San José State University
Department of Chemistry
Chem 155, Instrumental Analysis, Spring 2022

Course and Contact Information

Instructor:	Roger Terrill
Office Location:	DH-004B
Telephone:	408-924-4970
Email:	roger.terrill@sjsu.edu
Zoom:	https://sjsu.zoom.us/j/84919149523 (works for all meetings with me)
Office Hours:	M and W 03:00 – 04:00 in office, online, or by appointment
Class Days/Time:	Lecture: Monday and Wednesday 6:00 – 7:45 pm Lab: Tuesday ***or*** Thursday 9:00 – 11:50 am ***or*** Wed 7:30 – 10:20 am
Classroom:	Lecture: DH-250 or Online Lab: DH 010/011 or Online
Course Prerequisites:	Chem 100W, Chem 160 or 161A "C" or better, 161B concurrent if 161A taken.
Required e-Text:	Macmillan "Achieve" and Harris Quantitative Chemical Analysis
Final Date and time:	Wednesday, May 18 from 5:15 – 7:30 PM

Note that the first couple of meetings will be On Line at this Zoom address:

Course Format

This is an in-person course, but for at least the two first meetings, lecture and lab, it will be online at the above URL. It provides (2x1.25 hr.) plus a once-a-week plus a lab (3 hr.). Course credit is 4-units.

Faculty Canvas Page and MYSJSU Messaging

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on the Canvas learning management system course website. You are responsible for regularly checking with the messaging system through Canvas (http://sjsu.instructure.com) to learn of any updates.

Course Description

Principles and practices in the use of instrumental methods in chemical analysis. Basic physical chemistry necessary to understand the operation and limitations of the instruments.

Learning Outcomes

SJSU Chemistry Program Learning Objectives #'s 3, 6, 7 and 9.

Course Learning Outcomes (CLO)

Upon successful completion of this course, students will be able to:

Course Learning Objectives: Demonstrate proficiency in fundamentals of the following analytical chemistry topics:	
CLO	**Detail**
Measurements	Concepts, Statistics, Accuracy, Precision, Confidence Tests, Data Modeling by Regression
Calibration Methods	External, Internal Standards, Std. Additions, Spike Recovery
Spectroscopy General	Light, Diffraction, Monochromators, Spectrometers,
Atomic Spectroscopy	Atomic absorption, Atomic emission, Atomic mass spec.
Molecular Spectroscopy	UV-Visible, Infrared (FTIR) and Raman Spectroscopy
Mass Spectrometry:	Sample Intro: EI, ESI, APCI. Mass Analyzers: Quad, TOF
Analytical separations	Gas & Liquid Chromatography and Electrophoresis

Chem 155 Laboratory: In the laboratory, students will implement, document in an electronic laboratory notebook and report their qualitative and quantitative chemical analyses.

There will be two major experiments (HPLC, and MIP-OES) with a *commercial* analysis style report and four short experiments with brief report forms. All report formats are described in detail in the *Lab Manual*.

The major experiments will be: the determination of caffeine and benzoic acid in diet Coke, and the determination of iron and zinc or other metals in a vitamin tablet.

The first of the two major experiments will have an abstract plus results and analysis format that will require calculation of results and interpretation in terms of statistics and a brief description of the experimental method.

The first major experiment will be the determination of caffeine and benzoic acid in Diet Coke by high-performance liquid chromatography (HPLC) experiment. The second of the two major experiments will be an atomic spectroscopic analysis of a vitamin tablet. This order is subject to change.

The short reports will follow a format that is described in the lab notebook and will require planning, implementation, calculation, printout preparation and in some cases the answering of various questions. These experiments will be on the topics of 1. ultraviolet-visible spectrometry (UV-VIS), 2. Fourier transform infrared spectrometry (FTIR), 3. Raman spectroscopy, 4. fluorescence spectroscopy. A major goal of these experiments will be to attain a detailed and fundamental understanding of the measurement process and the instrument function.

