CHEMISTRY 311 W ADVANCED ANALYTICAL CHEMISTRY
FALL 2017
Lecture 12 noon MW, Lab 8am TR
FSC 214 FSC 317

Instructor

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I believe the information in this syllabus is accurate, but reserve the right to make corrections as needed.

Class Schedule

Lecture - Discussion	12:00 - 12:50 am MW	FSC 214
Lab	8:00-10:50 am TR	FSC 317

TEXTS and SUPPLIES

Skoog, D. A.; Holler, F. J.; Crouch, S. R. *Principles of Instrumental Analysis*, 6th ed., Saunders College Publishing: Fort Worth, 2007. ISBN 13:978-0-495-01201-6

Coghill, Anne M.; Garson, Lorrin R. *The ACS Style Guide*, 3nd ed., American Chemical Society: Washington, DC, 2007. ISBN 13:978-0-8412-3999-9 (ACS members get a significant discount, so you can probably save by ordering direct from ACS). ACS also provides chapter by chapter access to the *ACS Style Guide* through Mikkelsen Library - http://pubs.acs.org/isbn/9780841239999 - open this page in a browser, scroll down to the chapter you want, click the pdf link for that chapter (you may need to be on an Augie computer to have access). SciFinder Moodle document also has this link.

Permanently Bound (*not spiral*) Lab Notebook with carbon pages

Safety Goggles

Grading Criteria

POSSIBLE POINTS		APPROXIMATE CUTOFFS	
Exams (3)	300	A - A-	930 - 900 + A Candidacy Threshold
Candidacy Exam	20	B+ - B - B-	870 - 830 - 800 + B Candidacy Threshold
Lab Reports	400	C+ - C - C-	770 - 680 - 650
Instrument Proposal	100	D+ - D - D-	630 - 580 - 550
Review of Instrument Proposal	30	Borderlines are determined on a case by case basis.	
Presentations (2)	50	Late penalty assessments are listed with assignment	
Final Exam (ACS)	100	descriptions and summarized on the last page of the syllabus.	
TOTAL	**1000**	Last Day to request S/U Friday, Nov 3	

Catalogue Description

This course focuses on instrumental methods of analysis. The lecture is devoted primarily to instrument design and the advantages and disadvantages of that design. Laboratory is emphasized and centers on method development projects. Two hours of lecture and six hours of laboratory per week.

Nature of the Course

The goals for this course are based on the Department's Assessment Plan which monitors students' progress toward becoming a professional chemist. The specific focus is on concept development, critical thinking, oral and written communication, safety, and use of the chemical literature.

Student Learning Outcomes:

- Demonstrate a fundamental understanding of chemical concepts and calculations covered in this class:
  - Instrument design, advantages and limitations.
  - Data analysis with appropriate use and interpretation of statistics.
- Demonstrate critical thinking, problem solving, and safety analysis skills using the tools of chemistry:
  - Select appropriate methods for a required analysis or to solve a problem.
  - Design methods and execute experiments including assessment of safety.
- Demonstrate the ability to write in a professional chemistry style (emphasis in this course), evidenced in:
  - Essay exams.
  - Lab notebook.
  - Lab reports.
  - Proposal.
- Demonstrate the ability to communicate orally in a professional chemistry style, evidenced in:
  - Group work in class and lab.
  - Research project presentations.
- Demonstrate an ability to search the chemical literature, evidenced in the research projects.

Inherent in the Student Learning Outcomes but not explicitly stated:

- Development of team skills through cooperatively working together in small groups.
- Development of an ability to follow oral and written directions (lab and lecture).
- Development/refinement of laboratory skills using instrumentation for a quantitative determination including data analysis.
- Development and refinement of the fundamentals for maintaining a proper laboratory notebook.
- Development of the ability to think and act ethically as a professional chemist.

This course is also a "W" component course - that means:

- The instructor has attended a "writing across the curriculum" workshop to assure consistency for "W" courses.
- The "W" course will provide **at least three assignments** for which instruction in the writing process will be given, and each course will require **at least fifteen pages of written work** from among the following sorts of activities:
    - brief essays or themes
    - an empirical or library research report
    - journaling
    - essay exam questions
- The writing assignments will help students think more clearly and become more effective learners and communicators in chemistry.
- Specific feedback to each student is provided during the writing process, including at least one draft-revision assignment.

