Course Syllabus
Fall 2020
Chemistry 5575
Instrumental Analysis

Course Description: Spectrochemical and electrochemical methods of analysis.

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

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 several exams during the semester including a comprehensive final exam. These activities average at a minimum 6 hours of work each week to prepare outside of time spent engaging with the content.

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 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 2020
CHE 4443-001/CHE 5175-006
Instrumental Analysis

<table>
<thead>
<tr>
<th>Instructor: Dr. Darrell R. Fry</th>
<th>e-mail: <a href="mailto:frydr@sfasu.edu">frydr@sfasu.edu</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Department: Chemistry &amp; Biochemistry</td>
<td>Office: Math 120</td>
</tr>
</tbody>
</table>

Class meeting time and place: COVID-19 POLICIES
Students are expected to participate during class or show proof that they interacted completely with the material.
Weekly, students may choose how they will interact with the material. They will send their decision to Dr. Fry via email at frydr@sfasu.edu. The three choices for interacting with the material (and Dr. Fry and your fellow students) are:

1) Attend in person Bush Math 130 MWF 8:00 am – 8:50. Students must have a mask on and must sit on a desk (maximum of 2) and participate!

2) Attend via live ZOOM link given below. Students must have their camera on (showing themselves) and participate!
   a. [https://sfasu.zoom.us/j/97658598228?pwd=aFJHMWtrU2dQL0xmV3FwdDBONFlsdz09](https://sfasu.zoom.us/j/97658598228?pwd=aFJHMWtrU2dQL0xmV3FwdDBONFlsdz09)
   b. or use: Meeting ID: 976 5859 8228 with the Passcode: 773229

3) Attend asynchronous. Students will have to write a paragraph each class day over the material covered. The paragraph should be detailed. The paragraph may include items that the student needs help with. Three paragraphs (for the week) are due the following Sunday at 6pm.

Office Hours: MWF 9:00-10:15 AM and R 3:30-4:45 PM and by appointment
ZOOM LINK (for office hours and class):
[https://sfasu.zoom.us/j/97658598228?pwd=aFJHMWtrU2dQL0xmV3FwdDBONFlsdz09](https://sfasu.zoom.us/j/97658598228?pwd=aFJHMWtrU2dQL0xmV3FwdDBONFlsdz09)
or use: Meeting ID: 976 5859 8228 with the Passcode: 773229

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 underlying 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 4443 and Che 4043 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 10/2</td>
<td>Exam I-10/2</td>
<td>100</td>
</tr>
<tr>
<td>Friday 11/6</td>
<td>Exam II -11/6</td>
<td>100</td>
</tr>
<tr>
<td>Friday 12/4</td>
<td>Exam III -12/4 (Friday of Dead Week)</td>
<td>100</td>
</tr>
<tr>
<td>Wednesday Dec 10th</td>
<td>Final Exam Comprehensive ACS Final</td>
<td>100</td>
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<tr>
<td>8-10am</td>
<td>Problem Set and or Paragraph Description of Instrumentation</td>
<td>300</td>
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<tr>
<td>Saturday @ midnight</td>
<td>(10 @ 30 each; drop the lowest)</td>
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</tr>
<tr>
<td>in D2L dropdown</td>
<td>Participating in class (or paragraphs)</td>
<td>100</td>
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</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 Problem Sets, Paragraphs Descriptions of Instruments 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 total 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.

**ATTENDANCE POLICY:** Attendance will be monitored using Problem Set and/or Paragraph Description of Instrumentation. Students who do not complete the weekly assignments

**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 are FIXED.**

<table>
<thead>
<tr>
<th>Week</th>
<th>M Date</th>
<th>Chapter(s)</th>
<th>Topic</th>
<th>Exam#</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Measurement Basics</td>
<td></td>
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<tr>
<td>2</td>
<td>6</td>
<td>6</td>
<td>An Introduction to Spectrometric Methods</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>7</td>
<td>Components of Optical Instruments</td>
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<tr>
<td>4</td>
<td>9</td>
<td>9</td>
<td>An Introduction to Optical Spectrometry</td>
<td></td>
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<tr>
<td>5</td>
<td>13,14</td>
<td>13,14</td>
<td>Ultraviolet-Visible Spectroscopy</td>
<td>Exam 1</td>
</tr>
<tr>
<td>6</td>
<td>15</td>
<td>15</td>
<td>Luminescence Spectroscopy</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>16,17,18</td>
<td>16,17,18</td>
<td>IR and Raman Spectroscopy</td>
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<tr>
<td>8</td>
<td>19</td>
<td>19</td>
<td>NMR</td>
<td></td>
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<tr>
<td>9</td>
<td>20</td>
<td>20</td>
<td>MS</td>
<td></td>
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<td>10</td>
<td></td>
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<td></td>
<td>Exam 2</td>
</tr>
<tr>
<td>11</td>
<td>22,23,24,25</td>
<td>22,23,24,25</td>
<td>Electrochemistry</td>
<td></td>
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<tr>
<td>12</td>
<td></td>
<td></td>
<td>Thanksgiving</td>
<td></td>
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<tr>
<td>13</td>
<td>26</td>
<td>26</td>
<td>Separations</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>27,28</td>
<td>27,28</td>
<td>LC vs. GC</td>
<td>Exam 3</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.

