

Lehman College
City University of New York
Department of Chemistry

Instrumental Analysis CHE-449
Fall - 2018

Instructors:

Professor Andrei Jitianu – PhD

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Professor Naphtali O'Connor – PhD

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Course Description

CHE-449 – **Instrumental Analysis**,

Two lectures are offered twice per week Monday and Wednesday 10:00 – 10:50 AM

A laboratory is offered once per week – Monday 11:00 - 4:30 PM

8 hours / 5 credits

Electroanalytical, spectrophotometric, chromatographic, and other instrumental methods as applied to analytical chemistry.

Corequisites or Prerequisites:

CHE 344 and 345

Place of course in degree program

This course is a degree program requirement for Chemistry, and Biochemistry BA and BSc programs.

Academic or Learning Objectives

Student Learning Outcomes: Understand the principles involved in chemical instrument design.

After completing this course students should be able to:

- Identify and name the major instrumental methods,
- Define components and operation of modern chemical instrumentation,
- Understand theoretical background of instrument designs
- Interpret results acquired from various chemical instrumentation,
- Assess the benefits and limitations of different instrumentation methods and instrumental components,
- Identify appropriate instrumental methods for a chemical analysis

- Record experimental data and results in a manner in which it can be read and understood by anyone having a basic knowledge of analytical chemistry,
- Summarize experimental results in concise reports that meet the requirements.
- Effectively read and understand manuscripts on analytical instrumentation and method development

Required Readings

Principle of Instrumental Analysis Seven Edition, by D. A. Skoog, F.J. Holler, S.R. Crouch, at Cengage Learning, 2016, ISBN: 978-1-305-57721-3

Course Requirements and Grading

For this class there will be five laboratory reports and two exams

The final grade will be established as follows:

Laboratory reports - 80% (each experiment 16%):

Exam(s) - 20% (midterm (10%) and final exam (10%))

No make-up exams will be given.

Laboratory Reports: - Laboratory reports are due one week after completion. One point (out of the maximum of one hundred) will be deducted for each day (or part thereof) that the report is late. The reports will be not accepted anymore after three weeks from the date when those were supposed to be turned in.

- The lab reports should:

- have a journal paper format ACS Analytical Chemistry (an example of the Analytical Chemistry article will be distributed by the instructor in the first day of the laboratory)
 - describe the experiments and contain all the chemical equations of the reactions done in the lab,
 - answer to the “Questions to be considered”
 - answer to all questions which will be given by the instructor before each laboratory.
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Attendance Policy

Students **MUST** be present at every class and lab.

A student cannot miss any of the exam. For the final grade the presence at the Final Exam is compulsory.

The attendance to the laboratory is compulsory. A student cannot miss more than two laboratories. For the case of missing more than two laboratories the student will not receive a passing grade. **No make-up laboratories will be given. This is in accordance with the chemistry department’s policy.**

Accommodating Disabilities

Lehman College is committed to providing access to all programs and curricula to all students. Students with disabilities who may need classroom accommodations are encouraged to register with the Office of Student Disability Services. For more

information, please contact the Office of Student Disability Services, Shuster Hall, Room 238, phone number, 718-960-8441.

Classroom Policy:

Food policy: Food and drinks are not allowed in the classroom.

Cell Phone Policy. Cell phones are disruptive, even in vibrate mode. Make sure your cell phones are in silent mode before class starts. Text-messaging during class is also highly disruptive (besides absolutely rude) and is forbidden. If a cell phone rings during class, lecture will be stopped, until the student will shut down the device and the following penalties are applicable

5 pts penalty if your cell phone rings while I am in class; **10 pts penalty** if you continue the disturbance (e.g., by letting it ring again); **15 pts penalty** for 1st ring on 2nd occasion;

Electronic devices Policy No electronic devices can be used or kept accessible during examinations; this includes, but is not limited to i-Phones, cell-phones, beepers, iPods, MP3 players, tape-recorders, PDAs, **bluetooth** and other computing or music devices. Only basic calculators will be allowed.

Academic Integrity

For the college's policy towards academic integrity see the Lehman Undergraduate Bulletin. Students found cheating will be brought on charges of academic dishonesty which can result in a F in the course and even suspension or expulsion from the college. http://www.lehman.edu/lehman/about/policies_pdf/CUNYAcademicIntegrityPolicy.pdf

Course topics

The following topics will be covered:

Vibrational Spectroscopy (FT-IR and Raman); Absorbance Spectroscopy, Fluorescence Spectroscopy, Gas Chromatography, Gas Chromatography- Mass Spectroscopy, High Performance Liquid Chromatography, Electrochemistry (Cyclic Voltammetry).

