

CHEM 251 – Analytical Chemistry
Spring 2024
Schedule Number 3182

COURSE INFORMATION

Class Days / Times:

Lecture: M,W,F 1:00-1:50 pm

Labs: T or Th 8:00-12:40, or 1:00-5:40

Class Location:

Lecture LH-410

Labs CSL-424

Mode:

Lecture: In-person, flipped lectures

Labs: In-person

Platform:

Canvas and Google Drive

Instructor:

Prof. Christopher Harrison

Email:

charrison@sds.edu

Office location:

GMCS-213E

Office hours:

By appointment schedule via:

<https://harrison-sdsu.youcanbook.me/>

ESSENTIAL STUDENT INFORMATION

For essential information about student academic success, please see the [SDSU Student Academic Success Handbook](#).

- SDSU provides disability-related accommodations via Student Disability Services (sds@sdsu.edu | <https://sds.sdsu.edu/>). Please allow 10-14 business days for this process.
- Class rosters are provided to the instructor with the student's legal name. Please let me know if you would prefer an alternate name and/or gender pronoun.
- This course requires the use and handling of hazardous materials. You must complete the Environmental Health and Safety module and survey in our Canvas course by January 22nd 2024.

COURSE OBJECTIVE

This course will allow you to develop the foundational knowledge to understand modern analytical chemistry tools and techniques. This is done by learning how fundamental equilibria, and chemical reactions, alter the quantitative composition of a chemical system. In particular this course focuses on the quantitative aspects of chemistry, and the mathematical treatment of chemical equilibria.

COURSE MATERIALS

TABLE 1 COURSE MATERIALS

Materials	Required or optional	Where and how it can be obtained
Textbook "Analytical Chemistry 2.1" by David Harvey - free	Required	LibreTexts
Lab coat or apron	Require	SDSU Bookstore
Lab safety glasses	Required	SDSU Bookstore

COURSE DESIGN: MAJOR ASSIGNMENTS AND ASSESSMENTS

Homework:

There will be weekly homework assignments. The homework is more challenging than typical exam questions. The homework is designed to be done in groups. With only one result submitted and graded by the group. Group size and policy will be discussed and finalized in class.

Exams:

All mid-semester exams (4) will take place in the regular class time in the designated classroom. The exam questions will include calculations and theory, from both the lectures and labs. The final exam is scheduled by the university and will be two hours long, the final exam is a cumulative exam.

Exam wrappers will be required with each mid-semester exam, as a means of self-assessing your progress and adjusting your study strategies accordingly to ensure that you are developing into the most effective learner you can be.

Lab Results:

All lab results will be submitted digitally (details in Canvas). Lab results will need to be submitted periodically, as indicated in the course calendar. For each lab that is late to be submitted at a deadline a 1-point deduction to your total lab grade will be incurred. Late lab deductions are calculated at each grading period, so a missed lab can incur more than one deduction.

Lab Notebook:

Digital lab notebooks, will be used in this class. Details on how the lab notebooks work will be reviewed in class. The week following each lab result submission deadline the lab notebooks will be reviewed by your TA and graded for proper data recording, as indicated in the lab manual.

