Chemistry 220 - Fundamentals of Analytical Chemistry Lecture (Spring 2017)

Co-requisite: Chem 220L  
Pre-requisites: Chem 112, 112L, Math 111 or equivalents

Instructor: Dr. Jay G. Forsythe  
Office: SSMB 112  
Phone: 843-953-5052  
Email: forsythejg@cofc.edu  
Office Hours: Wed 9:00 – 12:00 PM

Lecture Time and Location: Tues / Thurs, 8:00 – 9:15 AM, SSMB 127

Final Exam Time and Location: Saturday, April 29, 8:00 – 11:00 AM, SSMB 127

Student Learning Outcomes:

- To carry out concentration, titrimetric, equilibrium, and statistical calculations.
- To explain and apply the theory behind quantitative methods and modern instrumentation.
- To assess the quality of laboratory data and identify any sources of error.
- To construct and apply calibration curves used in chemical analysis.
- To explain chemical equilibria and its applications and perform appropriate calculations.
- To select the most appropriate method for a given chemical analysis.
- To demonstrate problem-solving abilities in the area of chemical analysis.

Attendance and Participation: Due to the math-heavy nature of this course, the majority of lecture material will be written on the board. Therefore, it is highly recommended you attend all lectures, and it is your responsibility to follow up on missed notes. While in class, it is expected that you will actively participate. Please refrain from texting, online games, social media, etc.

Communication: Major class announcements and handouts will be discussed in class and sent via e-mail. Writing assignments will be edited, uploaded, and graded through the OAKS Dropbox. Grades for individual assignments and tests will be uploaded to OAKS.

Required Materials:

- Exploring Chemical Analysis, 5th Edition, Daniel C. Harris (print or digital okay)
- Scientific calculator with log and exponential functions

Optional Materials:

- ALEKS prep (up to 2% extra credit)

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) by January 19. If you are certified to have extra time on tests and quizzes, this will need to be arranged with the SNAP office so that you can take it there. I will need the envelope for this test at least one week before the test so that I can have it delivered to the SNAP office in time for you to take it there. The same applies to the final exam. No exceptions.

Honor Code: Lying, cheating, attempted cheating, and plagiarism are violations of the Honor Code (http://studentaffairs.cofc.edu/honor-system/studenthandbook/index.php) and will be reported without exception. During exams, cell phones, laptop computers, and tablets must be put away. Graphing calculators are permitted on exams but storing material and/or notes on them will be considered cheating.
Course Evaluation: Course evaluations will be completed on the last day of class. I will leave the room early so you can fill out the electronic forms objectively. Please take them seriously.

Recommended Study Practices: Working problems and going over class notes / in-class group problems are the best ways to prepare for exams. Book problems will not be collected or graded, but are essential in preparing for exams and should be done throughout the course. Also, the Student Learning Center (SLC) is a good resource and has science-specific assistance (http://csl.cofc.edu/).

ALEKS course prep (optional): An online prep assignment was designed to ensure students from different major and course backgrounds are ready to start the course. It is of no cost. ALEKS goes at the pace of each individual student – if you are a little rusty in chemistry, it may take a while. If you are not, it should not take long. Regardless of the length of time it takes, if you complete it you will receive 2% extra credit on your final grade. You will take an initial assessment and then go from there. Your extra credit percentage (up to 2%) is based on topic completion and not specific assessments. Please let me know if you have any issues with ALEKS. Sign up using the below instructions:

1. Go to aleks.com.
2. If you have used ALEKS before, login. If you have not, on the left-hand side there is a yellow box that says “New Student? Sign up now.” Click on it.
3. The course code is: VUVDV-6XF9Q. When you type it in, you will be able to start.

