INSTRUMENTAL ANALYSIS

CHEM 310, Fall 2025

Instructor: Dr. Kautzman (she/her/hers)
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Course Communications:

All course materials will be available on Blackboard. You are responsible for anything sent by the instructor via email or posted on Blackboard. All email communication will be sent to university email accounts; you are responsible for checking your university email account frequently. I will usually respond within 24 hours of receiving an email (48 hours on weekend).

Office Hours:

Tuesday 10 am – 11 am
TBD
Other times by appointment

Class Meeting Times:

Lecture: 9:00am – 9:50am Monday, Wednesday, Friday SC 5252
Lab: Monday, 1:00 PM – 4:50 PM, SC 5339

Required Materials:

- Daniel C. Harris, *Quantitative Chemical Analysis*, 10th Ed., 2020 (ISBN: 1-319-16430-7)
- Access to mobile clicker system
- Safety goggles, black ultra-fine permanent marker, and a bound composition notebook for lab
- Scientific calculator
- QT Clicker manufactured by Turning technologies (available for purchase in the UStore) or the corresponding smart phone app (available at Google Play and iTunes Store). I strongly recommend the app over the physical device.
    - Your clicker or smart phone app must be linked to a registered subscription in order for your entries to be saved. For details on how to register your clicker or app, visit: https://turningtechnologies-5.wistia.com/medias/nrmqd3cag9

Overview:

This is an advanced course in analytical chemistry emphasizing the theory and practice of instrumental analyses. You will learn how professional chemists determine the composition of solutions and materials in both "clean" and complex samples using a variety of widely-used analytical instruments. Topics to be examined include: spectrophotometry, liquid chromatography, gas chromatography, mass spectrometry, atomic spectroscopy, nuclear magnetic resonance spectroscopy, and electrochemical methods. We will also cover important quality assurance considerations, including sample preparation techniques, advanced calibration strategies, and

signal-to-noise ratios. Additionally, emphasis will be place on science writing and your ability to clearly convey scientific results in well-written reports.

Learning Objectives:

After completing this course, you should be able to:

- Determine appropriate analytical techniques required to assess a chemical system
- Explain the operational theory of selected instrumental methods of analysis
- Describe the advantages and limitations of the analytical methods discussed in class
- Perform safe, precise, and accurate analytical procedures in the laboratory
- Apply appropriate computational and statistical tools to assess analytical data
- Propose troubleshooting strategies for common errors associated with instrumental operations
- Critically assess reports related to analytical chemistry from the peer-reviewed literature
- Demonstrate mastery of course material through effective written communication skills

POLICY CONCERNING ELECTRONIC DEVICES

Research has shown that taking notes by hand improves learning relative typing notes on an electronic device (e.g., a laptop). Research has also shown that using electronic devices during class can significantly decrease your performance on exams and adversely affect the performance of your classmates. Therefore, the use of electronic devices (including, but not limited to, cell phones, laptops, tablets, and smart watches) during class is prohibited unless authorized in advance by the instructor. Cell phones must be in silent mode and used only to access the Turning Technologies clicker app during lecture. Cell phones should remain stowed out of sight for the duration of each lab session.

CLASSROOM DIVERSITY AND INCLUSION

The students, faculty, and staff at Towson University represent a diverse and vibrant community of learners and scholars. As a community, we value the unique contributions of each individual and promote active participation in all aspects of the learning process by each community member. Your instructor supports Towson University's goal of fostering a diverse and inclusive educational setting. Your instructor strives to create a classroom environment built upon the principles of mutual respect and support. Toward this end, all participants in this course are expected to demonstrate respect for all other members of the class. If you feel these expectations have not been met, please speak with your instructor or the designated diversity liaison, Dr. Cindy Zeller (czeller@towson.edu).

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

Students with approved accommodations should submit their memo from Accessibility & Disability Services (ADS) authorizing your accommodation(s) *the first week of class*. It is the responsibility of students to present this paperwork in a timely fashion and to follow-up regarding accommodations that require instructor participation (e.g., testing accommodations). Students who think accommodations might be appropriate for them are encouraged to contact ADS https://www.towson.edu/accessibility-disability-services/ (410-704-2638).

