Course Syllabus
Spring 2020
Chemistry 231
Quantitative Analysis

Course Description: Analytical applications of solution chemistry.

Number of Credit Hours: 4 semester hours - 3 hours lecture, 1 hr lab
Course Prerequisites and Corequisites: Prerequisite: CHE 134 and 134L. Lab fee required.

Course Description: Introductory laboratory experiments.

Hour Justification: This course is for 3 credits and spans 15 weeks. The course contains extensive content requiring students to prepare by completing the assigned weekly reading, homework, online content, etc. Students have significant weekly reading and homework assignments involving critical thinking and quantitative reasoning. Students are tested over the material via five exams during the semester including a comprehensive final exam, quizzes and homeworks. These activities average at a minimum 6 hours of work each week to prepare outside of time spent engaging with the content.

Number of Credit Hours: 1 semester hour – 2 hours lab per week. The grade is separate from the lecture grade.

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: To provide students with a more detailed explanation of the basic concepts, laws, and theories of some of the topics discussed in General Chemistry and to apply the knowledge to chemistry problem solving at an advanced level. The student will develop an appreciation for chemistry as it relates to the other disciplines. Furthermore, the student will recognize how chemistry provides solutions to contemporary, historical, technological, and societal issues.

Student Learning Outcomes: The student is expected to recognize and apply the fundamental and practical aspects of the following concepts and apply the concepts to problem solving:

- units of measure, unit conversions, density, and definitions of matter
- introduction to the analysis of real samples and the difficulties involved in handling real samples such as sampling, preparation, decomposition, dissolution, and the elimination of interferences
- principles of experimental error in chemical analysis including the sources of experimental errors and the application of statistics to data treatment and evaluation using spreadsheets
- concept of gravimetric analysis including experimental aspects of this type of analysis and the use of gravimetric factor in calculations
- principles of titrimetric methods of analysis, with emphasis on dilution of solutions, the theory of neutralization, titration curves for complex acid/base systems, precipitation titrimetry, oxidation/reduction titrations, potentiometric titrations, and complex-formation titrations
properties of aqueous solutions, including activity of ions, application of the Debye-Huckel equation to thermodynamic equilibrium constant
concept of equilibrium as it applies to complex systems and chemical analysis,
principles of electrochemistry including standard electrode potentials, the Nernst equation, and the theory of potentiometry, electrogravimetry, coulometry, voltammetry
basic principles of spectrochemical methods of analysis, with emphasis on ultraviolet and visible absorption spectroscopy, atomic absorption spectroscopy, and the application of Beer’s Law in problem solving and analysis
concepts of chromatography with the main emphasis on liquid and gas chromatography, response factors, and as time permits, the van Deemter equation

Outline of Topics (approximate course time):
• Introduction to Analytical Chemistry (5-15%)
• Errors and Statistical Data Treatment in Chemical Analysis (5-15%)
• Sampling, Standardization, and Calibration (5-15%)
• Aqueous Solutions and Chemical Equilibria (5-15%)
• Effects of Electrolytes on Chemical Equilibria (5-15%)
• Solving Equilibrium Calculations for Complex Systems (5-15%)
• Gravimetric Analysis (5-15%)
• Titrimetric Methods (5-15%)
• Neutralization Titrations (5-15%)
• Titration Curves (5-15%)
• Complexation Reactions and Titrations (5-15%)
• Electrochemistry (5-15%)
• Potentiometry and Voltammetry (5-15%)
• Spectroscopy (5-15%)
• Chromatography (5-15%)
Class Syllabus
Spring 2020
Quantitative Analysis (CHE 231-001)

Professor: Dr. Kefa K. Onchoke
Office: MATH-118
Phone: 936-468-2386
e-mail: onchokekk@sfasu.edu (Use this e-mail for a timely response)
Student Hours: M 12 - 1; W 11-1; R 4-5; F 12-1; 4-5.
Lecture times: TR 9.30 - 10.45 a.m. in Mathematics C-106

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

PREREQUISITES: A grade of C in both CHE 133 and CHE 134. Co-requisite: CHE 231L.

