Course Syllabus
Fall 2018
Chemistry 443L
Instrumental Analysis

Course Description: Spectrochemical and electrochemical methods of analysis.

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

Course Prerequisites and Corequisites: Prerequisite: 231 and 337. 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: To provide students with a more detailed explanation of the basic concepts, laws, and theories and to apply the knowledge to chemistry problem solving. 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. In addition, students will get experience in operating the following instruments: Fourier Transform Infrared Spectrometer, Atomic Absorption Spectrometer, Ultraviolet-Visible Spectrophotometer, Liquid Chromatograph, Gas Chromatograph, and Ion Chromatograph. Students will be taught to operate 400 MHz Nuclear Magnetic Resonance Spectrometer and a Gas Chromatograph-Mass Spectrometer. Students will be taught electrochemical techniques such as polarography, cyclic voltammetry, potentiometry, and chrono-amperometry.

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:
- The principles of gas, liquid, ion, and gel permeation chromatography,
- The principles of UV-visible, infrared, nuclear magnetic resonance, Raman, and X-Ray spectroscopy,
- The concepts involved in atomic absorption spectroscopy,
- The fundamentals of how flame and graphite furnace atomic absorption spectroscopy are applied to analytical chemistry,
- The concepts used in electron spin resonance spectroscopy,
- The fundamentals of electrochemistry that relate to half-reactions, Voltaic cells, and electrolytic cells,
- The fundamentals of electrochemical analysis, including polarography, pulse polarography, voltammetry, potentiometry, coulometry, and amperometry.
Class Syllabus  
Fall 2018  
CHE 443L-020 and 021  
Instrumental Analysis

Instructor: Dr. Darrell R. Fry  
Department: Chemistry & Biochemistry  
e-mail: frydr@sfasu.edu  
Office: Math 120  
Phone: TEXT: 936.208.3415  
Office Hours: MWF 9:30-11; TR 2:30-3:20 and by appointment  
Class meeting time and place: TR 8:00 am – 9:15 Math 132

TEXT AND MATERIALS:  
- Scientific Calculator  
- Other articles and spectra handouts will be distributed in the course as required reading.

SUPPLEMENTAL TEXTS:  
- Quantitative Chemical Analysis, Daniel C Harris any edition  
- Instrumental Methods of Analysis, 7th edition; Willard, Merritt, Dean, Settle

Specific Course Learning Objectives Include:  
1. Demonstrate knowledge of sampling methods for all states of matter.  
2. Assess sources of error in chemical and instrumental analysis and account for errors in data analysis.  
3. Recognize interferences in chemical and instrumental analysis.  
4. Comprehend the concept of and perform instrument and method calibration.  
5. Apply and assess concepts of availability and evaluation of analytical standards and formulate standardization methodology.  
6. Integrate a fundamental understanding of the underlining physics principles as they relate to specific instrumentation used for atomic, molecular, and mass spectrometry, magnetic resonance spectrometry and chromatography.  
7. Understand and be able to apply the theory and operational principles of analytical instruments.  
8. Distinguish between qualitative and quantitative measurements and be able to effectively compare and critically select methods for elemental and molecular analyses.
GRADING:
Grades are based upon performance. Please note, a single letter grade is given for Che 443 and Che 443 Laboratory.

The table below details the points available in the course.

<table>
<thead>
<tr>
<th>Date</th>
<th>Assessment</th>
<th>Points</th>
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</thead>
<tbody>
<tr>
<td>Friday 10/5</td>
<td>Exam I-10/5</td>
<td>50</td>
</tr>
<tr>
<td>Friday 11/9</td>
<td>Exam II -11/9</td>
<td>50</td>
</tr>
<tr>
<td>Friday 12/7</td>
<td>Exam III -12/7 (Friday of Dead Week)</td>
<td>50</td>
</tr>
<tr>
<td>Tuesday Dec 11th 8-10am</td>
<td>Final Exam Comprehensive ACS Final</td>
<td>100</td>
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<tr>
<td>Tuesday 8:00am sharp</td>
<td>Quizzes (10 @ 20 each; drop the lowest)</td>
<td>200</td>
</tr>
<tr>
<td>Thursday 8:00am sharp</td>
<td>Paragraphs describing instrumentation (10 @ 10 each; drop lowest)</td>
<td>100</td>
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<tr>
<td>9/28 and 11/2</td>
<td>Full Lab Report (2 @ 50 each)</td>
<td>100</td>
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<tr>
<td>Wednesdays</td>
<td>Results &amp; Post-Lab 100 points evenly distributed among the activities; drop the lowest</td>
<td>100</td>
</tr>
<tr>
<td>11/30</td>
<td>TEAM WORK ASSESSMENT</td>
<td>15</td>
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</tbody>
</table>

Exams 1-3 will be Friday afternoon—at a time and location to be determined. You will not have lab on exam days!

