Course Syllabus
Spring 2020
Chemistry 231L-020 & 021
Quantitative Analysis (CHE 231L-020, 021)

Course Description: Analytical applications of solution chemistry.

Number of Credit Hours: 4 semester hours - 3 hours lecture

Hour Justification: This course is 1 credit and spans 15 weeks. The student will gain skills throughout the duration of a semester (15 weeks) designed to develop analytical skills needed for professional success after graduation. Students are expected to prepare prior to each lab (literature and concepts), attend the lab (3 hours per week per credit hour to conduct experiments), and weekly report results. Students have required academic components and deliverables: written work (daily notebook, written report each week). These activities, inclusive of the lab expectations and academic components, average a minimum of 6 hours of work each week per credit hour.

Course Prerequisites and Co-requisites: Prerequisite: Prerequisite: CHE 134 and 134L. Required lab fee.

Program Learning Outcomes:
1. The student will demonstrate knowledge of fundamental content in the basic areas of chemistry: Analytical, Biochemistry, Inorganic, Organic, and Physical.
2. The student will integrate knowledge with critical thinking to solve problems.

General Education Core Curriculum Objectives: There are no specific general education core curriculum objectives in this course. This course is not a general education core curriculum course.

Course Objective: In this course, the students will demonstrate their laboratory skills and problem solving ability. Students will demonstrate laboratory techniques that are applied to quantitative analysis of chemical samples and solution chemistry. The basics of statistics related to analytical chemistry will be applied by the students. When possible the analyses will be related to practical problem solving of contemporary, historical, technological, and societal issues.

Student Learning Outcomes: The student is expected to demonstrate and apply the following concepts to problem solving:
- The calculations involved in the preparation of solutions using solid and liquid solutes.
- The basics of gravimetric analysis that involve preparing, collecting, treating, and weighing a precipitate and the use of a gravimetric factor in calculations.
- The techniques involved in volumetric chemical analysis with emphasis on solution preparation and dilution and chemical calculations involved in volumetric analysis
- Principles of endpoint detection emphasizing indicators and potentiometric methods.
- Principles of Kjeldahl analyses with associated calculations, titrations, catalyses, and standardization procedures.
- The basic techniques in atomic absorption analyses and Beer’s Law and its application.
- The basics of chromatography involving gas and liquid partitioning and the van Deemter equation.
- Principles of electrogravimetric analysis that involves special sample preparation using fuming solutions with sulfuric acid.
- Principles of complexometric titration with EDTA as titrant.
- Techniques in infrared spectroscopy and the application of absorbance measurements and their relationship to concentration.
Outline of Topics (approximate course time - See detailed schedule on Page 5 of this syllabus):

Orientation and Safety (1 lab period)
Volumetric Determination of the Percent Na₂O in a Soda Ash Sample (2 lab periods)
Compleximetric Determination of Calcium in Powdered Milk (1 lab period)
Potentiometric Determination of the Percentage of Chloride (1 lab period)
Gas Chromatography (1 lab period)
GC-MS (1 lab period)
Atomic Absorption (1 lab period)
Electrogravimetric Determination (1 lab period)
UV-Vis spectrum of a colored dye (1 lab period)
Ion Chromatography and HPLC (2 lab periods)
Quantitative Analysis (CHE 231L-020, 021)
Spring 2020
Professor: Dr. Kefa K. Onchoke
Office: Math – Rm. 118
Phone: 936-468-2386
e-mail: onchokekk@sfasu.edu (Use this e-mail for quick response)
Student Hours: M 12-1; W 11-1; R 4-5; F 12-1 and 4-5
Lecture times: M & T 2.30 - 4.50 & 2 - 4.50 p.m. in Rm. C302/304

CATALOG DESCRIPTION: Analytical Applications of solution chemistry – 4 semester hours, 3 hours lecture, 3 hours per week. Analytical applications of solution chemistry. Lab fee required.


REQUIRED TEXTS AND OTHER MATERIALS:
2. Scientific Calculator: Scientific calculator (non-graphing and non-programmable); for example, SHARP EL-501WBBK, CASIO 115, Texas Instrument 30 XIIS. Only non-programing non-graphing and non-programmable calculators are allowed in exams and quizzes.

REQUIRED SUPPLEMENTARY READINGS: none

COURSE OBJECTIVES: In this course, the students will improve their laboratory skills and problem solving ability. Students will learn laboratory techniques that are applied to quantitative analysis of chemical samples and solution chemistry. The basics of statistics related to analytical chemistry will be learned by students. When possible the analyses will be related to practical problem solving of contemporary, historical, technological, and societal issues.