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-programming non-graphing and non-programmable calculators are allowed in exams and quizzes.**

REQUIRED SUPPLEMENTARY READINGS: none

COURSE OBJECTIVES: The student will learn more about the basic concepts, laws, and theories of some of the topics discussed in General Chemistry and will be able to apply the knowledge to chemistry problem solving at an advanced level. The student will develop an appreciation for chemistry as it relates to the other disciplines. Furthermore, the student will earn how chemistry provides solutions to contemporary, historical, technological, and societal issues.

STUDENT LEARNING OUTCOMES: The student is expected to learn and apply the fundamental and practical aspects of the following, and master the following concepts to problem solving:
1. Units of measure, unit conversions, density, and definitions of matter.
2. Introduction to the analysis of real samples and difficulties involved in handling real samples such as sampling, preparation, decomposition, dissolution, and elimination of interferences.
3. Principles of experimental error in chemical analysis including the sources of experimental errors and the application of statistics to data treatment and evaluation using spreadsheets.
4. Concepts of gravimetric analysis including experimental aspects of this type of analysis and the use of gravimetric factor in calculations.
5. Principles of titrimetric methods of analysis, with emphasis on dilution of solutions, the theory of neutralization, titration curves for complex acid/base systems, precipitation titrimetry, oxidation/reduction titrations, potentiometric titrations, and complex-formation titrations.
6. Properties of aqueous solutions, including activity of ions, application of the Debye-Hückel equation to thermodynamic equilibrium constants.
7. Concepts of equilibrium as it applies to complex systems and chemical analysis.
8. Principles of electrochemistry including standard electrode potentials, the Nernst equation, and the theory of potentiometry, electrogravimetry, coulometry, voltammetry.
9. Basic principles of spectrochemical methods of analysis, with emphasis on ultraviolet and visible absorption spectrometry, atomic absorption spectroscopy, and the application of Beer’s Law in problem solving and analysis.
10. Concepts of chromatography with the main emphasis on liquid and gas chromatography, response factors, and as time permits, the Van Deemter Equation

Final Exam: Thursday, May 7; 8 – 10.30 a.m. in Mathematics –C-106
COURSE CONTENT: Chapters from the text will be covered with more emphasis on some chapters than others. The chapters that will be emphasized are marked with an asterisk.* (Note: **Exam schedule is tentative**).

1. The nature of Analytical Chemistry.
2. Chemicals, Apparatus, and Unit Operations of Analytical Chemistry.
3. Using Spreadsheets in analytical Chemistry
4. Calculations Used in Analytical Chemistry.
5. Errors in Chemical Analysis*
6. Random Errors in Chemical Analysis.*
7. Statistical Data Treatment and Evaluation.*
8. Sampling, Standardization, and Calibration.
9. Aqueous Solutions and Chemical Equilibria.
10. Effects of Electrolytes on Chemical Equilibria.
11. Solving equilibrium Calculations for Complex Systems
12. Gravimetric Methods of Analysis*.
13. Titrimetric Methods; Precipitation Titriemtry.*
15. Titration Curves for Complex Acid/Base Systems.
16. Applications of Neutralization Titrations.*
17. Complexation Reactions and Titrations.*
18. An Introduction to Electrochemistry. *
19. Applications of Standard Electrode Potentials.*
20. Applications of Oxidation/Reduction Potentials.*
21. Potentiometry.*
23. Voltammetry.
24. Introduction to Spectrochemical Methods.
25. Instruments for Optical Spectroscopy.
27. Atomic Spectroscopy.
29. Gas Chromatography.
30. High-Performance Liquid Chromatography.
31. Miscellaneous Separation Methods.
32. The Analysis of Real Samples.
33. Preparing Samples for Analysis.