Exam 3 is the Friday of Dead Week.

Make-ups will not be given for the Quizzes, Paragraphs describing the instrumentation or Results & Post-Lab. Instead the lowest one in each category will be dropped.

Only under rare circumstances (at the decision of the faculty member) will students be allowed to make up an exam or the final exam.

Half of the points in the Results & Post-Lab are for attendance, neatness and working well with others.

Students must score a 43 or better (out of 50) on the two full lab reports. Failure to do so will mean writing additional lab reports over different laboratories.

Grading Scale (percentage of 400 points): A: 100-90% B: 89-80% C: 79-70% D: 69-60% F: below 60

Note: The attached class schedule is tentative. I will attempt to follow it as closely as possible with respect to lecture topics and exam material. However, any changes as to the exact material to be covered in lecture and each exam will be announced in class. It is therefore important for you to attend class regularly.

MAKE-UP POLICY: There will be no make-up exams, quizzes, or labs.

ATTENDANCE POLICY: Attendance of class is mandatory. A total of two unexcused absences will result in the student being dropped from the class with a grade of "F".
**ACADEMIC INTEGRITY (A-9.1):** Academic integrity is a responsibility of all university faculty and students. Faculty members promote academic integrity in multiple ways including instruction on the components of academic honesty, as well as abiding by university policy on penalties for cheating and plagiarism.

*Definition of Academic Dishonesty*

Academic dishonesty includes both cheating and plagiarism. Cheating includes but is not limited to (1) using or attempting to use unauthorized materials to aid in achieving a better grade on a component of a class; (2) the falsification or invention of any information, including citations, on an assigned exercise; and/or (3) helping or attempting to help another in an act of cheating or plagiarism. Plagiarism is presenting the words or ideas of another person as if they were your own. Examples of plagiarism are (1) submitting an assignment as if it were one's own work when, in fact, it is at least partly the work of another; (2) submitting a work that has been purchased or otherwise obtained from an Internet source or another source; and (3) incorporating the words or ideas of an author into one's paper without giving the author due credit.

Please read the complete policy at [http://www.sfasu.edu/policies/academic_integrity.asp](http://www.sfasu.edu/policies/academic_integrity.asp)

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.

**COURSE CALENDER & CONTENT:**

Material will be covered in the following section order with approximate class time. **Exam dates and due dates for lab reports are FIXED.**

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic/Laboratory</th>
<th>Exam</th>
<th>Lab Report Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8/31</td>
<td>POGIL: Spec 20</td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>9/7</td>
<td>Overview of Instruments: UV-vis; AA; Fluorescence</td>
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<tr>
<td>3</td>
<td>9/14</td>
<td>Perform either UV-vis, AA or Fluorescence</td>
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<tr>
<td>4</td>
<td>9/21</td>
<td>Perform either UV-vis, AA or Fluorescence</td>
<td></td>
<td>First Due</td>
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<tr>
<td>5</td>
<td>9/28</td>
<td>Perform either UV-vis, AA or Fluorescence</td>
<td></td>
<td></td>
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<tr>
<td>6</td>
<td>10/5</td>
<td></td>
<td>Exam 1</td>
<td></td>
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<tr>
<td>7</td>
<td>10/12</td>
<td>Overview of Instruments: CV, IR, GC</td>
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<tr>
<td>8</td>
<td>10/19</td>
<td>Perform either: CV, IR or GC</td>
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<td></td>
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<tr>
<td>9</td>
<td>10/26</td>
<td>Perform either: CV, IR or GC</td>
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<td>Second Due</td>
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<tr>
<td>10</td>
<td>11/2</td>
<td>Perform either: CV, IR or GC</td>
<td></td>
<td></td>
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<tr>
<td>11</td>
<td>11/9</td>
<td></td>
<td>Exam 2</td>
<td></td>
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<tr>
<td>12</td>
<td>11/16</td>
<td>Make-up Laboratory</td>
<td></td>
<td></td>
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<tr>
<td>13</td>
<td>11/23</td>
<td>Thanksgiving</td>
<td></td>
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<tr>
<td>14</td>
<td>11/30</td>
<td>Group Assessment</td>
<td></td>
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<tr>
<td>15</td>
<td>12/7</td>
<td></td>
<td>Exam 3</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** This course schedule is tentative
**WITHHELD GRADES SEMESTER GRADES POLICY (A-54):**
Ordinarily, at the discretion of the instructor of record and with the approval of the academic chair/director, a grade of WH will be assigned only if the student cannot complete the course work because of unavoidable circumstances. Students must complete the work within one calendar year from the end of the semester in which they receive a WH, or the grade automatically becomes an F. If students register for the same course in future terms the WH will automatically become an F and will be counted as a repeated course for the purpose of computing the grade point average. The circumstances precipitating the request must have occurred after the last day in which a student could withdraw from a course. Students requesting a WH must be passing the course with a minimum projected grade of C.

