafted by the College of Arts & Sciences, which can be viewed at:

<https://www.luc.edu/cas/advising/academicintegritystatement/>

A basic mission of a university is to search for and to communicate the truth as it is honestly perceived. A genuine learning community cannot exist unless this demanding standard is a

fundamental tenet of the intellectual life of the community. Students of Loyola University Chicago are expected to know, to respect, and to practice this standard of personal honesty. Academic dishonesty can take several forms, including, but not limited to cheating, plagiarism, copying another student's work, submitting false documents, and deliberately disrupting the performance of other class members. Standards apply to both individual and group assignments.

Regarding Artificial Intelligence AI: Our provost has written 'Let us all make sure we are learning and sharing best practices and not allowing AI to do the learning for us'. Therefore any work you submit for credit in this course must represent your own ideas and understanding of the assigned material. If you are uncertain whether use of AI may be in conflict with university or course standards, please discuss your concerns with the instructor.

Any instance of dishonesty (including those detailed on the website provided above or in this syllabus) will be reported to The Chair of The Department of Chemistry & Biochemistry who will decide what the next steps may be. At the minimum the student will **receive a grade of "zero" for the item in question and this grade cannot be dropped.**

### **Student Accommodations:**

Loyola University provides reasonable accommodations for students with disabilities. Any student requesting accommodations related to a disability or other condition is required to register with Student Accessibility Center (SAC) located in Sullivan Center. Professors receive the accommodation notification from SAC via Accommodate. Students are encouraged to meet with their professor individually in order to discuss their accommodations. All information will remain confidential. Please note that in this class, software may be used to record class lectures in order to provide equal access to students with disabilities. Students approved for this accommodation use recordings for their personal study only and recordings may not be shared with other people or used in any way against the faculty member, other lecturers, or students whose classroom comments are recorded as part of the class activity. Recordings are deleted at the end of the semester. For more information about registering with SAC or questions about accommodations, please contact SAC at 773-508-3700; [SAC@luc.edu](mailto:SAC@luc.edu) or visit the website <https://www.luc.edu/sac/>.

### **Other Policies:**

#### *Privacy Policy:*

The covered course material will be posted on the Sakai class website within 24 -48 hours after lecture/discussion. Please be aware that the posted course material is copyrighted and cannot be shared with anybody outside the course without written permission by the instructor.

The lectures will not be recorded.

Recording of instructional activities in online or face-to-face classes may be used solely for internal class purposes by the faculty member and students registered for the course and only during the period in which the course is offered. Students will be informed of such recordings by a statement in the syllabus for the course in which they will be recorded.

### **Students with Co-Curricular Activities:**

Students missing classes while representing Loyola University Chicago in an official capacity (e.g., intercollegiate athletics, debate team, model government organization) shall be allowed by the faculty member of record to make up any assignments and to receive notes or other written information distributed in the missed classes.

Students should discuss with faculty the potential consequences of missing lectures and the ways in which they can be remedied. Students must provide their instructors with proper documentation i.e., "[Athletic Competition & Travel Letter](#)" describing the reason for and date of the absence.

This documentation must be signed by an appropriate faculty or staff member and it must be provided to the professor in the first week of a semester. It is the responsibility of the student to make up any assignments. If the student misses an examination, the instructor is required to allow the student to take the examination at another time.

(<https://www.luc.edu/athleteadvising/attendance.shtml>)

Students who will miss class for an academic competition or conference must provide proper documentation to their instructor as early in the semester as possible.

### **Course Repeat Rule:**

Effective with the Fall 2017 semester, students are allowed only THREE attempts to pass Chemistry courses with a C- or better grade. The three attempts include withdrawals (W). After the second attempt, the student must secure approval for a third attempt. Students must come to the Chemistry Department, fill out a permission to register form or print it from the Department of Chemistry and Biochemistry website: <https://www.luc.edu/chemistry/forms/> and personally meet and obtain a signature from either the Undergraduate Program Director, Assistant Chairperson, or Chairperson in Chemistry. A copy of this form is then taken to the Academic Advisor of the student in Sullivan to secure final permission for the attempt.

### **Accommodations for Religious Reasons:**

Students who observe religious holidays, which will cause missing class or otherwise effect performance in the class must alert the instructor within 10 calendar days of the first class meeting of the semester to request special accommodations, which will be handled by a cases by case basis.

### **Mask Policy:**

According to current University policy wearing a mask is optional.