CHEM 421
Instrumental Methods of Analysis
Spring 2022
Dr. Wendy Cory
MWF 11:00-11:50
Classroom: SSMB 127

Note: The syllabus is subject to change by the instructor.

Co-requisite CHEM 421L

Course Materials
- Instrumental Analysis, Revised Edition by Granger, Yochum, Granger, and Seinerth (book or ebook)
- Computer with ChemDraw, Excel; a scientific calculator
- Suggested: highlighter, colored pens or pencils

Other materials, including scientific articles and assignments, will be posted to our OAKS website throughout the semester.

Student Learning Outcomes
- To explain the theoretical basis of instrumental chemical measurements (spectroscopic, chromatographic, and electrochemical), including the dependence of measurements on atomic, ionic, and molecular properties of the analyte
- To compare and contrast the capabilities and limitations of different kinds of instrumentation
- To select the most appropriate instrumental method of analysis to answer real-world questions about a sample
- To interpret spectroscopic, chromatographic, and electrochemical data

E-mail
I communicate with the class using e-mail. It is your responsibility to read your @g.cofc.edu e-mail. If you have questions about the material in our class, you should attend or schedule an office hour. Don’t expect immediate responses to your emails with material-based or any last-minute questions; If you need an answer from me, make plans with me to meet in person or on Zoom.

If you are ill or under quarantine, do not come to in-person class.

Course Modality: This course is an in-person class. If necessary, we may meet on Zoom (instructor illness or quarantine, weather events). Monitor your email for updates. Otherwise, we will follow the College’s rules concerning the need to pivot to hybrid or online learning.

Attendance: If you miss class, it is your responsibility to find a classmate who will share notes with you. This is an in-person class and you are expected to attend. I will periodically monitor attendance.
If you are ill or under quarantine, do not come to class.
If you are ill or under quarantine, contact me by email ASAP. There will be no Zoom recordings.
Deportment: In this class, you are expected to be respectful of your teacher and other students. Talking and texting are prohibited. Keep your phone/Apple watch monitoring to a minimum. Using a tablet to take notes is OK. If you need to use these things, leave the room. It is important that you present yourself as a serious, professional student when dealing with faculty and other students. Think about what you want letters of recommendation to say about you.

Course Introduction
The focus of this course is on the theory and instrumentation of spectroscopy, mass spectrometry, chromatography, and electrochemical analysis. We will focus on how we use chemical phenomena to make analytical measurements, both qualitatively and quantitatively. We will relate these ideas to how instrumentation worked in the recent past, how modern instrumentation works now, and advances that will affect how instruments might work in the near future. We will pay close attention to the samples and analytes to which these methods are applicable and how to best obtain the chemical information needed to solve analytical problems. In order to choose the best instrumental method for addressing an analytical problem, we will consider:

- the property or quantity of the chemical system to be measured
- the physical and chemical principles upon which the measurement is based
- the generation of a signal by a suitable detector
- how the instrument actually makes the measurement
- some of the techniques used to improve analytical figures of merit (such as accuracy, precision, and sensitivity)
- the strengths and limitations of each particular instrumental method or approach

You will develop an understanding of the capabilities of a number of instrumental methods and should be able to suggest suitable instrumental methods to solve particular analytical problems.

Problem Sets
Problems from the book and other sources will be assigned for each topic we cover. Problem sets will be due at the beginning of class, 11:00 am, on the assigned due dates; late problem sets will lose 10% if turned in within 48 hours. An additional 10% points will be lost for each additional day that a problem set is late.

Quizzes: Quizzes will be given periodically.

Tests: There will be 4 tests plus the final exam; see schedule on next page of syllabus. If you know that you will miss a test for a school-sponsored event or grad school/med school/ etc interview, you must e-mail me at least 5 days in advance about this so that you can take the test early.

There are NO makeup exams. One test that is missed for a documented/excused reason can be replaced with the final exam grade, this includes if you miss a test due to illness or quarantine. If you become ill or must quarantine, do not come to class. Even if you have a good excuse, you should not miss more than one test. You will need to talk to me about options, including dropping this class, if you miss more than one test.
Final Exam: The final exam is cumulative over the entire semester and is a timed ACS-style test. It is weighted to count as 20% of your overall grade. Do *NOT* be late. You should be on campus at least 30 minutes before the start of the final and should plan on being in your seat at least 5 minutes prior to the start of the final exam.