Course Outline:

Unit I:
- Chapter 1 sections 1.3 and 1.4 (Chemical Concentrations and Preparing Solutions)
  - Recommended problems: 1-9, 1-10, 1-11, 1-12, 1-13, 1-14, 1-15, 1-17, 1-20
- Chapters 3 and 4 thru section 4.5 (Math Toolkit and Statistics: skip section 4-6)
  - Recommended problems: 3-1, 3-2, 3-3, 3-4, 3-5, 3-9, 3-11, 3-12, 3-13, 3-14, 3-15, 3-16, 3-20, 4-1, 4-2, 4-4, 4-5, 4-6, 4-7, 4-8, 4-9, 4-11, 4-12, 4-13, 4-14, 4-15
- Chapter 4 sections 4.6 - 4.7 and Chapter 5 (Calibration Curves)
  - Recommended problems: 4-19 (use Excel), 5-4, 5-14, 5-18, 5-22
- Chapter 6 (Titrations: incorporate section 1-5 with 6-4; skip sections 6-5 and 6-6)
  - Recommended problems: 1-27, 1-28, 1-29, 1-31, 6-1, 6-5, 6-6, 6-12, 6-14, 6-15, 6-17, 6-18, 6-20

Unit II:
- Chapter 8 (Acids/Bases)
  - Recommended problems: 8-1, 8-3, 8-4, 8-9, 8-11, 8-13, 8-14, 8-15, 8-16, 8-17, 8-18, 8-19, 8-21, 8-22, 8-23, 8-28, 8-32
- Chapter 9 (Buffers)
  - Recommended problems: 9-1, 9-2, 9-4, 9-6, 9-7, 9-8, 9-9, 9-12, 9-13, 9-14, 9-15, 9-16, 9-20, 9-22
- Chapter 10 (Acid and Base Titrations: skip derivatives in 10-4, skip section 10-6)
  - Recommended problems: 10-1, 10-2, 10-3, 10-6, 10-7, 10-8, 10-9, 10-11, 10-12, 10-13, 10-14, 10-15, 10-16, 10-17, 10-20, 10-23, 10-27

Unit III:
- Chapter 11 (Polyprotic Acids)
  - Recommended problems: 11-2, 11-3, 11-7, 11-9, 11-10, 11-12, 11-13, 11-17, 11-19, 11-20, 11-25, 11-26
• Chapter 12 (Equilibrium: skip problems using Debye-Huckel eqn in 12-2)
  o **Recommended problems**: 12-1, 12-2, 12-6, 12-7, 12-8, 12-9, 12-11, 12-16, 12-18, 12-22, 12-23, 12-24, 12-26, 12-29, 12-36, 12-37, 12-38

• Chapters 14 and 15 (Electrochemistry: skip section 15-5)
  o **Recommended problems**: 14-1, 14-2, 14-3, 14-4, 14-8, 14-9, 14-10, 14-11, 14-12, 14-14, 14-16, 14-17, 14-20, 14-23, 14-24, 14-25, 15-1, 15-2, 15-11

**Unit IV:**
• Chapters 18 – 20 (Spectroscopy: skip sections 19-1 thru 19-3, 20-2, and 20-4 thru 20-6)
  o **Recommended problems**: 18-1, 18-2, 18-3, 18-4, 18-5, 18-7, 18-12, 18-14, 18-15, 18-19

• Chapters 21 and 22 (Chromatography: skip sections 21-5, 22-2, and 22-4)
  o **Recommended problems**: 21-1, 21-2, 21-3, 21-4, 21-7, 21-11, 22-2, 22-5

**Key Dates:** Writing assignment due dates are subject to change. These assignments will be due at the beginning of class (8:00 AM) for the specified dates below. Test dates are unlikely to change, but the material covered may change depending on lecture pace.

