Instructor: Professor C.M. Mauck Kenyon College
Spring 2020, MWF 9:10-10:00 am Department of Chemistry

Overview and Course Objectives

Chemical analysis is central to research and applications within chemistry, biology, engineering, and medicine. Researchers, clinicians, and engineers frequently need to determine the composition and quantity of a sample of interest, with careful and rigorous quantification of measurement error. Modern instrumentation enables a wide range of chemical analyses. In this course, students will:

- understand the physical principles behind common instrumental techniques in chemistry
- evaluate and select the most appropriate analytical technique(s) for an analyte
- identify sources of error and quantify the uncertainty associated with a measurement
- assess the credibility of experimental results
- manipulate data graphically and statistically
- summarize experimental results with clarity through effective written and visual presentation

Information, Materials, & Resources

Location:		Fischman 103
Suggested Text:		Skoog, West, Holler, & Crouch, *Fundamentals of Analytical Chemistry* with additional supplemental texts to be provided by instructor
Office Hours:	W	2:10 – 4:40 pm
	Th	3:10 – 4:10 pm
	F	2:10 – 3:10 pm
		and by appointment (email)
Contact:		Tomsich 314 / 740-427-5949 / mauck1@kenyon.edu
Final Exam:		Thursday, May 7, 8:30 am (plan travel accordingly)

Point Distribution

Exams (3)	300 pts (100 pts ea.) = 35%
Problem Sets (3)	90 pts (30 pts ea.) = 10%
Practicals (3)	150 pts (50 pts ea.) = 17%
Design Assignment	100 pts = 12%
Design Presentation	40 pts = 5%
Literature Report	100 pts = 12%
Final Presentation	80 pts = 9%
Class Participation	20 pts = 3%

Grade	Percent of Total Points Earned
A (+/-)	100% - 90%
B (+/-)	89% - 80%
C (+/-)	79% - 70%
D (+/-)	69% - 60%
F	< 60%

Policies & Expectations

Academic Honesty: Academic integrity is foundational to the work that students and instructors engage in at Kenyon. This course is intended to further your understanding of complex instrumentation and to foster an analytical mindset. Its design and structure anticipates your honest, individual engagement with the material. All students are expected to practice proper ways of documenting and acknowledging those whose ideas and words they draw upon in their work through proper citation and use of quotation. If you are unclear about the expectations for academic honesty, you are encouraged to review the Academic Honesty policy in the Course Catalog; if you are still unsure, please ask for clarification. Specifically in this class, you are encouraged to discuss course material, work collaboratively with classmates on problem sets, and solicit feedback from your peers on writing assignments and lab practical reports. However, all work submitted should be your own, and collaborations or partnerships must be acknowledged appropriately.

Late Work and Absences: Because class attendance is crucial to achieving the learning goals of this course, the course absence policy will result in the reduction of a student's final grade by a third of a letter grade for every absence in excess of two. I understand that emergencies and unavoidable conflicts may arise during the semester. Please notify me by email as soon as possible to discuss

extensions and/or excused absences. Typically, extensions may be granted for 24 hours after the initial due date. Beyond the agreed-upon extension, the grade on the assignment will be reduced by 10% each day. I encourage you to email as well in advance as possible, but in the case of severe illness, I particularly appreciate notice within 24 hours of the absence.

Accessibility & Accommodations: At Kenyon, we strive to create an inclusive and equitable learning environment. Any student with a need for accommodations should contact Student Accessibility and Support Services (SASS) to discuss specific needs. If you require an accommodation, be mindful that you must register with Student Accessibility and Support Services (SASS) each semester. Once you have completed the process through SASS, please email me so that we may meet and make arrangements well in advance of exams or assignments. Any students with challenges securing class materials or meeting basic needs due to resource limitations are encouraged to contact the Office of Diversity, Equity, and Inclusion (ODEI) in addition to meeting with me individually, should they feel comfortable doing so.