STUDENT LEARNING OUTCOMES: The student is expected to master the following concepts to problem solving:
1. The calculations involved in the preparation of solutions using solid and liquid solutes.
2. The basics of gravimetric analysis that involve preparing, collecting, treating, and weighing a precipitate and the use of gravimetric factor in calculations.
3. The techniques involved in volumetric chemical analysis with emphasis on solution preparation and dilution and chemical calculations involved in volumetric analysis.
4. Principles of endpoint detection emphasizing indicators and potentiometric methods.
5. Principles of Kjeldahl analyses with associated calculations, titrations, catalyses, and standardization procedures.
6. The basic techniques in atomic absorption analyses and Beer’s law and its application.
7. The basics of chromatography involving gas and liquid partitioning and the van Deemeter equation.
8. Principles of electrogravimetric analysis that involves special sample preparation using fuming solutions with sulfuric acid.
10. Techniques in infrared spectroscopy and the application of absorbance measurements and their relationship to concentration.

Final Exam (Lecture Exam): Monday, May 7; 8 – 10.30 a.m. in C-106
COURSE CONTENT: The experiments at the end of this syllabus will be performed according to schedule.

COURSE REQUIREMENTS: The student is expected to do all of the experiments and turn in a laboratory report on each one. All laboratory reports must be turned in before the beginning of the class. A 20% point deduction will be assessed for each day a laboratory report is late.

<table>
<thead>
<tr>
<th>Strategies for Succeeding in Chemistry 231:</th>
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<tbody>
<tr>
<td>1. Attend every lecture because the topics covered in this course build on each other.</td>
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<tr>
<td>2. Prior to class, read the chapter which will be covered in lecture.</td>
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<tr>
<td>3. Review your lecture notes after each class. Correct obvious errors and note topics which require further study or clarification.</td>
</tr>
<tr>
<td>4. Work on homework problems until you can solve them without any help or guidance.</td>
</tr>
<tr>
<td>5. Spend the necessary amount of time studying chemistry. The rule of thumb for succeeding in Chemistry is <strong>three hours of study for every hour of lecture</strong>. This means that you should plan to study Chemistry for a minimum of nine hours each week.</td>
</tr>
<tr>
<td>6. Don’t procrastinate. The concepts take time to sink in, and you may have to practice these exercises over a period of many days in order master the necessary skills.</td>
</tr>
<tr>
<td>7. Form a study group. This is your first avenue for getting help. Be able to communicate with each other on short notice, not just before class.</td>
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METHOD OF EVALUATION: YOUR LABORATORY GRADE WILL BE DETERMINED IN THE FOLLOWING WAY.

Each report is worth 10 points each: See the *Guidelines for writing Good laboratory Reports on page 6*

- There are 11 experiments in total to be done, therefore a total number of 220 points to be attained. This constitutes **one-fourth** of your grade in the course.
- The laboratory and the lecture portions of this course are not separate. Lecture is **three-fourths** (¾) of your grade in the course.

MAKE-UP POLICY: Students will be able to make-up one laboratory during the dead week. The student must arrange make-ups before the dead week by contacting the laboratory assistant for details. **Makeup quizzes** will not be given.

ATTENDANCE POLICY:
Laboratory attendance is mandatory. The student must notify the laboratory assistant about missing a laboratory before missing a laboratory before the time the laboratory meets.

ACADEMIC HONESTY POLICY: Any student found cheating will be subject to the penalties as stated in the Student Code of Conduct handbook; including but not limited to a score of zero on exam, expulsion from the class or expulsion from the University. Academic misconduct includes plagiarism, copying answers from friends, copying solution manual answers that you claim to be your own. ([http://www.sfasu.edu/upp/pap/academic_affairs.html](http://www.sfasu.edu/upp/pap/academic_affairs.html)).

Examples of academic dishonesty include:

- Exchanging answers or information during a test or quiz
- Looking at another student’s paper during a test or quiz
- Bringing or looking at a book or other unauthorized source during the quiz or test

Students engaging in any type of academic misconduct (including, but not limited to: cheating, plagiarism, or any other action that can improperly affect my evaluation of your performance) will be subject to sanctions in accordance with SFA Academic Integrity Policies. Please note: The usage of electronic devices (including, but not limited to: cell phones, PDAs, mp3 players, etc.) while a quiz or exam is being given will be treated as academic misconduct. DO NOT HAVE THESE DEVICES OUT DURING A QUIZ OR AN EXAM! **I will recommend a grade of "F" for the course and expulsion from the University for any such violations.** You are **NOT** allowed to use graphing calculators on quizzes and exams.

