Course Syllabus  
Spring 2019  
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

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.
- 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 complexiometric titration with EDTA as titrant.
- Techniques in UV-VIS spectroscopy and the application of absorbance measurements and their relationship to concentration.

Outline of Topics (approximate course time):
Orientation and Safety (1 lab period)
Using Microsoft Excel (1 lab period)
Standardizing a strong base (1 lab period)
Identification of a weak acid using molecular weight and the pKₐ and K value (3 lab periods)
Constructing a calibration curve and standard addition (1 lab period)
Using the Analytical Balance (1 lab period)
Introduction to Spectroscopy (2 lab period)
Spring 2017

Professor: Dr. Darrell R. Fry
Phone: 936-468-1406
Office: 120 Math Building
Office Hours: MW F 10-11:30

Office: Math Rm. 120
e-mail: frydr@sfasu.edu
Laboratory: 3rd floor of Chemistry Building
Laboratory Office Hours: 1:30-2:20MT

Students should feel free to come to both the laboratory and/or the office. Both locations, at the appropriate time, will serve as “office hours”.

Class meeting place & time: Math 132 TR 8-9:15am
Laboratory meeting place & time: Chemistry 303 M or T 2:30-5:20

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:
- Scientific Calculator.
- 12 bluebooks
- 3 ring binder approximately 1-2 inches

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. The basic techniques in atomic absorption analyses and Beer’s law and its application.
6. The basics of chromatography involving gas and liquid partitioning and the van Deemter equation.
7. Principles of complexiometric titration with EDTA as titrant.
8. Techniques in Ultraviolet-Visible spectroscopy and the application of absorbance measurements and their relationship to concentration.
**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 report sheet before leaving lab. Students who fail to complete all experiments (and turn in report sheets) will be given no more than a 50% for the laboratory.

**Lab Preparation and Procedures:**

Quantitative Analysis laboratory is a results oriented laboratory. As such, two opportunities exist for students who have done sub-par work to redo their work. These opportunities are at mid-term and at the end of the semester. Some students find it difficult to achieve the level of precision required to pass the laboratory. A comprehensive list of the reasons why the students have difficulty with the labs is difficult. However, there are some generalities which are listed below.

- You cannot operate a buret and your mouth at the same time.
- You cannot operate an analytical balance and your mouth at the same time.
- You cannot carry out a quantitative transfer and a conversation at the same time.

While the list above was meant to be humorous, the observations in the list are true. In order to get good results one must concentrate on what one is doing. This means closing your mouth, thinking about what you are doing, observing with all of your sense, and being prepared. Have faith; with hard work most people are able to achieve high quality results.

An outline is required prior to each lab.

Being prepared for lab is critical. Foremost, prepared students are safe students. We will be working with (potentially) dangerous chemicals and equipment. Those who have not read (and understood and mentally rehearsed) the procedure are a danger to themselves and others. Therefore, those who are not prepared will not be allowed in the laboratory. Preparedness is judged (in part) by having outlined the procedure in your lab notebook before lab starts. Students should be able to execute the procedure without referring to the lab manual or asking the lab TA (or other students multiple questions). Of course, one needs to exercise a bit of wisdom—if despite being prepared for the laboratory, you find yourself not knowing something critical, have the sense to ask or look at the procedure! The instructor may require students to use only their outline in order to execute the procedure. A secondary reason that being prepared for lab is critical is time. Time is precious everyone. Prepared students are quicker at executing the laboratory than those who are not prepared. Your preparedness will also be judged (and graded). In general, the lab TA has been told to leave at 5:05—when the lab ends. The instructor may be available after this time for students who, despite being prepared, did not have enough time to finish the experiment. However, the instructor may not be available after this time. In which case, your grade will suffer for not being prepared.

How do you prepare yourself for the laboratory? This is an excellent question. MAKE and OUTLINE of the PROCEDURE in your lab notebook! As you make the outline think about what you will be doing and why. Draw diagrams. Think about what is necessary to set up what you need, and where these items are located within the laboratory. Think about alternate ways to complete the set-up. Do this at least 24 hours before the lab starts. This will give you time to ask the TA or the instructor questions about specifics that you do not understand.