In this course the writing component will be composed of four aspects:

- one major paper
- the lab notebook
- lab reports
- essay exams

On most assignments you may "win back" points missed by turning in a revision (more details given below). To pass the course you must make a reasonable writing effort in all these areas.

During the first lab period we will discuss the writing process, some of the specifics of writing in Chemistry, and the writing resources available in the Chemistry Department. The Writing Center, Humanities 220, will also provide assistance - contact them by email at writing@augie.edu or see more details about the Center (including hours) on line at http://http://www.augie.edu/writing-center.

Moodle

Syllabus, other handouts, any powerpoint presentations used in class, answer keys to exams, and other information files for this class will be posted on Moodle under Chem 311A. The grade book will be updated after each exam so you can check that grades are recorded correctly and see how you stand. If you encounter problems with Moodle, please let the instructor know. Electronic copies of assignments will be collected in Moodle drop boxes.

COURSE POLICIES

Attendance

Attendance is required for examinations and laboratory work. Although attendance at lectures is expected, it is not required. However, you are responsible for all lecture material and announcements, whether present or not. If an absence is unavoidable for lab or an exam, notify the instructor as soon as possible. If you participate in sports, make sure I have a schedule that includes projected travel times.

Communications with the Class

The instructor will use your Augie email addresses (@ole) for general communication with the class and with individuals; check your email daily. Email is sometimes erratic, so I will respond to every message you send. If you don't get a response in a day or two, send your message again. **DON'T SEND MESSAGES THAT CONSIST OF *ONLY* A LINK OR ATTACHMENT; provide a line or two of context to distinguish them from spam.** See the Help Desk (Madsen Basement) for details on accessing your email. If you use another email account, put a forwarder in your @ole account (contact the Help Desk for help in setting up a forwarder).

Late Assignments

In general late assignments are docked 5% per week late. Revisions more than one week late will not be accepted. No late assignments are accepted after 5 pm on the last day of classes.

UNIVERSITY POLICIES

Accessibility

Augustana welcomes students with disabilities to participate in all of its courses, programs, services, and activities. If you have a documented disability and are requesting accommodations, please contact Susan Bies, Director of Accessibility and Academic Support. Her office is located in the Student Success Center (Edith Mortenson Center, Suite 100) and she may be reached at 605-274-5503 or susan.bies@augie.edu.

Chemistry, by its very nature, involves handling of potentially hazardous substances. The labs in this course will teach you how to handle these substances properly while minimizing the range of exposure. However, exposure effects vary from person to person. So, if you have asthma, allergies, are pregnant, or have other special circumstances, please inform your lab instructor so we can plan appropriate accommodations for your safety.

Honor Code

As a community of scholars, the students and faculty at Augustana University commit to the highest standards of excellence by mutually embracing an Honor Code. The Honor Code requires that examinations and selected assignments contain the following pledge statement which students are expected to sign:

> "On my honor, I pledge that I have upheld the Honor Code, and that the work I have done on this assignment has been honest, and that the work of others in this class has, to the best of my knowledge, been honest as well."

Faculty members are responsible for investigating all instances involving any student who does not sign the Honor Pledge or who bring forward an academic integrity concern. The complete Honor Code can be found at www.augie.edu/honor.

What does this mean in this course?

- You do your own work on individual assignments (not copying others). On group assignments you contribute to the group effort and strive to understand all parts of the project, not just the part you do.
- In lab you are "true" to your data - your report reflects what *you* measured and observed; data is not changed or manufactured to fit expectations. If you missed collecting some data, see the instructor; don't copy someone else's data.
- Give credit where credit is due. When you gather data from the Web, books, magazines, etc. cite the reference (author, title, etc.).

I presume we are in this class to help each other learn some chemistry (yes, instructors learn in this class too), so I trust you to turn in work that reflects your efforts and also, that as individuals and in your small groups, to help each other adhere to the **Honor Code**. The above statement will be appended to each exam and *you should add it to each assignment* (Word file on Moodle):

If you cannot, in good conscience, sign this pledge or if you have other concerns about academic integrity in this course, please come visit with me (in confidence of course) or send me an e-mail note. At a minimum, students caught violating this code will receive a zero (0) on the assignment or exam and the incident will be reported to the Academic Dean in accordance with the **Honor Code** procedures.