**COPYING SOMEONE’S LABORATORY REPORT AND TURNING IT IN as your OWN IS CONSIDERED CHEATING. I WILL BE FORCED TO GIVE A ZERO FOR BOTH COPIED LABS.**

SEMESTER WITHDRAWALS: Last day to withdraw from the course without obtaining WP or WF grade is Wednesday, March 21.
ACADEMIC DISABILITIES POLICY: Students with Disabilities – To obtain disability – related accommodations and/or auxiliary aids, students with disabilities must contact the Office of Disability Services, Human Services Building, Room 325, 468-3004/468-1004 (TDD) as early as possible in the semester. Once verified, DS will notify the course instructor and outline the accommodation and/or auxiliary aids to be provided.

LABORATORY/CLASSROOM BEHAVIOR POLICY: To ensure a classroom environment conducive to learning, any forms of classroom disruptions will not be tolerated (examples but not limited to – talking, use of cell phones/beepers, sleeping, reading other material, eating/drinking). Students who violate these rules will be asked to leave. Repeat offenders will be subject to disciplinary action in accordance with University policies as described in the Code of Student Conduct.

Students are expected to observe laboratory decorum. This means absolutely no horse play will be tolerated in the laboratory at any time. Students are expected to wear their goggles from the time they enter the laboratory until they leave the laboratory and enter the hall way area. Depending on the seriousness of the offense of the behavior, a student could be dismissed from the laboratory and given a zero for the experiment. Not wearing goggles in the laboratory is considered a serious offense.

Note: If you are taking this course in preparation for the TEKS (to become a teacher) you need to contact the Chair Dr. Michael Janusa in Room MATH-104.

LABORATORY SCHEDULE

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
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<tbody>
<tr>
<td>Jan. 20/21</td>
<td>General directions, Syllabi &amp; expectations</td>
</tr>
<tr>
<td>Jan. 27/28</td>
<td>General directions, Syllabi &amp; expectations, Check in</td>
</tr>
<tr>
<td>Jan. 30/31</td>
<td>Orientation, General Information and Lab Safety (Significant Figures)</td>
</tr>
<tr>
<td>Feb. 6/7</td>
<td>Volumetric Determination of the Percent Na₂O in a Soda Ash Sample</td>
</tr>
<tr>
<td>Feb. 13/14</td>
<td>Volumetric Determination of the Percent Na₂O in a Soda Ash Sample</td>
</tr>
<tr>
<td>Feb. 20/21</td>
<td>Talk/Demonstration of Next set of experiments. Everyone must attend.</td>
</tr>
<tr>
<td>Feb. 27/28</td>
<td>Complexometric Determination of Calcium in Powdered Milk</td>
</tr>
<tr>
<td>March 6/7</td>
<td>Potentiometric Determination of the Percentage of Chloride</td>
</tr>
<tr>
<td>Saturday, March 7</td>
<td>Beginning of spring holidays</td>
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<tr>
<td>Mar. 9/10</td>
<td>Spring Break</td>
</tr>
<tr>
<td>Mar. 16/17</td>
<td>Direction on the next set of experiments and instrumentation – Demonstration of instruments</td>
</tr>
<tr>
<td>Mar. 23/24</td>
<td>Atomic Absorption Spectroscopy (2 - 3 per group), UV/Vis, Fluorescence, HPLC</td>
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<tr>
<td>Thursday, April 9</td>
<td>Beginning of Easter Holiday</td>
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<tr>
<td>April 13/14</td>
<td>Atomic Absorption Spectroscopy (2 - 3 per group), UV/Vis, Fluorescence, HPLC</td>
</tr>
<tr>
<td>April 20/21</td>
<td>Atomic Absorption Spectroscopy (2 - 3 per group), UV/Vis, Fluorescence</td>
</tr>
<tr>
<td>April 27/28</td>
<td>High Performance liquid Chromatography and AAS, UV/vis, Fluorescence</td>
</tr>
<tr>
<td>May 4/5</td>
<td>High Performance liquid Chromatography and AAS, UV/Vis, Fluorescence</td>
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<tr>
<td>May 4/5</td>
<td>Clean up and Check out/ Review note: must check out otherwise you will not be allowed to take the final exam. Questions on your grades</td>
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<tr>
<td>Mon., May 7</td>
<td>Final exam for Lecture.</td>
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What sections of the lab are graded?