Students who are deemed not prepared will not be allowed to continue in the laboratory for that day. The student will receive a zero for the results and also appropriately penalized if the lab also has a lab report. Please note—assessing if a student is prepared is an informed judgment of the instructor. Just because you have written the steps down does not mean that you are prepared.

Calculations and results are to be submitted prior to leaving the laboratory.

Students are required to complete all calculations and submit results prior to cleaning their station and leaving the laboratory. Again, there are logical reasons for this rule. First, if you did not make an obvious measurement, it is easiest to make this measurement prior to cleaning up. Most of the time, you would have to reassemble the apparatus,
find the chemicals, do the experiment (again) to make a simple measurement. Second, immediately after the experiment is completed the data is fresh in your mind; this is the most efficient time to do the calculations. Students will submit results for each laboratory on the appropriate sheet of paper found in the lab manual. The sheet of paper has the relevant data, sample calculations and other information upon which your grade may be determined.

Keep your area clean.

If nothing else an Analytical Chemist is clean. Again, there are reasons for this. Consider the OJ Simpson case. The defense lawyers were able to cast doubt onto the forensic evidence because of sloppy work (or the forensic evidence could have been tampered with). A “peak” consistent with EDTA (a metal chelator and also used commonly as a preservative) was evident in a chromatogram of some blood. EDTA is commonly used to calibrate the instrument. Some sloppy worker (or a person bent on bending the data so that OJ seemed guilty), did not rinse the syringe out well enough (or document that the EDTA should be present). In the University setting, instead of being fired, your grade will suffer. If you are not clean, you will not get reliable results. (It is really that simple.) Furthermore, you will be docked points if your area is not clean. (The entire lab will be docked points if the instructor or lab TA cleans the common areas.) Another reason is safety. Clean, uncluttered labs are safer. (Yes, it is that simple.) Finally, the instruments are expensive. For instance, the analytical balances, used for most of the experiments, cost around $2500. If kept clean, they should be usable for 10+ years, or if they are not kept clean they may last 1 year.

In order to help keep the laboratory running smoothly, the following assignments will be made. Each student will be assigned two drawers to keep their equipment in. Each drawer has a different combination lock. Write the combinations in a couple of different places (you may also text it to yourself). Within the drawer, keep the equipment checked out to you at the beginning of the semester. Use the sink (and only the sink) at the end of your row. Use the deionized water (and only the deionized water) from the water reservoir at the end of your row. Common equipment has been placed in drawers or cabinets and appropriately labeled. RETURN the COMMON equipment to the appropriately labeled drawer before leaving lab. Points will be deducted if common equipment is found in your individual drawer!

Follow the rules for the analytical balance.

Analytical balances are precision instruments. As such, they need extra care when using and in the preparation for use. The analytical balances are located in a balance room—only 3 people are allowed in the room at one time. When you plan to mass something, take your lab note book, a pen, the chemical you want to mass and proceed to the balance room. Wait outside the door (calmly, without talking to the people inside) until YOUR balance becomes available. **Do not move the analytical balances!** The balances were leveled (and calibrated) before the semester began. Sit down at the balance table. Gently place your lab note book and other stuff on the table. Open the balance door. Notice that the pan is CLEAN! Fold a piece of weigh paper so that you can pour the contents out of it easily (or use a weigh boat) and place it onto the pan. Tare the balance. (Tare sets the reading to zero.) CAREFULLY open the chemical you wish to measure and using a spatula transfer it to the analytical balance. This will take some time. Do not spill anything on the balance (or on the table). If you do spill something, clean it up immediately. Close the balance doors and wait for the balance to equilibrate (this may mean asking people to get out of the balance room or to stop moving around so much). Record your mass (and label it in the lab notebook and/or on your weigh paper) and carefully remove your chemical. Close the balance door. On the first day of laboratory you will be assigned an analytical balance to use.
Lab Notebook (BLUEBOOKS):

All calculations must be completed prior to leaving the lab and must be included within your lab notebook!! The rule of thumb is that someone with similar skill should be able to repeat your work with only your lab notebook. (This includes any mistakes.) Your lab notebook has to be contiguous and in chronological order. A lab notebook does not necessarily have to be neat. It should be legible, continuous, chronological, and honest. Specifics are given below.