Test Schedule: Because of possible hurricanes and the pandemic, the following are tentative dates for the exams. These dates are subject to change.

<table>
<thead>
<tr>
<th>Day</th>
<th>Date</th>
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</thead>
<tbody>
<tr>
<td>Test 1</td>
<td>W February 9</td>
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<tr>
<td>Test 2</td>
<td>F March 4</td>
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<tr>
<td>Test 3</td>
<td>W March 30</td>
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<tr>
<td>Test 4</td>
<td>M April 25</td>
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<tr>
<td>Final exam</td>
<td>W April 27, 1:00 – 3:00 pm</td>
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</table>

The last day to drop with a grade of "W" is Friday, March 25.

Grading Scheme: Your final grade will be calculated by the following formula:

| Problem Sets, Assignments, Quizzes | 20% |
| 4 tests**                         | 60% |
| Final Exam                       | 20% |

**please note: a person who misses any of tests 1-4, for any documented/excused reason, including illness or quarantine, or school interviews, will have the final exam grade replace their missing test grade. Anyone who takes all 4 tests will have their lowest test grade replaced by the final exam.

If you are ill or under quarantine, do not come to class.

Inclement Weather, Pandemic or Substantial Interruption of Instruction: If the College of Charleston closes and members of the community are evacuated due to inclement weather, you are responsible for taking course materials with you in order to continue with course assignments consistent with instructions provided by faculty. All students must have access to a computer equipped with a web camera, microphone, and Internet access.

Electronic Device Policy: The use of wireless communication devices during class is prohibited other than to respond to a Cougar Alert announcement. This includes phones and Apple watches. Phones must be on “silent” ring. The use of any wireless communication device during a quiz, test, or final exam is a violation of the Honor Code. You will not be allowed to use your phone or Apple Watch as a calculator, even if you forget your calculator.

College of Charleston Honor Code and Academic Integrity: Lying, cheating, attempted cheating, and plagiarism are violations of our Honor Code that, when
suspected, are investigated. Each incident will be examined to determine the degree of deception involved.

Incidents where the instructor determines the student’s actions are related more to misunderstanding and confusion will be handled by the instructor. The instructor designs an intervention or assigns a grade reduction to help prevent the student from repeating the error. The response is recorded on a form and signed both by the instructor and the student. It is forwarded to the Office of the Dean of Students and placed in the student’s file.

Cases of suspected academic dishonesty will be reported directly by the instructor and/or others having knowledge of the incident to the Dean of Students. A student found responsible by the Honor Board for academic dishonesty will receive a XXF in the course, indicating failure of the course due to academic dishonesty. This status indicator will appear on the student’s transcript for two years after which the student may petition for the XX to be expunged. The F is permanent.

Students can find the complete Honor Code and all related processes in the Student Handbook at: http://deanofstudents.cofc.edu/honor-system/studenthandbook/

COVID-19 Reminders: For the health and safety of yourself and those around you, you are required to wear a face-covering over both your nose and mouth while inside all campus buildings (you should do the same inside other public buildings). This mask should fit well; there should not be gaps anywhere between your face and the mask. Also remember that students, faculty, and staff should not come to campus when they feel unwell.

For CofC rules and regulations regarding COVID, see the College’s website https://today.cofc.edu/2021/12/31/cofc-covid-19-update-for-spring-2022-semester/

The CDC’s guidance has changed over the course of the pandemic as new data and new variants have emerged; check the latest info for yourself: https://www.cdc.gov/coronavirus/2019-ncov/if-you-are-sick/quarantine.html and find CofC’s info here: https://cofc.edu/back-on-the-bricks/ The easiest thing to do is to contact Student Health about your particular situation to get their guidance: https://studenthealth.cofc.edu/ If you cannot attend class due to a COVID-related situation, contact your instructors as soon as possible for help in making up assignments.

CofC Student Health requests that you inform them of positive COVID testing results and any close contact with someone who is COVID-positive, so they can monitor the campus health situation and give you personalized healthcare. CofC holds regular free testing events on campus for anyone in the campus community to get tested for COVID infection. CofC also holds free vaccination events on campus for all students. Vaccination remains the best way to protect yourself, your family, and those around you.
Course Topics – Study Guide

We will cover the following chapters and sections in *Instrumental Analysis, Revised Edition* by Granger, Yochum, Granger and Sienert. Problems assigned from the book, as well as additional problems, notes from class, and these readings will be the basis of quizzes, tests, and the final exam.