ARTIFICIAL INTELLIGENCE POLICY

In this course, the use of all Artificial Intelligence (AI) tools is restricted to support learning rather than replace individual effort. Students may only use AI tools for enhancing understanding of course materials e.g. generating additional practice problems. However, AI is not permitted for completing graded

assignments, exams, quizzes, or any assessments intended to evaluate individual knowledge, skills, or critical thinking. All submissions must represent the student's own work and understanding. Any use of AI tools in permitted contexts must be fully disclosed, including a brief explanation of how they were used. Misuse of AI, including uncredited or unauthorized AI-generated content, will be considered academic misconduct and may result in penalties up to and including a zero for the assignment, or a failing grade for the course.

ACADEMIC INTEGRITY

The reputation of Towson University and the intrinsic value of your academic degree hinge on the personal integrity of each member of the TU community. Your instructor assumes a proactive role in preventing and reporting academic integrity violations; students in this course are expected to do the same. Examples of academic integrity violations include (but are not limited to) all forms of: cheating, plagiarism, unauthorized collaborations, alteration of graded assignments, forgery, falsification, lying, facilitating academic dishonesty, and unfair competition. In particular, the scope and severity of plagiarism is often underestimated. Plagiarism is defined as using someone else's words or ideas without proper acknowledgement. Plagiarism is an "academic felony" that your instructor takes very seriously. The following information concerning plagiarism is provided in the Towson University Student Academic Integrity Policy:

> ***Plagiarism*** *- presenting work, products, ideas, words, or data of another as one's own is plagiarism. Indebtedness must be acknowledged whenever:*
>
> 1. *one quotes another person's actual words or replicates all or part of another's product. This includes all information gleaned from any source, including the Internet.*
> 2. *one uses another person's ideas, opinions, work, data, or theories, even if they are completely paraphrased in one's own words.*
> 3. *one borrows facts, statistics, or other illustrative materials.*
>
> *Because expectations about academic assignments vary among disciplines and instructors, students should consult with their instructors about any special requirements related to citation.*
>
> *Some examples: Submitting as one's own the work of a "ghost writer" or commercial writing service; knowingly buying or otherwise acquiring and submitting as one's own work any research paper or other writing assignment; submitting as one's own work in which portions were produced by someone acting as tutor or editor; collaborating with others on papers or projects without authorization of the instructor.*
>
> *In addition to oral or written work, plagiarism may also involve using, without permission and/or acknowledgement, internet websites, computer programs or files, research designs, ideas and images, charts and graphs, photographs, creative works, and other types of information that belong to another.*
>
> *Verbatim statements must be enclosed by quotation marks, or set off from regular text as indented extracts, with full citation.*

Unless explicitly authorized by the instructor, students may not reference, review, or otherwise rely on assignments (including, but not limited to, problem sets and lab reports) authored by others, including assignments authored by students who were enrolled in CHEM 310 in a previous semester.

The penalty for academic integrity violations may include receiving a failing grade for the assignment or receiving an "F" as the final grade for the course, depending on severity. If you have questions regarding how best to avoid plagiarism and other academic integrity violations, please consult with your instructor.

For some activities in this course, collaboration with your colleagues is encouraged. Examples are provided below to clarify what levels of collaboration are deemed acceptable.

Acceptable Collaboration Activities:

- Consulting with your colleagues when you have methodological and/or calculation-based questions in the laboratory.
- Working in groups to determine what key concepts or general strategies may be relevant to an assignment. Then, each member of the group works alone when writing their responses to the assignment to ensure that one's *individual* understanding of the assignment is expressed in one's *individual* responses.
- Answering a colleague's question in a manner similar to how your instructor would answer the question (i.e., helping your colleague to understand the concepts *without* giving away the answers).

Unacceptable Collaboration Activities:

- Viewing another student's final version of an assignment.
- Sharing Excel spreadsheets which contain anything except raw (unprocessed) data.
- Asking a colleague questions similar to, "Is this the answer you arrived at?"
- Seeking (or providing) answers to assignments or exams.

You are strongly encouraged to review the entire Student Academic Integrity Policy posted at:
http://www.towson.edu/studentaffairs/policies/

COURSE TOPICS

Topics	***Reading Assignment*** (10th edition of textbook)*
QA/QC, Advanced Calibration Techniques	5.1-5.4
Spectrophotometry	19.1; 20.1 – 20.5; additional reading
Noise and signal-to-noise ratios	additional reading
Nuclear magnetic resonance spectroscopy	additional reading
Atomic spectroscopy and ICP-MS	21.1 – 21.5; 21.7
Mass spectrometry and tandem mass spectrometry (including LC-MS/MS)	22.1 – 22.7
Sample extraction/ Sample preparation	23.1; 28 intro.; 28.2 – 28.3
Fundamentals of chromatography (review)	23.2 – 23.5
High-performance liquid chromatography	25.1 – 25.4
Gas chromatography	24.1 – 24.5
Ion chromatography	26.1 – 26.2
Potentiometry	15.1 – 15.6

* Additional reading assignments will periodically be distribute in class and/or posted on Blackboard.