Technology and Devices: The use of personal electronic devices including laptop computers and mobile phones is strongly discouraged. These devices are distracting not only to the user but also to others in the class, and have been shown to negatively affect student learning. Mobile phone use is not classroom behavior that will be tolerated and will certainly increase the likelihood you will be called on during lecture and discussion! At times, you may need the use of a laptop for a classroom activity, and you will be notified. Students that require a laptop for note-taking may discuss this accommodation with me individually. Otherwise, notes should be taken on paper. For example, in lieu of taking a cell phone picture of the board, please raise your hand and ask for more time to copy notes or diagrams down.

Title IX: Faculty members are invested in the well-being of each student we teach, and are here to assist you with your work in this course. If you come to an instructor with non-course-related concerns, we will do our best to help. It is important for you to be aware that all faculty members are mandated reporters, and obligated to report to the Office of Civil Rights on campus (OCR) any incidents of harassment, discrimination, sexual misconduct, interpersonal violence, or other form of harassment based on a protected characteristic. Should you need them, there are confidential resources that do not have the same mandatory reporting requirements: the Health and Counseling Center, the College chaplains, and the staff at New Directions Domestic Abuse Shelter & Crisis Center in Mount Vernon.

Email: Email is the most effective way to communicate with me about questions for the course. You may expect a response to email from me within 24 hours (36 hours on weekends); I hope that I may expect the same from you. Please be aware that longer discussions about concepts or inquiries about grading are most appropriately taken up during office hours. Should you find you have a question about due dates, expectations, or assignments, please take a moment to check the syllabus to see if your question is answered there; I also encourage you to check with a classmate to see whether that question was answered previously, particularly if you have missed a class session.

Safety: At times in this course you will need to work in laboratory spaces. All students will need to have taken the department safety quiz and signed the lab safety contract before beginning any laboratory work. If you have not done so yet, please contact me at the beginning of the semester and I will administer safety training. Please remember that your safety is your priority as well as the department's, and act responsibly at all times. Think carefully through the procedures and instrumentation you will be using, and understand the hazards that may apply. If you have any questions whatsoever about safe lab practices, please do not hesitate to ask me (by email or in person).

Participation: Active participation in this course is the best way to facilitate your own learning. Many of our learning goals require risk-taking, such as the development of an analytical mindset and learning to give effective presentations. In light of this, I ask you to take seriously your role in creating a supportive learning community. Often, we will engage in collaborative work, discussion, and feedback in class. Remain aware of biases, both structural and individual, and be mindful of others' experiences and challenges that may differ from your own. Strive for equity, balance, and respect, with

regards to your contributions and the contributions of your teammate or partner. Above all, practice kindness with yourself and one another.

Assignments & Evaluation

Formatting: Formatting of all written work in this course should follow ACS guidelines for citations, figure captions, and tables, with double spaced text in 12 pt Times New Roman with 0.5" margins. Your name or the name of each student in a team should be in the top left corner along with the date, the name of the assignment, and the course number (CHEM341). Please strive for concision and clarity in all writing assignments for this course.

Due Dates: Assignments are due by the beginning of class on the dates on the syllabus schedule below, either electronically via the course Moodle page or in hard copy, to be specified.

Problem Sets: There are three problem sets (PS) due in this course, centered on the following topics: Statistics & Uncertainty; Spectroscopic Techniques; and Chemical Separations. They are due at the beginning of class on the due date. You may collaborate with other students on problem sets but all work presented therein must be your own. I encourage you to begin the problem sets early and to make use of office hours as necessary.

Exams: There are three exams in this course. Exam 1 will cover topics from Weeks 1 & 2. Exam 2 will cover topics from Weeks 4-7. Exam 3 will cover topics from Week 8 and Weeks 11-13. Exams missed without an excused absence will receive a 0.

Practicals: There are three lab practicals in this course, scheduled on the following Fridays: 1/24, 2/14, and 4/17. These are designed to expose students to working and analyzing real chemical data through statistical methods and visual presentation. Students will work in teams to complete these tasks, but each practical will be assessed in lab report form, with each student individually preparing their own report to turn in. The reports must be less than six pages.