Commitment to Diversity

Augustana University is committed to creating and fostering a learning and working environment based on open communication and mutual respect. This is an integral part of the academic mission to enrich our students' educational experiences and prepare them to live in and contribute to a global society. If you encounter sexual harassment, sexual misconduct, sexual assault, or discrimination please contact the Title IX Coordinator at 605-274-4044 or belam@augie.edu. If you make a report of this nature to a faculty member, they must notify the Title IX Coordinator about the basic facts of the incident (you may choose whether you or anyone involved is identified by name). For more information about options at Augustana, please visit www.augie.edu/titleix.

COURSE ACTIVITIES DETAILS

Bibliography of Resources for this Class

Several texts, lab manuals, and other resources will be available in the Chemistry Computer Lab (FSC 312). DO NOT REMOVE THESE REFERENCES FROM THE CHEMISTRY COMPUTER LAB. Other resources available in the department are summarized in a file on Moodle entitled Class Resources. These should be useful as supplements to your text, as resources for preparing reports, and as sources of experimental procedures.

Lecture & Exams

Lecture will rely primarily on the text book with some supplemental material supplied by the instructor. The lecture/exam schedule and outline of the text material to be covered are given at the end of this syllabus and in the Study Guide. **Exams** (3 at 100 points each) will cover the topics discussed in class up to that point. These exams will be open notes, open book exams with time limited to one class period. Exams typically include a "group question" where groups of 3-4 discuss the question for 10-15 minutes and then each person writes an answer. Since exams are part of the "W" component, students will have the opportunity to submit revisions on exams. Exam corrections are due one week after exams are returned to the class. The **final exam**, the ACS standardize Instrumental Methods exam, will be given at the scheduled time. The final is a "one-shot," multiple choice exam - there is no opportunity for revisions.

Candidacy

There are **TWO** criteria for attaining a grade in the A range or the B range in this course:

1. Attain the designated level of performance on the candidacy exam.
   AND
2. Achieve the corresponding cumulative percentage on exams and other assignments.

In other words, attaining candidacy (see criteria below) gives you a hunting license for (candidacy for) a grade in the A range or the B range, but does not guarantee that grade. **However, failure to attain candidacy at a particular level means that you cannot receive that grade no matter how well you do on exams and other assignments.**

The first opportunity for Candidacy is an ACS standardized exam in Quantitative Analysis (final for Chem 242) during the first month of the course (specific dates in the schedule on last page):

- This provides a review of concepts covered in Analysis, which will not be covered in class.
- The exam has 50 questions with a 110 min time limit.
- It may be taken at any time outside of lecture and lab.
- You may take this exam as many times as you want, but no more than once per day.
- The instructor is willing to help in your preparation for this exam by answering your questions about the concepts, but he will not discuss specific questions from the exam.
- To encourage you to take it early, the score required for candidacy at a particular level increases weekly (Table 1).

Table 1. Designated Proficiency Levels for Candidacy*

Target Grade	1st Week	2nd Week	3rd Week	4th Week
	Pctile	Pctile	Pctile	Pctile
For B Candidacy	63	67	72	75
For A Candidacy	81	85	88	90

Percentile indicates the percentage of the pool that scored **lower**
*Adjusted to fit the norms for the exam used

- As soon as you establish candidacy for the grade of your choice, you may stop taking the exam.
- Once you establish candidacy for an A, you must stop.
- Points for the Candidacy Exam are based on the highest percentile achieved and are determined by the following formulas where % = highest percentile scored and %min = minimum percentile for that attempt at the specified grade level:
  - If A candidate, Points = [90 + (% - %min)/2] * 20
  - If B candidate, Points = [80 + (% - %min)/2] * 20
- Points for scores less than B candidacy are set by the final exam scale used in Analysis (Final Exam Score (100) = 0.573 * percentile + 38.2).

The final exam may also be used to establish candidacy, but candidacy exam points are determined by your best performance on the Quantitative Analysis exam. Candidacy targets for the final exam are shown in the table below.

	Pctile
For B Candidacy	60
For A Candidacy	80

General Guidelines for Written Assignments

Good writing takes time and several revision drafts so these assignments should not be left to the last minute for preparation. Part of the revision process is built into the various reports as described in the *General Assignment Guide* and several Guides specific to the assignment.