EVALUATION AND GRADING

The course is graded out of 1000 total points. The lecture is worth 65% of the course and lab is worth 35% of the total course grade. There is no curve for the course, and no extra credit assignments will be offered. Your grade will be assigned based on the following scale:

Lecture Evaluation Item	*Contribution to Final Grade*		*Lab Evaluation Item*	*Contribution to Final Grade*
Lecture Assignments	80		**Lab 1 Notecard**	30
Exam 1 Friday, September 26	110		**Lab 1 Assignment**	55
Exam 2 Friday October 24	130		**Lab 2 Assignment**	55
Exam 3 Monday November 24	130		**Lab 4 Assignment**	75
Cumulative Final Exam Wednesday, Dec 10 (8:00 – 10:00 AM)	200		**Lab 5 Assignment**	70
			Lab Interview	65

100	A	93	A-	90	B+	87	B	83	B-	80	C+	77	C	70	D+	67	D	60	F	0

Exams: Exam dates are shown above. **No make-up exams will be given**. If you miss an exam due to an unavoidable (and documented) reason, your percentage score on the final exam will also be your percentage score for the missed exam. During exams, students may not leave the room and must remain in their seats at all times prior to submitting their exam (exception with instructor approval). Students may not access any electronic devices during exams. On some exams, calculators may not be permitted; any "no calculator" exams will be announced in advance. Students not adhering to these policies may receive a grade of "zero" on the exam and may be subject to additional sanctions described in the Academic Integrity Statement.

Lecture Assignments: Most assignments will be completed in class, but some may be given time outside of class. For in-class assignments, **no make-up assignments will be given**.

Lab Assignments: Details on lab assignments will be provided in lab. Grades for lab assignments will be reduced by up to 50% if you do not attend all lab periods associated with the assignment (excepting unavoidable absences with documentation).

Late Policy: Assignments received **up to 24 hours late** will be assessed a **15% late fee** (deducted from the total points available on the assignment). *Assignments submitted more than twenty four hours late will not be accepted.* If you plan on submitting an assignment after the deadline, please inform your instructor as soon as possible.

Re-Grade Policy: If you believe a grading error has been made on an exam or an assignment, you must notify me via email within 48 hours of the grade being posted. In your email, you must clearly explain your rationale for requesting that the exam or assignment be re-graded, including references to the textbook and/or to the peer-reviewed literature. If a re-grade request is accepted, I reserve the right to carefully re-grade the entire exam or assignment.

OTHER IMPORTANT DATES

September 1st (Monday) Labor Day no class
September 3rd (Wednesday)–Last day to Drop/Add
October 17th (Friday)-Fall Break no class

November 3rd (Monday)- Last day to withdraw with a "W"
November 26–30th - Thanksgiving Break no class
December 8 (Monday)- Last day of classes

COPYRIGHT NOTICE

Your instructor retains all copyrights to all original materials distributed in this course (including, but not limited to, hard copies and electronic copies of lecture slides, notes, practice problems, worksheets, assignments, answer keys, lab materials, and exams). Reposting or otherwise distributing these materials without advance written permission from your instructor is prohibited.

SYLLABUS SUBJECT TO CHANGE

Although your instructor makes every effort to adhere to the syllabus in its current form, all information, schedules, due dates, and policies outlined herein are subject to change. Any changes (including those potentially resulting from a University-wide emergency) will be announced via email and/or via Blackboard.

Laboratory Schedule

Fall 2025

Subject to Change with Notice!