**Final Exam: Thursday, May 7; 8 – 10.30 a.m. in C-106**

* **Final Exam:**
  1. Your final exam will be a comprehensive, nationally-standardized exam developed by the American Chemical Society (ACS).
  2. The exam consists of multiple-choice questions, and is graded on a scantron. **YOU WILL NEED TO OBTAIN A SCANTRON FORM 882E FOR THE FINAL (bookstore).**
  3. More specific info about the final will be given during dead week.
  4. You need to study hard in all exams and for the final.

All of your course grades will be posted on D2L. ([https://Brightspaced2L.sfasu.edu](https://Brightspaced2L.sfasu.edu)) throughout the semester. You may check your grade at anytime on D2L.
**Course Requirements:** 4-semester exams (100 pts each), Comprehensive Final (200 points) cumulative with emphasis on the material covered since last. These exams will be given in the evening from 6.00 p.m. - 8.00 p.m. All of these exams will be comprehensive. These exams will consist of problems that must be set up and solved, discussion questions, and/or multiple choice, true/false, math problems, fill-in-blanks or essay type questions. Partial credit will be given for short answer problems worked partially correct; therefore, it is crucial to show your solutions to the problems, not just the answer. Students have one week from the day any graded item is returned to notify professor of grading error or ask questions about the grade of item. After one week no points will be returned. The professor has the prerogative of also re-grading the entire item. Credit will not be given for correct answers unless you show how you arrived at the answer. Multiple choice questions will have no partial credit. In addition homework problems will be assigned.

**Homework** – Homework will total 50 points (#points correct*50/ total points available). Homework will be collected according to dates announced in class. Homework will not be accepted after the due date without legitimate documentation (NO EXCEPTIONS). To receive full credit, your work needs to be legible and comprehensible. You will get zero credit for illegible and/or incomprehensible scribbles.

**Quizzes** - Quizzes will total 50 points (#points correct*50/ total points available). A weekly 10-point quiz will be given in class.

**Strategies for Succeeding in Chemistry 231:**

1. Attend every lecture because the topics covered in this course build on each other.
2. Prior to class, read the chapter which will be covered in lecture.
3. Review your lecture notes after each class. Correct obvious errors and note topics which require further study or clarification.
4. Work on homework problems until you can solve them without any help or guidance.
5. Spend the necessary amount of time studying chemistry. The rule of thumb for succeeding in Chemistry is three hours of study for every hour of lecture. This means that you should plan to study Chemistry for a minimum of nine hours each week.
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.
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.

**Method of Evaluation:** The final grade will be based upon percentage of points obtained in the following:

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Points</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>840—933</td>
<td>90.0—100.0 %</td>
</tr>
<tr>
<td>B</td>
<td>746—839</td>
<td>80.0—89.9 %</td>
</tr>
<tr>
<td>C</td>
<td>653—745</td>
<td>70.0—79.9 %</td>
</tr>
<tr>
<td>D</td>
<td>560—652</td>
<td>60.0—69.9 %</td>
</tr>
<tr>
<td>F</td>
<td>&lt; 559</td>
<td>0.0—59.9 %</td>
</tr>
</tbody>
</table>

Four exams will be given during class. No one coming in late may start an exam after the first person has left. Each exam will be worth 100 points. The final exam will be comprehensive and will be worth 200 points.

This syllabus is subject to change. My e-mail is onchokekk@sfasu.edu

<table>
<thead>
<tr>
<th>Exam Schedule</th>
<th>Day/Date</th>
<th>Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam 1</td>
<td>Feb. 6 (Thursday)</td>
<td>C-106</td>
</tr>
<tr>
<td>Exam 2</td>
<td>March 5 (Thursday)</td>
<td>C-106</td>
</tr>
<tr>
<td>Exam 3</td>
<td>April 2 (Thursday)</td>
<td>C-106</td>
</tr>
<tr>
<td>Exam 4</td>
<td>April 23 (Thursday)</td>
<td>C-106</td>
</tr>
<tr>
<td>Comprehensive Make-up</td>
<td>April 30 (Thursday)</td>
<td>C-106</td>
</tr>
<tr>
<td>Final Exam</td>
<td>Thursday, May 7, 8.00 a.m.-10.30 a.m.</td>
<td>C-106</td>
</tr>
</tbody>
</table>

Note: The lab grade constitutes ¼ (25 %) of the final grade. The Lecture section constitutes ¾ (75%) of the Final grade.
• **Please note:** In order for you to have enough time to complete exams, all exams (except for the final) will be given from 6-8 pm. *It is your responsibility to make any needed adjustments in your class/work/extracurricular schedule to accommodate for this.* Please keep in mind that 2 hours are allotted for the exams for a reason. You should expect exams that are thorough and challenging. Plan to stay for the entire two-hour period.