Nr. Crt. Date	Subject
1. 08/27	Chapter 5 Signal and Noises <ul style="list-style-type: none">- The signal – to noise ratio- Source of noises in instrumental analyses- Signal to Noise enhancement
2. 08/29/2018	Chapter 16 An introduction to Infrared Spectroscopy <ul style="list-style-type: none">- Theory of IR absorption spectroscopy- IR instrumentation
3. 09/05/18	Chapter 16 An introduction to Infrared Spectroscopy (Continuation) <ul style="list-style-type: none">- IR sources and transducers Chapter 17 Application of IR Spectrometry <ul style="list-style-type: none">- MID-IR Absorption Spectrometry

4. 09/12/18	<ul style="list-style-type: none"> - MID-IR Reflection Spectrometry Chapter 18 Raman Spectroscopy <ul style="list-style-type: none"> - Theory of Raman Spectroscopy - Instrumentation <ul style="list-style-type: none"> o SERS
5. 9/17&24	Chapter 2 Basic electronics & Chapter 4 Digital Electronics Chapter 14 An introduction to UV-Visible Spectroscopy <ul style="list-style-type: none"> - Theory of UV-Vis Spectroscopy - UV-Vis instrumentation
4. 9/26 & 10/1	Chapter 15: Molecular Luminescence Spectrometry <ul style="list-style-type: none"> - Theory of Fluorescence and Phosphorescence - Instruments for Measuring Fluorescence and Phosphorescence
5. 10/3&10	Chapter 15: Molecular Luminescence Spectrometry <ul style="list-style-type: none"> - Instruments for Measuring Fluorescence and Phosphorescence - Applications of Photoluminescence - Advances of Fluorescence and Phosphorescence
6. 10/15&17	Chapter 19 An Introduction to NMR <ul style="list-style-type: none"> - Theory of NMR - NMR instrumentation including MRI
7. 10/22&24	Chapter 19 Nuclear Magnetic Resonance Spectroscopy <ul style="list-style-type: none"> - Application of Proton NMR - Carbon-13 NMR - Application of NMR to Other Nuclei - Multi-pulse and Multidimensional NMR
8. 10/29&31	Midterm Exam Chapter 26: Introduction to Chromatographic separations
9. 11/5&7	Chapter 28 Introduction to Liquid Chromatography <ul style="list-style-type: none"> - Liquid Chromatography-HPLC, UPLC - Instrumentation of HPLC
10. 11/12&14	Chapter 20 Introduction to Mass Spectrometry <ul style="list-style-type: none"> - Instrumentations –MS - Applications of LC-MS - Advances of LC-MS
11. 11/19&21	Chapter 27 Gas Chromatography <ul style="list-style-type: none"> - Principles of GLC - Instruments for GLC
12. 11/26&28	Chapter 27 Gas Chromatography and GCMS <ul style="list-style-type: none"> - GC columns and stationary phases - Applications of GC - Advances in GC
13. 12/3&5	Chapter 22 An introduction to Electroanalytical Chemistry <ul style="list-style-type: none"> - Theory of electrochemistry - Instrumental considerations - Applied Experimental conditions
14. 12/10&12	Miscellaneous aspects of Instrumental Analysis
	Final exam

CHE-449 Instrumental Analysis Laboratory
2018 Fall Semester

Please Note: This schedule is subject to minor change so that course material can be best presented. **All reading assignments are to be completed before class.**

Nr. Crt.	Date	Lab
1.	08/27/18	Check-in Discussions about lab reports
2.	09/05/18	Exploring Resolution, Signal and Noise using an FT-IR spectrometer
3.	09/17/18	Building a UV-Vis Spectrometer
4.	09/24/18	Building a UV-Vis Spectrometer (<i>Continuation</i>)
5.	10/1	Building a UV-Vis/fluorescence Spectrometer
6.	10/15	Fluorescence Spectrometry – method development and instrumental design. NMR demonstration.
7.	10/22	Investigating Gas Chromatography
8.	10/29	Investigating Gas Chromatography
9.	11/5	GC-MS Analysis of Fatty Acid Methyl Esters in Egg Yolk
10.	11/12	GC-MS Analysis of Fatty Acid Methyl Esters in Egg Yolk
11.	11/19	Analysis of Caffeine using LC
12.	11/26	Analysis of Caffeine using LC
13.	12/3	Electrochem
14.	12/10	Electrochem and checkout