Assignments: An important goal for this class is the development of oral, written, and graphical skills, in particular the concise presentation of experimental data in a manner that is legible and clear to a general technical audience. As such, there are two written assignments, both of them coupled with brief presentations.

I. Designing Analytical Experiments: Student teams will propose and investigate a real-world analytical question that is both accessible and of interest to them. Questions may be qualitative, quantitative, or both. Possibilities include "What is the lead content in Kenyon's drinking water?" or "What type of chlorophyll compounds are present in a plant?" This assignment will have three deliverables: (1) a one paragraph proposal, containing a clear question and evidence that the team has done some preliminary literature research to assess how that question could be answered, and a proposed experiment to execute; (3) a presentation of four slides or less summarizing the question and approach(es); (4) a written report, no longer than seven pages including figures. For the report and presentation, teams will present the background and motivation for the question, a description of the analytical techniques needed to answer this question, and finally the results of at least one of these techniques performed by the student team.

II. Primary Literature: Each student will choose an instrumental technique that we have not yet covered within analytical or instrumental chemistry for this assignment. The technique will the subject of a written report, containing 1 original schematic or diagram of how the technique or instrument works and the physical principles that underlie it, a clear description of its function and uses, and finally two distinct primary literature sources to describe how the technique may be used and with what types of analytes. The written report should be less than six pages. During the final exam period, each student will present a summary of their report in an oral presentation less than 10 slides in length.

Schedule of Topics (Subject to change as necessary)

Week	Date	Topic	Assignment due date
1	M 1/13 – Ch 2 Skoog W 1/15 – Ch 5 Skoog F 1/17 – Ch 6 Skoog	Measurement, uncertainty, and statistics	W – 1/15 Intro Survey
2	M 1/20 – Ch 7 Skoog W 1/22 – Ch 8 Skoog F 1/24 – **Practical 1**	Calibration and standardization	W 1/22 – PS 1
3	M 1/27 W 1/29 F 1/31	Data presentation and workup	W 1/29 – Practical 1
4	M 2/03 – **Exam 1** W 2/05 – Ch 24 Skoog F 2/07 – Ch 25 Skoog	Spectroscopy I: Introduction to spectrochemical methods	
5	M 2/10 – Ch 26 Skoog W 2/12 – F 2/14 – **Practical 2**	Spectroscopy II: Characterizing electronic states	
6	M 2/17 – Ch 25C Skoog W 2/19 – Addt'l text F 2/21	Spectroscopy III: Characterizing vibrational states	W 2/19 – Practical 2
7	M 2/24 – Addt'l text W 2/26 F 2/28 – **Exam 2**	Spectroscopy IV: Chemical and material structure	W 2/26 – PS 2
-	Spring Break	-	-
8	M 3/16 W 3/18 – Ch 18 Skoog F 3/20 – Ch 23 Skoog	Electrochemical methods	W 3/18 – DAE Proposals
9	M 3/23 – Experimental W 3/25 – Experimental F 3/27 – Experimental	Designing analytical experiments: Week 1	
10	M 3/30 – Presentations W 4/01 – Presentations F 4/03 – Presentations	Designing analytical experiments: Week 2	Team Presentations
11	M 4/06 – Ch 30 Skoog W 4/08 F 4/10	Theory of analytical separations	M 4/6 – DAE Reports
12	M 4/13 – Ch 31 Skoog W 4/15 – Ch 32 Skoog F 4/17 – **Practical 3**	Chromatography	W 4/15 – PS 3
13	M 4/20 – Addt'l text W 4/22 F 4/24 – **Exam 3**	Mass Spectrometry	W 4/22 – Practical 3
14	M 4/27 – Addt'l text W 4/29 F 5/01	Other analytical techniques	F 5/1 – Prim. Lit. report
Exam	Thursday, May 7 8:30 a.m.	Primary literature presentations	Individual Presentations