<table>
<tr><th colspan="2">Experiment</th><th>Analyte</th><th>Report Format</th></tr>
<tr><td>Experiment 0</td><td>UV-Vis</td><td>Crystal Violet Dye</td><td>Brief, Excel Report</td></tr>
<tr><td>Major Experiment 1 or 2</td><td>Caffeine / Benzoic Acid in Coke</td><td>Diet Coke</td><td rowspan="2">Major Report / Analysis Format</td></tr>
<tr><td>Major Experiment 1 or 2</td><td>Metals in Vitamin Tablet</td><td>Multivitamin</td></tr>
<tr><td>Short Experiment</td><td>UV-Vis</td><td rowspan="3">Organic Solvent Mixture</td><td rowspan="3">Brief Format / Specified in Canvas</td></tr>
<tr><td>Short Experiment</td><td>FTIR</td></tr>
<tr><td>Short Experiment</td><td>Raman</td></tr>
<tr><td>Short Experiment</td><td>Fluorescence</td><td>Rhodamine 6G Dye</td></tr>
</table>

Required Texts/Readings

Textbook

$$ Required: MacMillan Quantitative Chemical Analysis and Sapling Learning for Chem 155
Required: Lecture Notes, available on Canvas Learning Management System.
Required: Lab Manual, available on Canvas.
Optional: Skoog, Holler, Nieman Principles of Instrumental Analysis. 6th (or more recent) Ed., Saunders 1998.

Course Requirements and Assignments

SJSU classes are designed such that to be successful, it is expected that students will spend a minimum of forty-five hours for each unit of credit (normally three hours per unit per week), including preparing for class, participating in course activities, completing assignments, and so on. More details about student workload can be found in University Policy S12-3 at http://www.sjsu.edu/senate/docs/S12-3.pdf.

Lab Reports*: as described above.*
Lecture exams*: one midterm and one final exam.*

NOTE that University policy F69-24 at http://www.sjsu.edu/senate/docs/F69-24.pdf states that "Students should attend all meetings of their classes, not only because they are responsible for material discussed therein, but because active participation is frequently essential to insure maximum benefit for all members of the class. Attendance per se shall not be used as a criterion for grading."

Grading Policy

A single letter grade will be assigned for Chem 155. The final exam will be on Wednesday, May 18 from 5:15-7:30 PM in the regular lecture room.

Lecture Grade: (Approximately 50% of the total 155 grade.) Grade will be based on two short papers or quizzes, one, one-hour exam, and a comprehensive final exam. Material on the exams will be based on the lecture and homework assignments.

Laboratory Grade: (Approximately 50% of the total 155 grade.) This will be based on reports, laboratory notebook and instructor evaluation. Details on the format and content of the reports and notebook are in the laboratory notebook and on Canvas.

Preliminary plans for grading structure:

Lecture Grade: 450 points

One-hour exam:	200 points	
Final two-hour exam:	200 points	
Homework:	100 points	500

Laboratory Grade: 450 points

Trace Metal Atomic Spectroscopic Analysis:	100 points	
Coke Analysis by Liquid Chromatography:	100 points	
4 Short Reports:	200 points total	
Notebook and subjective evaluation:	100 points	500
Approximate Total	1000 points	

95%	-	100%	A+
90%	-	95%	A
85%	-	90%	A-
80%	-	85%	B+
75%	-	80%	B
70%	-	75%	B-
65%	-	70%	C+
60%	-	65%	C
55%	-	60%	C-
50%	-	55%	D+
45%	-	50%	D
40%	-	45%	D-
	<	45%	F

Note that "All students have the right, within a reasonable time, to know their academic scores, to review their grade-dependent work, and to be provided with explanations for the determination of their course grades." See University Policy F13-1 at http://www.sjsu.edu/senate/docs/F13-1.pdf for more details.