**Unit I:**
• Writing 1 (first draft) due Thursday, 1/19
• Extra Credit ALEKS Prep due Thursday, 1/26
• **Exam 1**: Thursday, 2/2 at 8:00 AM (in class)

**Unit II:**
• Writing 1 (final submission) due Thursday, 2/7
• Writing 2: due Tuesday, 2/21
• **Exam 2 (Midterm)**: Thursday, 3/2 at 8:00 AM (in class)

**Unit III:**
• Writing 3: due Thursday, 3/23
• **Exam 3**: Tuesday, 4/4 at 8:00 AM (in class)

**Unit IV:**
• Writing 4: due Thursday, 4/20
• **Exam 4 (2/3 cumulative, 1/3 new material)**: Saturday, 4/29 at 8:00 AM (SSMB 127)

**Grading:** Final grades will be given based on the following scale (decimal places of 0.50 and greater round up).

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>(100 – 93%)</td>
</tr>
<tr>
<td>A-</td>
<td>(92 – 90%)</td>
</tr>
<tr>
<td>B+</td>
<td>(89 – 87%)</td>
</tr>
<tr>
<td>B</td>
<td>(86 – 83%)</td>
</tr>
<tr>
<td>B-</td>
<td>(82 – 80%)</td>
</tr>
<tr>
<td>C+</td>
<td>(79 – 77%)</td>
</tr>
<tr>
<td>C</td>
<td>(76 – 73%)</td>
</tr>
<tr>
<td>C-</td>
<td>(72 – 70%)</td>
</tr>
<tr>
<td>D+</td>
<td>(69 – 67%)</td>
</tr>
<tr>
<td>D</td>
<td>(66 – 63%)</td>
</tr>
<tr>
<td>D-</td>
<td>(62 – 60%)</td>
</tr>
<tr>
<td>F</td>
<td>(below 60%)</td>
</tr>
</tbody>
</table>

Student performance in lecture will be evaluated by:
Writing 10%
Exam 1 20%
Exam 2 20%
Exam 3 20%
Exam 4 30%

100%

(ALEKS up to +2%)

**Writing Assignments:** Documents should be \( \leq 1 \) page, single spaced. These will be graded as follows:

- **Content / accuracy / clarity** 80%
- **Grammar and spelling** 10%
- **Citations** 10%  
  (see [http://library.williams.edu/citing/styles/acs.php](http://library.williams.edu/citing/styles/acs.php))

100%

**Assignment 1:** Find a news article in the popular press (newspaper, magazine, internet) that involves analytical or environmental chemistry. Do NOT use a technical journal. Your first assignment will be submitted to the OAKS Dropbox and will be edited by Dr. Forsythe. You will then re-submit the final version to be graded. This will only occur for the first writing assignment – the purpose of this process is to learn how to write clearly and effectively.

1. Summarize the article in one paragraph.
2. Make three lists of terms and concepts:
   a. terms you understand well
   b. terms that you are reasonably sure about
   c. terms that you don't understand
3. Write a list of questions, technical or otherwise, that the article raises in your mind.
4. Critique the article by addressing the validity of the data/arguments that the other uses. Be sure to include a proper bibliographic citation of your article.

**Assignment 2:** Find an article in *Chemical and Engineering News* of interest to you that involves analytical or environmental chemistry (examples: a new innovation, a real-world problem to be solved, employment opportunities, or government regulations). Discuss why you selected the article.

1. Briefly summarize the article.
2. What new chemistry concepts did you learn or if you did not learn new chemistry what was reinforced for you?
3. Do you agree or disagree with any ascertains made by the author and why?

Be sure to include a proper bibliographic citation of your article.

**Assignment 3:** Find an article in one of the following journals that describes a new chemical analysis: *Analytical Chemistry* or *Environmental Science and Technology*. 

1. Summarize the method employed and the results that were found.
2. Describe how well you understood the article (or not).
3. What would you do as an analytical chemist to improve the procedure?

Be sure to include a proper bibliographic citation of your article.

*Anal. Chem.* link: [http://pubs.acs.org/journal/ancham](http://pubs.acs.org/journal/ancham)

*Environ. Sci. & Tech.* link: [http://pubs.acs.org/journal/esthag](http://pubs.acs.org/journal/esthag)

**Assignment 4:** You will be given a journal article to critique with additional instructions.