**ATTENDANCE AND PARTICIPATION POLICY AND GRADING:** Baring you becoming ill, the following policy applies.

Student-faculty interaction is crucial to a student’s mastering this content! One of my major goals is to get you to think about the analytical activities you have done in other courses, research or at a job and view this experience in light of the course content. I want you to tell me (and the class) what you have done! Others will learn from this, and ideally everyone understand the analytical process better. This course content is mastered by discussion—not just doing it, or reading about it, or even writing about it—discussion is how it is mastered.

A part of the grade is based upon participation (not attendance).

Participation is required and determined by the instructor. Take care of any business you need to prior to coming to class (i.e. using the restroom, eating, etc…) If you know you will be leaving early for a reason (or arriving late) let me know. If you need to leave for an emergency, just leave—there is no need to tell me. Your cell phone should be put away and on silent (no checking your RobinHood, FACEBOOK, Instagram, messages, etc…). For the majority of the class period I expect you to be paying attention, contributing and taking notes. There are numerous opportunities for you to offer your experience, ask questions or volunteer an answer. You should be prepared to do all of these things regardless of how you will be attending.

Weekly, students may choose one of the three modes to attend. Students should email Dr. Fry how they plan to participate each Sunday evening.

a) You can attend in person. You must be wearing a mask and socially distance from other students.
b) If you choose to do the live ZOOM link, then your camera must be on and you must participate. If you choose the live ZOOM I suggest you have a dedicated area which is free of distractions. Just like class, I expect you to be dressed appropriately, taking notes and paying attention. Like class, if you need to leave for an emergency, just leave—there is no need to tell me. Unlike class, you will not be able to tell if I realize you are not paying attention. I’ll give you the benefit of the doubt couple of times I call on you and you do not answer (or are completely clueless). After two times, you have no more rope and must prove each day that you are participating (for the entire class).
c) You may choose to attend asynchronously. In this case, you will need to write a paragraph over each class period. Volunteer information!!! If you have used a piece of equipment, let me know by describing what you did and why. As appropriate, I will share this with the class.

If you are not participating adequately, I will email you and give you suggestions on how to do better. Weekly, participation scores will be given. The weekly scores will be scaled up to 100 points for the course grade.

**WHAT TO DO IF YOU GET SICK:** As soon as it is convenient for you, email Dr. Fry. Be honest with me. Since this is a senior level (or graduate level) course, I’ll do what I can to help you get through the course.

**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/).
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. (unless that is what you are Zooming with the phone)
   d. Computers, tablets and other electronic devices are not allowed to be out during class time. (Unless that is what you are Zooming with.)
   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 lecturing (or talking).
   a. Do not distract others (including Dr. Fry) from the course material.
   b. I disable the chat in the ZOOM during course time; I do pause for questions. **If you are not paying attention, please do not ask questions—instead listen when you can pay careful attention.**
   c. The chat is enabled during the office hours. Please use it.

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.

9. Technology has provided us with some wonderful tools, and we will utilizing some of these tools in class/laboratory. However, technology has not displaced some common sense. Indeed, technology often distracts us from doing these simple, but essential, things. Some of them are:
   a. This class/laboratory has to be a priority for you. When it is not a priority, there is little I can do to help.
   b. Get enough rest. Working until midnight (or past midnight) every day makes getting up very difficult. Get enough exercise—exercise has a way of clearing your mind and relieving your stress. Eat healthy—nutrition makes a difference. Finally, sick people have a really, really hard time doing the material—so do your best to stay well! This includes a wearing a mask as appropriate.
   c. Controlling (as much as possible) your environment so that it is conducive to doing your best. In the classroom, I monitor (and correct) the environment for you. I cannot do the same with ZOOM.
   d. Paying attention to what you are doing at the time and only this. (Multitasking does not work with complicated material—like chemistry.)
   e. Surrounding yourself with positive people who have similar aspirations as yourself. Everyone needs support. Mr. Fry (my Dad) says: “to have be a friend in order to have a friend”. Cultivate friendships that propel you towards your goals.

The highlighted items were added in the Fall 2020 for COVID-19
Note: This syllabus is subject to change at the discretion of the instructor.