University Policies

General Expectations, Rights and Responsibilities of the Student

As members of the academic community, students accept both the rights and responsibilities incumbent upon all members of the institution. Students are encouraged to familiarize themselves with SJSU's policies and practices pertaining to the procedures to follow if and when questions or concerns about a class arises. To learn important campus information, view University Policy S90–5 at http://www.sjsu.edu/senate/docs/S90-5.pdf and SJSU current semester's Policies and Procedures, at http://info.sjsu.edu/static/catalog/policies.html. In general, it is recommended that students begin by seeking clarification or discussing concerns with their instructor. If such conversation is not possible, or if it does not address the issue, it is recommended that the student contact the Department Chair as the next step.

Dropping and Adding

Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Refer to the current semester's Catalog Policies section at http://info.sjsu.edu/static/catalog/policies.html. Add/drop deadlines can be found on the current academic year calendars document on the Academic Calendars webpage at http://www.sjsu.edu/provost/services/academic_calendars/. The Late Drop Policy is available at http://www.sjsu.edu/aars/policies/latedrops/policy/**.** Students should be aware of the current deadlines and penalties for dropping classes.

Information about the latest changes and news is available at the Advising Hub at http://www.sjsu.edu/advising/.

Consent for Recording of Class and Public Sharing of Instructor Material

University Policy S12-7, http://www.sjsu.edu/senate/docs/S12-7.pdf, requires students to obtain instructor's permission to record the course and the following items to be included in the syllabus:

- "Common courtesy and professional behavior dictate that you notify someone when you are recording him/her. You must obtain the instructor's permission to make audio or video recordings in this class. Such permission allows the recordings to be used for your private, study purposes only. The recordings are the intellectual property of the instructor; you have not been given any rights to reproduce or distribute the material."
    - It is suggested that the greensheet include the instructor's process for granting permission, whether in writing or orally and whether for the whole semester or on a class-by-class basis.
    - In classes where active participation of students or guests may be on the recording, permission of those students or guests should be obtained as well.
- "Course material developed by the instructor is the intellectual property of the instructor and cannot be shared publicly without his/her approval. You may not publicly share, or upload instructor generated material for this course such as exam questions, lecture notes, or homework solutions without instructor consent."

Academic integrity

Your commitment, as a student, to learning is evidenced by your enrollment at San Jose State University. The University Academic Integrity Policy S07-2 at http://www.sjsu.edu/senate/docs/S07-2.pdf requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The Student Conduct and Ethical Development website is available at http://www.sjsu.edu/studentconduct/.

Campus Policy in Compliance with the American Disabilities Act

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 at http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf requires that students with disabilities requesting accommodations must register with the Accessible Education Center (AEC) at http://www.sjsu.edu/aec to establish a record of their disability.

Chem 155 / Instrumental Analysis, Fall 2021 Course Schedule

Prospective Course Schedule

Week	Topics, Readings, Assignments, Deadlines	
1	Intro, Exp Design overview	Introductory 1.1 to 1.5
1	AChem Overview, Stats	1.6 to 1.8 Statistics and Regression
2		1.9 to 1.14 Exp. Design and Calibration
2	Last day to drop	2. Differential Analysis of Uncertainty
3		3 Spectrometric Methods
3	Last day to add	4.1 to 4.6 Photometric Methods
4		4.7 Lasers fundamentals
4		4.7 Lasers applications
5		5.1 to 5.6 Photoelectric Detectors
5		5.7 to 5.8 Semiconductor Detectors
6		6.1 to 6.7 Monochromators I
6		6.8-6.12 Monochromators II
7		7 and 8 Atomic Spec
7		9 Atomic Spec (Plasma)
8		10 Molecular Spec (UV-Vis)
8		11 Molecules Electronic Spec
9		12 FT Spectroscopy
9	Review for Exam 1	Review
10	**Midterm Exam**	

Week	Topics, Readings, Assignments, Deadlines	
10		13 and 14 FTIR
11	**Lab Report I (HPLC or ICP) Due**	15 Raman I
11		15 Raman II
12		Separations
12		Separations
13		Separations
13	**Lab Report II (HPLC or ICP) Due**	Mass Spec
14		Mass Spec
14		Mass Spec
15	**Short labs due**	Review
Final Exam	**Final Exam**	Wednesday, May 18 5:15-7:30 PM