Activity	Date(s) of experimental work	Post-lab assignment	Due date of post-lab assignment
Lab #1: UV-vis spectrophotometry	September 8 September 15 September 22	Experimental Results and Questions	Worksheet Due Sept 24 Questions Due Oct 15
*Lab #2:Spectrometer Build**	September 29 October 6	Calculations and Questions	October 29
*Lab #3: Atomic absorption spectroscopy**	October 13 October 20 October 27	Introduction, Results and Discussion	November 12
*Lab #4: High-performance liquid chromatography-Chocolate**	November 3 November 10 November 17	Experimental Section, Calculations and Questions	December 8 by 1PM
Check-out/ Wrap up	November 24	---	---
Notebook Interviews	Dec 1	---	---

***** These experiments will be completed with a partner. Nevertheless, **all** post-lab assignments must be completed **individually.**

CHEM 310 LABORATORY POLICIES

- *Required clothing*: **Long pants** (or skirts covering the ankles) and **closed-toe shoes** are mandatory. Shorts are not permitted. Shoes and socks must **completely** cover the entire foot and ankle. Students lacking appropriate clothing will not be allowed to enter the laboratory.

- *Safety goggles:* Approved safety goggles must be worn at **all times** in the laboratory.

- *Nitrile gloves:* Wearing nitrile gloves while handling concentrated acids/ bases is strongly recommended. Remove gloves as soon as you are finished transferring the chemical. Gloves should never be worn while touching common-use items (faucets, door knobs, computers, etc). Gloves should not be worn in the hallway.

- *Cleanliness:* Cleanliness is a prerequisite for a safe and professional analytical laboratory. In addition to posing significant safety hazards, an unclean or cluttered laboratory calls into question the quality of any data generated therein (If your lab bench is sloppy, how can others trust that your results aren't?). As such, students are required to keep their lab bench, assigned equipment (e.g., balances), and communal areas clean.

- *Food/Drinks:* Eating, drinking, and chewing gum are prohibited in the laboratory. To further minimize exposure to chemicals, you should not place pens in your mouth, and you should avoid touching your face.

- *Be aware of your neighbors:* You will be working in close proximity to your fellow students in this laboratory. Walk slowly and avoid turning around abruptly to minimize bumping into others. If you see your neighbor doing something unsafe, say something to this neighbor and/or alert your instructor.

- *Waste disposal:* Many chemicals **cannot** be safely (or legally) disposed of down the drain. All chemicals must be disposed of as directed. If in doubt, please ask.

- *Accidents:* Notify the instructor **immediately** in the event of any accident or injury (regardless of how minor).

- *Personal electronics:* The use of cell phones and other personal electronic devices is **not** permitted during laboratory (or lecture). Some chemicals in the laboratory can harm your cell phones. Please turn all cell phones off (or place on silent mode) and keep cell phones stowed at all times.

- *Laboratory notebook:* The proper recording of measurements and observations is central to any laboratory science. For all CHEM 310 laboratory experiments, you are required to record all data and observations in a laboratory notebook. Method details should also be recorded when such details are not available elsewhere (e.g., in the lab handouts). Recording method details is particularly important during experiments in which you design the experimental methods.

  A suitable laboratory notebook must be permanently bound with consecutively numbered pages (hand numbering is permissible). Writing notes on scrap paper, paper towels, etc., for later recording is **never** acceptable. Your instructor reserves the right to confiscate any notes recorded outside of your laboratory notebook (e.g., on scrap paper).

- *Working in groups:* For some labs, you will have the opportunity to work in groups while performing the experiment. All group members are responsible for understanding and contributing to all components of the experiment, as well as for recording all methodological details and all raw data in their lab notebook.

- *Pregnant students:* Pregnant students should consult their physicians for advice on whether or not to perform experiments in the laboratory. Students are encouraged to provide their physician with a list of the chemicals that they might be exposed to while in lab. Students should also check the Material Safety Data Sheets (MSDS) to be aware of the hazards posed by chemicals in the laboratory. MSDS sheets are available through the Chemistry Department office (SC 4301).

  If a student is advised against performing laboratory work, the instructor will make appropriate accommodations for the student. Any accommodations will comprise a workload that is approximately equivalent to the regularly scheduled laboratory workload. These accommodations may include:
  - Performing "dry" experiments only in a place free from exposure to ongoing "wet" experiments
  - Performing "wet" experiments at a later date
  - Receiving an incomplete grade in the course pending completion of experimental work

- *Accountability:* Your instructor reserves the right to reduce your grade for violations of the aforementioned lab policies, including (but not limited to) failure to wear goggles at all times, improper waste disposal, failure to keep your lab bench and assigned equipment clean, rowdy/disruptive behavior, use of personal electronic devices, or failure to properly use the laboratory notebook. Flagrant or repeated violations may result in a grade of "F" for the course.