The order and coverage of topics is subject to change.

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<thead>
<tr>
<th>Chapter</th>
<th>Topic</th>
<th>Sections</th>
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<td>The Analyst’s Toolbox</td>
<td>1.1</td>
</tr>
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<td>4</td>
<td>Instrumental Electronics</td>
<td>4.1 – 4.7</td>
</tr>
<tr>
<td>3</td>
<td>Light and Optics</td>
<td>2.6, 3.1 – 3.4</td>
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<td>6</td>
<td>UV/Vis Spectroscopy</td>
<td>1.2, 6.1 – 6.8</td>
</tr>
<tr>
<td>5</td>
<td>Signals and Noise</td>
<td>5.1 – 5.5</td>
</tr>
<tr>
<td>8</td>
<td>Luminescence Spectroscopy</td>
<td>8.4 – 8.4</td>
</tr>
<tr>
<td>3,11</td>
<td>IR Spectroscopy</td>
<td>1.3, p. 81-83 (Ch. 3), 11.1 – 11.6, 11.8</td>
</tr>
<tr>
<td>12</td>
<td>Raman Spectroscopy</td>
<td>12.1 – 12.3, p. 419</td>
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<tr>
<td>13</td>
<td>Mass Spectrometry</td>
<td>1.5, 13.1 – 13.5</td>
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<td>15</td>
<td>Liquid Chromatography</td>
<td>15.1 – 15.5</td>
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<td>16</td>
<td>Gas Chromatography</td>
<td>16.1 - 16.6, p. 585-587</td>
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<tr>
<td>14</td>
<td>NMR Spectroscopy</td>
<td>1.4, 2.7, 14.1 – 14.7</td>
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<tr>
<td>9,13</td>
<td>Atomic Emission and ICP-MS</td>
<td>9.1 – 9.6, p.441-443 (Ch 13)</td>
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<tr>
<td>19</td>
<td>Voltammetry</td>
<td>19.1 – 19.2, 19.4, 19.6</td>
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<tr>
<td>17</td>
<td>Electrophoresis</td>
<td>17.1 – 17.3, 17.5, 17.9</td>
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<tr>
<td>18</td>
<td>Potentiometry</td>
<td>18.2 – 18.4</td>
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Center for Disability Services: If you are a student with a documented disability who will require accommodations in this course, you must provide the proper documentation in the form of a Professor Notification Letter (PNL) **during the first week of class**. If you are certified to have extra time on tests, **this will need to be arranged with the Center for Disability Services** so that you can take your tests at their location. For all tests and the final exam, you will need to schedule this with the CDS **at least five school days before the exam** so that I can deliver it to their office. No exceptions.

Mental & Physical Wellbeing: At the college, we take every student’s mental and physical wellbeing seriously. If you find yourself experiencing physical illnesses, please reach out to student health services (843.953.5520). And if you find yourself experiencing any mental health challenges (for example, anxiety, depression, stressful life events, sleep deprivation, and/or loneliness/homesickness) please consider contacting the Counseling Center (professional counselors at http://counseling.cofc.edu or 843.953.5640.) These services are there for you to help you cope with difficulties and to maintain optimal physical and mental health.

Food & Housing Resources: Many CofC students report experiencing food and housing insecurity. If you are facing challenges in securing food (such as not being able to afford groceries or get sufficient food to eat every day) and housing (such as lacking a safe and stable place to live), please contact the Dean of Students for support (http://studentaffairs.cofc.edu/about/salt.php). Also, you can go to http://studentaffairs.cofc.edu/student-food-housing-insecurity/index.php to learn about food and housing assistance that is available to you. In addition, there are several resources on and off campus to help. You can visit the Cougar Pantry in the Stern Center (2nd floor), a student-run food pantry that provides dry-goods and hygiene products at no charge to any student in need. Please also consider reaching out to Professor Cory if you are comfortable in doing so.

Inclusion: The College of Charleston offers many resources for LGBTQ+ students, faculty and staff along with their allies.

- Preferred Name and Pronoun Information
- On Campus Gender Inclusive facilities
- Campus Resources
- College of Charleston Reporting Portals
- National Resources for Faculty & Staff
- GSEC Reports
- Documenting LGBTQ Life in the Lowcountry (CofC Addlestone Library Special Collections Project)
- College of Charleston Quality Enhancement Plan (QEP)
- Articles about CofC and LGBTQ+ Issues