**STUDENTS WITH DISABILITIES:** To obtain disability related accommodations, alternate formats and/or auxiliary aids, students with disabilities must contact the Office of Disability Services (ODS), Human Services Building, and Room 325, 468-3004 / 468-1004 (TDD) as early as possible in the semester. Once verified, ODS will notify the course instructor and outline the accommodation and/or auxiliary aids to be provided. Failure to request services in a timely manner may delay your accommodations. For additional information, go to [http://www.sfasu.edu/disabilityservices/](http://www.sfasu.edu/disabilityservices/).

**SEMESTER WITHDRAWALS:** Last day to withdraw from the course without obtaining WP or WF grade is given on the sfa website.
Guidelines for Laboratory notebooks

• Bound.

• Entries are written in ink.

• Two-three pages at the front are dedicated to a table of content.

• Each page is dated and numbered.

• Blank pages have a single diagonal line indicating that they are intentionally left out.

• Incorrect entries are crossed out with a single line.

• Written as experimental work proceeds (not the next day).

• Contains drawings of experimental apparatus, descriptions of how work was actually carried out (when changes are made in the lab manual procedure, you should indicate what you did, not what the lab manual said), and experimental observations.

• Includes results, equations and calculations.

• Includes explanations, interpretations, questions that arise, future plans.
Laboratory Report
1. The report should be of publication quality in content, writing and style of presentation. All reports must conform to the following guidelines

   • The report should have a cover page listing the title of the experiment, the name of the student, the course number and date (first day of execution)

   • The report should contain an Introduction, Experimental, Results, Discussion, Post-Lab Questions and Conclusion sections

   • **Only typed reports will be graded.** Use subscripts, italics and Greek symbols as appropriate. Do not use shorthand notation, computer notation or slang. For example, use $\alpha$ instead of alpha, $1.5 \times 10^{-5}$ not $1.5E-5$, $K_a$ not Ka, $x^2$ not $x^2$. Do not write special characters by hand. Learn to create the necessary symbols and notation using computer software. All equations must be generated with an equation editor (e.g. Microsoft equation).

   • All tables should contain a caption and should be numbered sequentially (do not use Roman numerals). Tables should be generated with an appropriate software (word, excel, etc).

   • All figures should contain a caption and should be numbered sequentially. Graphs should be generated with appropriate software.

   • Tables and figures may be included with text or may be placed on a separate page.

   • All sources should be cited using the format employed in the Analytical Chemistry Journal.

2. The grading scheme for lab reports will be as follows:

   I. Introduction - 20%
      At least 3 paragraphs. The first should describe the utility of the technique, its advantages and disadvantages. Alternative techniques should be offered and compared. The second paragraph should reference a block diagram of the instrument and using the diagram, explain how the instrument works. For some experiments, this may take more than one paragraph. The final paragraph will briefly summarize the experiment including what the analyte is.

   II. Experimental Section - 10%
      Describe the main experimental setup in paragraph form. Reference the lab manual for specifics. A table of specific settings should be included.
III. Results - 20%
   a) Raw data: present raw data in a suitable format. Be sure to title the tables properly.
   b) Clearly list your results. Sample calculations and error analysis should be shown.
   c) Include all plots and printouts. Spectra, chromatograms, etc. should be placed at the end of the report.