<table>
<thead>
<tr>
<th>Lab</th>
<th>Sections to be graded</th>
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<tbody>
<tr>
<td>Significant Figures</td>
<td>Full report</td>
</tr>
<tr>
<td>Percent Na₂O in a Soda Ash Sample</td>
<td>Procedure, Results, Conclusion</td>
</tr>
<tr>
<td>Complexometric Determination of Calcium in Powdered Milk</td>
<td>Introduction, Procedure, Results, Conclusion</td>
</tr>
<tr>
<td>Potentiometric Determination of the Percentage of Chloride</td>
<td>Introduction, Procedure, Results, Conclusion</td>
</tr>
<tr>
<td>AAS</td>
<td>Full Report (all sections)</td>
</tr>
<tr>
<td>HPLC</td>
<td>Results, Conclusion</td>
</tr>
<tr>
<td>UV-Vis</td>
<td>Abstract, Introduction, Results, Conclusion</td>
</tr>
<tr>
<td>Fluorescence</td>
<td>Introduction, Results, Conclusion</td>
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</table>
Guidelines to Writing Good Laboratory Reports

RULES FOR LAB NOTEBOOK  (1 pt for errors)

a.) ALL DATA IS TO BE RECORDED IN BLACK INK DIRECTLY IN THE NOTEBOOK!!!!

b.) Label and date all entries.

c.) An error should be lined through with a single horizontal line, initialed and briefly explained.

d.) A single diagonal line should be drawn across any page that is to be ignored, initialed and briefly explained. This includes completely blank pages.

e.) The backs of the yellow pages may be used for scratch work BUT, measurements and readings are to be recorded as DATA.

f.) Number all the pages in the notebook in the upper right hand corner of the page.
The yellow carbon copies must bear the same number as the white originals.

NOTEBOOK FORMAT - Begin each experiment on a new page.

Note: Lab should not be written in first person (1pt)

1.) Abstract (1 pts)

This is a short, quantitative discussion of the main purpose and findings of the experiment. It should be stated clearly and briefly. What was done? And what results were obtained?
The following must be addressed in the abstract section
- What was done?
- Purpose of the experiment?
- Findings of experiment? Results obtained.

Note: Ensure that clearly that labs are clearly written reports without spelling mistakes and typos.

2. Introduction/Literature review (1 pts)

- A brief review of the major field, and a more intensive coverage of the specific topic at hand. (Copying from the internet will be considered plagiarism and will merit a Zero for the whole lab whenever detected).
- What is known? Define the purpose of experiment.
- You want to give the background of the project/experiment which will help define your purpose.

2.) Experimental section  (2 pts)

Description of main experimental set up. This section should have a step-by-step description of what they did in the lab but not every little detail. Details such on chemical manufacturer, grade, lot number and expiration date, should be noted if available.
Reference lab manuals and other procedures. Need summary in own words of the experimental procedure (looking for paragraph not long essay).

3.) Results  (4 pts)

(a) Raw data in a suitable form – Title Tables, Figures etc properly (1 pts)
(b) Clear listing of your results. Sample calculations and error analysis (1 pts)
(c) Include plots and printouts- spectra, chromatograms etc. (2 pts)
- List all data obtained with information provided as to how the data was obtained, as well as the experimental accuracy of all measurements. The data should be compiled into tables or graphs if appropriate. All figures, spectra, and tables should be labeled, contain important parameters, and numbered. Only significant results should be presented.
- Results must be presented in continuous prose.

4.) Discussion  (3 pts)
- Data should be discussed and evaluated, both positively and negatively
- Don’t describe your graphs verbally; discuss their significance. A discussion of possible sources of error should be included as well as any limitations which may have affected the validity, and/or application of the results.

- Answer all questions if required by the handout (1 pts)

5.) **Conclusion**  (1 pt)
Comparisons to known values should always be made whenever possible. Estimation of errors should be discussed including possible sources of errors. Suggest any possible improvements in the experiment.

6.) **References** (1 pt)
Include references (a minimum of 4 references) using the ACS format used in the journal *Analytical Chemistry*; i.e.: number all references consecutively in parentheses and include them at the end of your report in a section titled references. No websites e.g. *Wikipedia* are to be cited). Textbooks and journals are the accepted norm for citations.