INSTRUMENT PROPOSAL (100 pts for report and 30 pts for the Review)

In a career most chemists will face two major types of "writing assignments," the technical report and the proposal. All of you have had some experience writing technical reports in the form of progress reports for research or formal reports for other chemistry courses. In addition the reports you write for labs in this course will give you more practice in some of the aspects of writing a technical report (more on this later). This assignment will give you experience in the other major type - writing a proposal. The process for generating this Instrument Proposal is designed to simulate the way proposals are usually generated, i.e. a mixture of individual and group effort that involves several rounds of revisions and at least one round of Peer Review. See the *Proposal Guide* for specific details.

LAB

This course has a heavier emphasis on lab and a correspondingly lighter emphasis on lecture than most chemistry courses. The 400 points for lab are prorated to the lab projects according to the hours spent on each.

General lab guidelines
Chemistry is a lab science, but it involves more than following a procedure and getting good results. So, the lab will focus on two major goals

- Provide experience in the scientific method of inquiry through problem-based lab exercises (research-like projects) and in written and oral reporting of results.
- Provide experience on instruments, with an emphasis on quantitative techniques.

You will work in groups of two. You are allowed to select projects of personal interest within the following guidelines:

- All groups will do the electronics lab provided.
- Each group will do at least two other projects.
- The other projects require a mini-proposal and written report, and two of them will require a presentation. More details on each of these aspects are presented in the *Notebook Guide*, *Mini-Proposal Guide*, *Final Report Guide*, and *Oral Presentation Guide*). A list of projects that are of interest is also provided.

Scheduled lab time expectations
All experimental activity must be carried out during the scheduled lab time. You are expected to log a minimum of 72 hours in the lab. This semester there are 78 hours of scheduled lab time, so you have some flexibility in meeting the time requirement. In your lab notebook, keep a table of the total hours logged for each experiment and a running total of hours logged on all labs.

- *Logable activities (carried out during scheduled lab time):*
  - up to 6 hours of planning time per experiment (except electronics experiment). Logged planning time must be **time spent during the scheduled lab time**, planning time spent outside of scheduled lab time is **not** logable.
  - solution prep • instrument setup • instrument training with instructor
  - data collection • troubleshooting • cleanup • attending lab presentations
  - up to 3 hours of data analysis time per experiment (except electronics experiment). Logged data analysis time must be **time spent during the scheduled lab time**, data analysis time spent outside of scheduled lab time is **not** logable.

Mini-proposals for projects (planning the experiment)
The mini-proposal is not required for the electronics experiment. For the other projects choose a problem and a method for solving it and then write a proposal describing your plan. Include a safety report formatted like the Safety Reports for Analysis: risk assessment, hazards, handling, disposal, reference, organized by reagent. Consult with the instructor as you build your proposal. The instructor should be a partner in the process, not just the judge at the end. The instructor must approve your project proposal **before** you begin lab work. There is no specific grade for the mini-proposal, but you will update the intro and experimental sections for your Final Report. See the *Mini-Proposal Guide* for details. Suggestion: During the first week select all the projects you plan to do and begin working on the mini-proposals early. Writing assignment deadlines pile up during the second half of the semester.

Lab notebook
The laboratory notebook serves as **permanent**, **chronological** record of what has been done in lab. In legal matters, such as the dispute of results reported in papers, patent applications or court cases, the lab notebook is considered the authority on the matter. It is imperative that a chemist maintains a detailed written account of lab work. **Anyone in the field** should be able to pick up the notebook and understand what is written there well enough to repeat the experiment or calculate the results. See the *Notebook Guide* for further details.

Final Report
These reports are written in the style for a manuscript submission to *Analytical Chemistry*. Begin writing your reports as you work, don't leave all the writing until the end. See further details in the *Final Report Guide* and the *Author Guide for Analytical Chemistry*.

PRESENTATIONS (2 @ 25 pts each)
Chemists depend on oral presentation skills as much as they do on writing skills. To give you an opportunity to develop those skills, groups will give two presentations this semester (built into the lab schedule) over lab projects. Preparation of presentations, like writing, requires several revisions and fine tuning, and benefits from others' input. See *Oral Presentation Guide* for details.