COURSE SCHEDULE

TABLE 2 COURSE SCHEDULE

WEEK	DATES	COURSE TOPICS	CHAPTER	VIDEOS	PROBLEM SETS
1	JAN. 16 – 19	Overview, calculations	1	1-3	1
2	JAN. 22 – 26	Measuring Tools & Measurements	2A-E & 4A	4-7	2
3	JAN. 29 – FEB. 2	Distributions & Statistical Analysis	4B-F	8-15	3-5
4	FEB. 5 – 9	Sampling & Equilibrium	7A-C & 6A-F	16-19	6,7
-	FEB. 12	Exam 1 – Videos 1-19			
5	FEB. 12 – 16	Acid-Base Equilibrium	6G	20-22	8
6	FEB. 19 – 23	Buffers	6H	23-25	9
7	FEB. 26 – MAR. 1	Activity coefficients & Equilibria	6I	26-27	10
-	MAR. 4	EXAM 2 – VIDEOS 20-27			
8	MAR. 4 – 8	Titrimetric Analyses - acid-base	9A-B	28-31	11,12
9	MAR. 11 – 15	Titrimetric Analyses - redox	9C-D	34-37	13-15
10	MAR. 18 – 22	Titrimetric Analyses - complexation & precipitations	9E	32, 33, 38, 39	16
-	MAR. 25	EXAM 3 – VIDEOS 28 - 39			
11	MAR. 25 - 29	Standardization & Calibration	5A, B, C, E	40-43	17
	APR. 1 – 5	SPRING BREAK			
12	APR. 8 – 12	Electrochemical Analyses	11A-B	44-47	18
13	APR. 15 – 19	Spectroscopic Analyses	10A, B, D-G	48-52	19
-	APR. 22	EXAM 4 – VIDEOS 40 – 52			
14	APR. 22 – 26	Chromatography & Electrophoresis	12	53-56	N/A
15	APR. 29 – MAY 1	REVIEW			
-	MAY 3	FINAL EXAM - 1:00 – 3:00 PM	CUMULATIVE		

Lab Schedule

The labs will begin the second week of the course (January 23rd). The first three weeks of the lab will be a training period where all students will perform the same calibration and evaluation exercises. For the remainder of the labs each student will have an individual schedule (posted in Canvas) that they will follow to complete the labs for the semester.

STUDENT LEARNING OUTCOMES

In the lecture:

- Students will evaluate and interpret the error and uncertainty in measurements.
- Students will apply statistical tools, such as Student T's, F, and Grubbs tests to the comparison of data from chemical analyses in order to identify different and/or equivalent results.
- Students will be introduced to a range of sampling techniques/methods and their advantages and limitations.
- Students will apply their knowledge of acid/base equilibria for the preparation and evaluation of buffers to meet specific requirements.
- Students will calculate chemical equilibria using both chemical concentrations and chemical activities, thus identifying the limitations in the use of chemical concentrations in calculations.
- Students will explore a range of titrimetric analysis techniques and use their knowledge of the related chemical equilibria to predict the chemical changes through the process of the titrations.
- Students will be introduced to the techniques related to gravimetric chemical analysis.
- Students will apply their knowledge of redox chemistry to the calculation and evaluation of electrochemical analytical methods.
- Students will quantify chemical concentrations based on spectroscopic data, relating chemical interactions with light to the quantity of chemical present in solution.
- Students will be introduced to the fundamental equilibria which govern chromatographic chemical separations.
- Students will gain perspective on the diversity of scientists working to advance analytical chemistry.

In the labs:

- Students will master classical and fundamental analytical techniques for chemical measurement and analysis.
- Students will evaluate the robustness and validity of quantitative chemical measurements.
- Students will use modern chemical analysis tools to quantify the composition of unknown substances.
- Students will learn safe chemical handling and disposal practices.
- Students will learn to maintain a detailed and accurate digital laboratory notebook.
- Students will develop independent time management skills for complex and detailed laboratory procedures.

- Students will become familiar with reading and interpreting standard operating procedures.

GRADING POLICIES

As with any course, the grade that you receive is based upon your demonstrated knowledge of the course material. With this in mind, each graded element of this course will be used to evaluate your mastery of the material. In the table below you will find the point values for each course component.