**MAKE-UP POLICY:** A comprehensive make-up exam will be given on **Thursday April 30 (6-8.00 p.m)**. If one performs well in the make-up test, it (the make-up test) will replace any one of the lowest grades of the first 4 exams. **Make-up quizzes** will not be given.

**ATTENDANCE POLICY:**
Attendance of class is mandatory. A student with **Four or more** excused absences will result in an "F" for the course.

**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
- If caught cheating a zero will be given to the cheater and or both students colluding in cheating. Other steps will be taken as stated in [http://www.sfasu.edu/upp/pap/academic_affairs.html](http://www.sfasu.edu/upp/pap/academic_affairs.html)

Students engaging in any type of academic misconduct (including, but not limited to: cheating, plagiarism, or any other action that can improperly affect your 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.

**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.

**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.

**Note:** If you are taking this course in preparation for the TEKS (to become a teacher) you need to contact **Dr. Michael Janusa** in Math-104 (Math Building).
**EXPECTED BEHAVIOR & CONSEQUENCES IF PROPER BEHAVIOR NOT FOLLOWED**

<table>
<thead>
<tr>
<th>My Expectations and Class actions/Behavior</th>
<th>Expected action for conducive learning</th>
<th>Consequences if not followed</th>
<th>Your Expectations of the Professor</th>
</tr>
</thead>
</table>
| 1. No talking when professor is talking  | Pay attention, participate and take notes | -The offender will be sent out of class. No warning will be given to the offender. | - Will respect you, when talking to him/you.  
- Will instruct you to the highest level. |
| 2. No lateness or tardiness to class.   | Attend *every* lecture because the topics covered in this course build on each other; doors locked | Will be counted absent from class. | Will start class on time and not keep you late. |
| 3. Roll will be taken first 5 minutes.  |   |   |   |
|   Anyone coming late will be marked absent. Anyone leaving class before class ends will be marked absent |   |   |   |
| 4. Students are allowed to speak *Only* when the professor says so. |   |   | - Will not want to embarrass you in front of other students. |
| 5. No use of cell phones in class       | All cell phones are turned off during class time | - offender will be asked to leave class. | Professor will not text or talk on phone. |
|   No text messaging in class            |   |   |   |
| 6. No sleeping during class time       |   | - offender will be asked to leave class. | Will not talk down to you. |
| 7. No reading of other material        | Only class material to be covered for that day to be read | - offender will be asked to leave class. | Will not go off on tangents not related to class material. |
| 8. No eating/ drinking in class        |   | - Will be asked to leave class. |   |
| 9. Respect other students during class | Rude behavior is not to be tolerated | Will respect you and not be rude to students. |   |
| 10. No copying of other students’ work | Honesty ensures learning | Both students will be given a zero |   |
| 11. No late homeworks/Quizzes.         | Prepare ahead of time | - A zero will be assigned to any homework not turned in. | Graded work will be returned in a timely manner. |
|   Homeworks are due at the start of class. Homeworks turned in at the end of class will not be accepted. |   |   |   |
| 12. **No use of graphical calculators in quizzes or exams.** |   | Professor has the right to erase the memory of such calculators prior to any quiz or exam. |   |
| 13. Students have one week from the day any graded item is returned to notify professor of grading error or ask questions about the grade of item. | The professor has the prerogative of also re-grading the entire item. | Professor must be notified one week from the day any graded item is returned to notify professor of grading error or ask questions about the grade of item. | The professor will be fair in grading homeworks, quizzes and exams. |