List of Handouts on Moodle and/or the Class Website

Course
Syllabus
Study Guide for Skoog, Holler, Crouch 6th
Ethical Considerations for Scientific Endeavors
Class Resources (Moodle only)
General Assignment Guide
Writing Process
Word Usage Guide (Moodle only)
Op Amps
Detection Limits from Rubinson & Rubinson (Moodle only)
311 Guide to Interpreting Grades Spreadsheet (Moodle only)
Using Chemistry's Virtual Machines (Moodle only)

Lab
Chemistry Instrumentation List (Moodle only)
Labs of Interest to the Dept (Moodle only)
Electronics Lab
Mini-Proposal Guide
Notebook Guide
Data Analysis Guide
Data Analysis Table Template.doc (template)
Final Report Guide
Oral Report Guide
Obtaining Graphics from Instruments Guide
Presentation Guide
Work in Progress Form - by the work (Moodle only)
Work in Progress Form - hall door (Moodle only)

Proposal
Proposal Scenario
Proposal Guide
NSF ILI Guide
Proposal Reviewers Guide
Proposal Example (funded) GCMS (Moodle only)
Proposal Discussion Powerpoint (Moodle only, when available))

Grading Criteria
Writing Rubric Gen Ed (Moodle only)
Chem Dept Assessment Rubrics - Critical Thinking, Written & Oral Reports (Moodle only)
Mini-Proposal Criteria (Moodle only)
Oral Report Grading Criteria (Moodle only)
Written Report Grading Criteria (Moodle only)
Proposal Grading Criteria (Moodle only)
Proposal Review Grading Criteria (Moodle only)

Variety of References Discussed in Lecture (Moodle Only)

Powerpoints Used in Class

CHEM 311 TENTATIVE LECTURE SCHEDULE			
Mo	Days	Topic	Chapters
Aug	30	Introduction	1
Sept	**4**	**no class - Labor Day**	
	6	Operational Amplifiers	2, 3
	11	Digital Electronics	4
	13, 18	Signals and Noise	5
	20	Intro to Electroanalytical Chemistry	22
	25	Voltammetry	25
Sept 27 (W)		**EXAM 1**	
Oct	2	Proposal Discussion	
Oct	4, 9	Introduction to Chromatography	26
	11	Gas Chromatography	27
	16	High Performance Liquid Chromatography	28
	18	**no class - MWRM**	
	23-24	**Fall Break**	
	25	Capillary Electrophoresis	29, 30
	30	Components of Optical Instruments	7
Nov 1 (W)		**EXAM 2**	
Nov	6	NMR Spectrometry	19
	8	IR Absorption and Raman Spectrometry	16, 17, 18
	13	Mass Spectrometry	11, 20
	15	Atomic Absorbance and Emission Spectrometry	8, 9, 10, 15
	20	Introduction to Molecular Absorption Spectrometry	13, 14
	22-24	**Thanksgiving Break**	
	27	X-Ray Spectrometry	12
Nov 29 (W)		**EXAM 3**	
Dec	4	Surface Characterization	21
	6	Thermal Methods	31
Final Exam Dec 12 (T) 1 pm			

GENERAL ASSIGNMENT DUE DATES	
DUE	ASSIGNMENT
Before Starting Each Project	Mini-Proposal
After Each Lab Period	Notebook Carbons
1 Week after Lab Completed	Revised Final Report and Notebook & Results
1 Week after Returned	Revisions
NO ASSIGNMENTS OR REVISIONS ACCEPTED AFTER 5 PM ON THE LAST DAY OF CLASSES	
THE PREVIOUS DRAFT WITH INSTRUCTOR COMMENTS MUST ACCOMPANY REVISIONS	

Calendar of Deadlines

September

Sun	Mon	Tues	Wed	Thurs	Fri	Sat
			Aug 30 Cand Open	Aug 31	1	2
3	4 Labor Day	5	6	7	8 Pre-Proposal	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27 Exam 1	28	29 Cand Close	30

October

1	2 1st Draft Proposal	3	4	5 1st Prelim Slides	6	7
8	9	10	11	12 1st Present	13 1st Final Slides	14
15	16	17	18 MWRM	19 MWRM	20 MWRM	21
22	23 Fall Break	24 Fall Break	25	26	27 2nd Draft Proposal	28
29	30	31				

November

			1 Exam 2	2	3	4
5	6 Prop Review	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22 Thanksgiving	23 Thanksgiving	24 Thanksgiving	25
26	27 Exam 3	28	29	30 Final Draft Proposal 2nd Prelim Slides		

December

					1	2
3	4	5	6	7 2nd Present 2nd Final Slides All Revisions Lab Cleanup	8	9
10	11	12 1 pm Final	13	14	15	16