1. Up to date table of contents containing a short description of each entry, the page numbers and the dates on which the entry was performed.
2. The title of the experiment and experiment dates should be placed on the outside of the bluebook.
3. Pages should be numbered in consecutive order and no pages should be missing. If you accidentally miss a page, mark it as intentionally skipped and mark through the page.
4. Do not destroy data. A single line through the mistake is often sufficient. People should still be able to read the mistake. If you make a mistake simply indicate the mistake and go forward.
5. All entries are to be written in the lab notebook first. **Do not write on scraps of paper and then transfer them to the lab notebook (-3 per incident).**
6. All entries should be in pen.
7. Label everything. For example, if you accidentally weigh out the wrong chemical, you should indicate your mistake and then continue.
8. If you take notes from the board at the beginning of lab, these should be in your lab notebook. Simply label them, notes from board and include them in chronological order.

Individual and Group work: Most of the laboratories will require you to work as an individual; however, some experiments will require you to work within a group.

Attendance Policy: Laboratory attendance is mandatory. The student must notify the laboratory assistant and the lab instructor 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).

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
- Fabricating, modifying or manipulating data
- Copying other’s lab write-ups

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!* 
- **COPYING SOMEONE’S LABORATORY REPORT AND TURNING IT IN as your OWN IS CONSIDERED CHEATING.**
- **Fabricating data is cheating.**
I will recommend a grade of "F" for the course when students cheat!

**SEMESTER WITHDRAWALS:** Last day to withdraw from the course without obtaining WP or WF grade is Wednesday, March 23.

**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 form 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 Dr. John Moore in NM Room 117 of the Chemistry Building.

**GRADING SCHEME:** Grades are based upon performance. **A single grade will be given for the laboratory and the lecture.**

Students are responsible for all lab techniques presented in chemistry 133L and Chemistry 134L. If you need to review, please do so early on in the semester.

The table below gives the category, the percent of the grade, and approximately what the material category entails.

The rubric for the written reports follows. Study the rubric before starting writing.
<table>
<thead>
<tr>
<th>Item</th>
<th>%</th>
<th>Date(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam 1</td>
<td>7</td>
<td>2/7</td>
</tr>
<tr>
<td>Exam 2</td>
<td>7</td>
<td>2/28</td>
</tr>
<tr>
<td>Exam 3</td>
<td>7</td>
<td>3/7</td>
</tr>
<tr>
<td>Exam 4</td>
<td>7</td>
<td>4/11</td>
</tr>
<tr>
<td>Exam 5</td>
<td>7</td>
<td>4/25</td>
</tr>
<tr>
<td>HW Exam 1</td>
<td>2</td>
<td>2/5</td>
</tr>
<tr>
<td>HW Exam 2</td>
<td>2</td>
<td>2/26</td>
</tr>
<tr>
<td>HW Exam 3</td>
<td>2</td>
<td>3/5</td>
</tr>
<tr>
<td>HW Exam 4</td>
<td>2</td>
<td>4/9</td>
</tr>
<tr>
<td>HW Exam 5</td>
<td>2</td>
<td>4/23</td>
</tr>
<tr>
<td>HW separations</td>
<td>2</td>
<td>5/9</td>
</tr>
<tr>
<td>Course Final</td>
<td>18</td>
<td>5/13</td>
</tr>
<tr>
<td>Instrument Report</td>
<td>4</td>
<td>3/12 or 3/13</td>
</tr>
<tr>
<td>Titration report</td>
<td>4</td>
<td>4/29 or 4/30</td>
</tr>
<tr>
<td>Lab Final</td>
<td>5</td>
<td>5/6 or 5/7</td>
</tr>
<tr>
<td>Weekly NB</td>
<td>4</td>
<td>Fridays—either Satisfactory or Unsatisfactory</td>
</tr>
<tr>
<td>Notebook (NB): NaCl &amp; Spec 20</td>
<td>2</td>
<td>Will grade NB more fully on the following dates:</td>
</tr>
<tr>
<td>With Tools of the Trade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Results NaCl</td>
<td>3</td>
<td>2/18 or 2/19</td>
</tr>
<tr>
<td>Results Spec-20</td>
<td>3</td>
<td>3/12 or 3/13</td>
</tr>
<tr>
<td>NB: UV/VIS, AA, GC</td>
<td>2</td>
<td>4/22 or 4/23</td>
</tr>
<tr>
<td>With Instrument Questions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NB: MW, pkₐ &amp; standardization</td>
<td>2</td>
<td>This grading will include a close look at the questions and your results.</td>
</tr>
<tr>
<td>With REDOX Balancing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NaOH Standardization Results</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Results pKₐ and MW</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
2019 Quantitative Analysis Laboratory Schedule: 36 lecture; capped at 18 in each lab; Five groups of 3