TABLE 3 GRADING PLAN

Component	Quantity	Each	Total	% of Total
Lab Notebook	3	5	15	3%
Homework	14	5	70	16%
Lab Results	Best 7 of 8	10	70	16%
Analytical Scientist Assignment	2	10	20	5%
Mid-semester Exams	4	50	200	46%
Final Exam (cumulative)	1	60	60	14%
		Total	435	

TABLE 4 LETTER GRADES

LETTER	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
CUTOFF	93%	90%	87%	84%	80%	77%	74%	70%	65%	60%	55%	<55%

Lab Grading:

- The lab grades are determined by the accuracy of your analysis and are ranked out of 10 points. To obtain 10 points for a lab you must have a very accurate analysis. The lowest grade for any submitted lab will be 2 points.
- The Grade Center in Canvas is used to display all your individual grades, it is not used to calculate your final grade, due to the best X of Y nature of some of the grading components. Please use the Grade Center to verify that the correct grade has been entered for your assignments and midterms.

Lab Grade Review:

- If the grade for an analysis is below 5 points the student can earn up to 2 points of credit. To do this the student must meet with Dr. Harrison and present a viable reason for why the analysis result was far from the true value. If a definitive cause for the error can be found, the student will get 2 points of credit added back to their score. If no clear source of error is found they will receive 1 point of credit.
- *This review of the lab grades must take place within one week of the lab having been graded.*

ABSENCE & DEADLINE POLICIES

- All deadlines are firm and extensions will not be provided on an individual basis.
- Technology failures (e.g. webpages not loading, dog ate my computer, internet being down...) are likely to occur, do not leave the submission of homework or labs to the last minute. No extensions will be provided for such occurrences.
- Each student will be allowed one unexcused absence from a lab. For this absence the student will be allowed to make-up the missed lab period in one of the other lab sections. The student is not guaranteed to have access to any of the labs that require advanced sign-up when making-up a lab in a different lab section.
- Subsequent absences from lab may be allowed to be made-up provided that there was appropriate justification, as determined by the course instructor, for the missed lab.
- *Unexcused* absences for an exam will be treated as a zero. If an excused absence is allowed (e.g. medical reason, conference schedule conflict...) the points value for the exam will be redistributed over the other exams, or an estimate of the likely exam grade will be made based on all other exams taken in the course during the semester (comparing the student's performance to that of all their classmates as a benchmark).

UNIVERSITY POLICIES

Accommodations: If you are a student with a disability and are in need of accommodations for this class, please contact Student Ability Success Center at (619) 594-6473 as soon as possible. Please know accommodations are not retroactive, and I cannot provide accommodations based upon disability until I have received an accommodation letter from Student Ability Success Center.

Student Privacy and Intellectual Property: The [Family Educational Rights and Privacy Act](#) (FERPA) mandates the protection of student information, including contact information, grades, and graded assignments. I will use Canvas to communicate with you, and I will not post grades or leave graded assignments in public places. Students will be notified at the time of an assignment if copies of student work will be retained beyond the end of the semester or used as examples for future students or the wider

public. Students maintain intellectual property rights to work products they create as part of this course unless they are formally notified otherwise.

Religious observances: According to the University Policy File, students should notify the instructors of affected courses of planned absences for religious observances by the end of the second week of classes.

Resources for students: A complete list of all academic support services--including the [Writing Center](#) and [Math Learning Center](#)--is available on the Student Affairs' [Academic Success](#) website. [Counseling and Psychological Services](#) (619-594-5220) offers confidential counseling services by licensed therapists; you can Live Chat with a counselor at http://go.sdsu.edu/student_affairs/cps/therapist-consultation.aspx between 4:00pm and 10:00pm, or call San Diego Access and Crisis 24-hour Hotline at (888) 724-7240.

SDSU Economic Crisis Response Team: If you or a friend are experiencing food or housing insecurity, or any unforeseen financial crisis, visit sdsu.edu/ecrt, email ecrt@sdsu.edu, or walk-in to Well-being & Health Promotion on the 3rd floor of Calpulli Center.

LAND ACKNOWLEDGMENT

For millennia, the Kumeyaay people have been a part of this land. This land has nourished, healed, protected and embraced them for many generations in a relationship of balance and harmony. As members of the San Diego State University community, we acknowledge this legacy. We promote this balance and harmony. We find inspiration from this land, the land of the Kumeyaay.