IV. Discussion - 20%
   Discuss your results.

V. Post Laboratory Questions 20%
   Answer all questions listed in the handout. Rewrite every question using the numbering in the experiment handout.

VI. Conclusion – 5%
   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.

VII. References - 5%.
   (i) Include 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. At least 5 journal articles must be cited. The journal articles must be within ±15 years from September 1, 2018. UNLESS THE JOURNAL ARTICLE IS A MAJOR ARTICLE IN THE FIELD

Responsible use of instrumentation:
The instrumentation you will be using in CHE 443L is used both for teaching and research throughout the year. You can therefore appreciate the need to maintain it in good working order, and to keep the area around the instrument clean. It is important for you to be prepared for the experiments you perform, in order to maximize your learning experience and minimize the possibility of breakage. Your preparation should consist of:

1. reading the background chapter in Skoog, Holler & Nieman (see syllabus);
2. reviewing relevant lecture notes, and
3. preparing your lab notebook before the lab period. [You may also wish to consult materials from the library, particularly for your written reports.] Please respect the equipment, and recognize that breakage can be costly (money and down time). The instructor is available to help you if you are uncertain of how to proceed. We recognize that occasionally, things do break down. It is your responsibility to report any problems to the instructor immediately.
**During the lab:** The lab notebook should be your constant companion. Follow good laboratory notebook practice, just as you would be expected to in industry or at the NIH. All entries should be complete and legible. *Nothing* should be written on scraps of paper; everything is entered in the lab notebook. Record procedures (e.g., how serial dilutions were made, or how solutions of solids were prepared), any qualitative observations (e.g., appearance of solutions, difficulties encountered during sample preparation, etc.) as well as quantitative observations. Spectra or other information that are printed or plotted separately should be labeled clearly, titled, and marked with your initials and lab notebook page number. You should record the creation of such output in your notebook.

**At the end of the lab:** The instructor or teaching assistant will sign your lab notebook for the day. You do not need to submit copies of spectra or chart outputs with those pages, but the existence of such data must be clearly indicated in your notebook entries. At that time, the teaching assistant will also check that the instrument and sample preparation areas are clean, before you leave for the day.
Specific Expectations for Dr. Fry’s courses/laboratories

1. Refer to Dr. Fry as Dr. Fry—not Mr. Fry.
   a. Since 2001, Dr. Fry has found that every student who call him Mr. Fry, has utterly failed the course. It is not that I fail them for this—rather the students do not understand that they are in college. Students who do not recognize that I understand chemistry a lot better than their high school teacher do not recognize that they have to study—and they fail.

2. Pay attention DURING class!
   a. Dr. Fry has found that those students who pay attention in class tend to do their best. He has reached this same conclusion at the end of each semester since 2001—when he began teaching.
   b. Dr. Fry looks for understanding among the students as he presents the material. If you do not understand something often he is able to read your expression. As time allows, he can then explain the topic further. However, if you are not paying attention, Dr. Fry cannot do this.
   c. Do not have your cell phone out.
   d. Computers, tablets and other electronic devices are not allowed to be out during class time.
   e. Remember, that paying attention makes a difference. For most students (and everyone else) the cell phone represents the largest avoidable distraction. Exercise your self-control and do not look at your cell phone during class.
   f. Do not use your cell phone to take pictures of material in class including due dates. Instead write it down!

3. Work the homework until you understand it.
   a. Dr. Fry has found that those students who do their homework until they understand it tend to do their best. He has reached this same conclusion at the end of each semester since 2001 when he began teaching.
   b. A lot of students mistake going through the homework with working it until you understand it.

4. Do not talk while others are talking (or lecturing).
   a. Do not distract others (including Dr. Fry) from the course material.

5. Come to class/lab prepared.

6. Do not email Dr. Fry through the d2l system—he will not respond.

7. Students are expected to check their sfa email on a regular basis. Dr. Fry often communicates important items to individual students via email. For instance, if you left your calculator in the classroom.

8. Grades are not discussed immediately before or immediately after class. Instead, grades will be discussed during office hours. This prevents us arguing about a specific item in front of everyone in the class. Moreover, it gives us a chance to understand one another.
   a. After graded work is returned, you have a limited time to review it and find any problems. If you do find a problem, of something that you do not understand, see Dr. Fry in his office. In general, 1-2 class periods after something is handed back is an upper limit on regrading items.

Note: This syllabus is subject to change at the discretion of the instructor.