<table>
<thead>
<tr>
<th>Week #</th>
<th>Monday Date</th>
<th>Monday</th>
<th>Tuesday Date</th>
<th>Tuesday</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1/21</td>
<td>MLK no Laboratory</td>
<td>1/22</td>
<td>NO LABORATORY</td>
</tr>
<tr>
<td>2.</td>
<td>1/28</td>
<td>Check-in and <strong>PREVIEW</strong></td>
<td>2/1</td>
<td>Check-in and <strong>PREVIEW</strong></td>
</tr>
<tr>
<td>3.</td>
<td>2/4</td>
<td>NaCl Solution; Spec-20; GC; UV/VIS; AA</td>
<td>2/5</td>
<td>NaCl Solution; Spec-20; GC; UV/VIS; AA</td>
</tr>
<tr>
<td>4.</td>
<td>2/11</td>
<td>NaCl Solution; Spec-20; GC; UV/VIS; AA</td>
<td>2/12</td>
<td>NaCl Solution; Spec-20; GC; UV/VIS; AA</td>
</tr>
<tr>
<td>5.</td>
<td>2/18</td>
<td>NaCl Solution; Spec-20; GC; UV/VIS; AA</td>
<td>2/19</td>
<td>NaCl Solution; Spec-20; GC; UV/VIS; AA</td>
</tr>
<tr>
<td>6.</td>
<td>2/25</td>
<td>NaCl Solution; Spec-20; GC; UV/VIS; AA</td>
<td>2/26</td>
<td>NaCl Solution; Spec-20; GC; UV/VIS; AA</td>
</tr>
<tr>
<td>7.</td>
<td>Mar 4</td>
<td>NaCl Solution; Spec-20; GC; UV/VIS; AA</td>
<td>3/5</td>
<td>NaCl Solution; Spec-20; GC; UV/VIS; AA</td>
</tr>
<tr>
<td>8.</td>
<td>3/12</td>
<td>--preview--</td>
<td>3/13</td>
<td>--preview--</td>
</tr>
<tr>
<td>9.</td>
<td>3/18</td>
<td>Spring Break no Laboratory</td>
<td>3/19</td>
<td>Spring Break no Laboratory</td>
</tr>
<tr>
<td>10.</td>
<td>4/1</td>
<td>NaOH Standardization</td>
<td></td>
<td>NaOH Standardization</td>
</tr>
<tr>
<td>11.</td>
<td>4/8</td>
<td>MW or pK&lt;sub&gt;A&lt;/sub&gt;</td>
<td></td>
<td>MW or pK&lt;sub&gt;A&lt;/sub&gt;</td>
</tr>
<tr>
<td>12.</td>
<td>4/15</td>
<td>MW or pK&lt;sub&gt;A&lt;/sub&gt;</td>
<td></td>
<td>MW or pK&lt;sub&gt;A&lt;/sub&gt;</td>
</tr>
<tr>
<td>13.</td>
<td>4/22</td>
<td>--</td>
<td></td>
<td>--</td>
</tr>
<tr>
<td>14.</td>
<td>4/29</td>
<td>--</td>
<td></td>
<td>--</td>
</tr>
<tr>
<td>15.</td>
<td>5/6</td>
<td>Laboratory Quiz</td>
<td></td>
<td>Laboratory Quiz</td>
</tr>
<tr>
<td>16.</td>
<td>5/13</td>
<td>Finals: no laboratory</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Only the Spec-20, UV/VIS and AA experiment will be performed in groups of three. The remaining tasks will be performed as an individual. Remember, around 16% of your course grade depends upon your technique. Make adjustments early in the semester if your laboratory technique is lacking.