CHEMISTRY 361
Analytical Instrumentation
Syllabus Spring 2012

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Office hours: TH 8:30-10 or by appointment
Office: Science 1-084
Lecture/Lab: M 11:00-11:50 and F 12:00-5:00 in S-2-41

Objective: This course provides a survey of the different types of instrumentation that is in the chemist's tool box. We will stress advantages and disadvantages and develop the insight that is necessary to choose the right tool for the right problem. We will use several of these tools in the laboratory portion of the course. The course can be broken down into several components.

1. brief lectures on a given instrument
2. current literature
3. lab demonstrations/hands-on in small groups
4. lab projects

Course Structure:

The lectures are going to cover the basics of the instrumental method that is the focus of that week's lab experience. Homework will be based on assignments from an instrumental technique discussed in a recent issue of Analytical Chemistry. Each week you will be required to find a paper from the literature that discusses an application using the instrumentation we will be using in lab. You will turn in a copy of this paper as evidence of doing your homework. On any given week three or four of you will asked to briefly share the details of the paper you have found with the class. Your grade will consist of a midterm and a final, literature assignments, homework, class participation and lab reports.

Text: Principles of Instrumental Analysis, 6th Edition by Skoog, Holler, and Nieman

Grading:

4 lab reports and one revision, 100 pts each, 36 %
5 literature assignments, 50 pts each, 19 %
5 HW assignments, 100 pts, 15 %
Participation (attendance/group and class discussions), 150 pts, 11 %
Mid term Exam, 100 pts, 8 %
Final Exam, 100 pts, 8 %

Grading Scale:

Total points	Grade	Total points	Grade
1110-1200	A (92.5)	850-914	C (70.8)
1050-1109	A- (87.5)	810-849	C- (67.5)
1020-1049	B+ (85.0)	770-809	D+ (64.2)
980-1019	B (81.7)	720-769	D (60.0)
940-979	B- (78.3)	660-719	D- (55.0)
915-939	C+ (76.3)	< 659	F

No late assignments will be accepted!!!!!

Attendance: You are expected to attend all lectures and lab periods. Chronic class skipping and tartiness will be reflected in your class participation grade.
Academic dishonesty: For much of the semester you will be working in teams, and team work is encouraged and expected. However, all written lab reports are to be the work of the individual. If I receive lab reports from team members that look identical, both individuals will receive a zero.

Lecture Schedule:

Date	**Chapter**	**Topic**
Jan 27	Ch 20	Mass Spec (EI, CI)
Jan 27	Ch 20	Mass (ESI, MALDI)
Jan 30- Feb 3	Ch 26,27	Separations, GC
Feb 6/10	Ch 28	HPLC
Feb 13/17	Ch 30	CE
Feb 24	Ch 6-8,13-14	Spectroscopy overview, UV-vis
Feb 27/Mar 2	Ch 9,10	AA, atomic emission
Mar 5/9	Ch 15	Molecular fluorescence
Mar 12/16	SPRING	BREAK
Mar 19/23	Ch 18	FT, FT-IR
Apr 26/30	Ch 19	Raman Spectroscopy /NMR
Apr 2/6	Ch 19, handouts	NMR
Apr 9/13	Ch 21	X-ray spectroscopy/ X-ray crystallography
Apr 20	Ch 21	Surface techniques: AFM, SEM, aujer, SIMS
Apr 23/27		Wrap up
Apr 30/May 4	Final Exam Period	Final Exam
May 9		
May 14-18		

Lab Schedule:

Date	Topic
Jan 27	
Jan 30- Feb 3	LC-MS
Feb 6/10	GC-MS
Feb 13/17	HPLC
Feb 24	UV-vis, AA
Feb 27/Mar 2	Fluorimeter
Mar 5/9	FT-IR
Mar 12/16	SPRING BREAK
Mar 19/23	ICP-AES
Apr 26/30	Lab 1
Apr 2/6	Lab 2
Apr 9/13	Discuss, Share and Refine, Report 1 due
Apr 20	Lab 3, Report 2 Due
Apr 23/27	Lab 4
Apr 30/May 4	Discuss, Share and Refine, Report 3 due
May 9	Report 4 due, NMR
May 14-18	Final exam period

Guide to Writing Lab Reports

You lab reports should be written in the style and format of the Analytical Chemistry journal articles. Here is a brief description of expectations.

Scientific communications, including lab reports generally contain the following sections that appear in order; Abstract, Introduction, Methods, Data and Analysis, Discussion and Conclusion. The Introduction, Methods, Data and Analysis, Discussion, Conclusion and References sections make up the body of the document. The abstract stands alone because it simply summarizes the other sections. Below is a detailed description of what should be written in each of the sections.

Abstract:
The abstract is a bit like a movie preview or the back cover of a book in that it is designed to help the reader to make a judgment about whether the rest of the paper is worth reading. It summarizes each of the sections. Therefore, it should always be the last section that is written, even though it appears in the document first. A simple recipe for writing an effective abstract is to start with a sentence that summarizes the experiment that was performed and then form a paragraph by adding summary sentences of each of the other sections of the lab report.

Introduction:
In a scientific research article this section of the paper is devoted to making the case for why the work is important and significant and for discussing the previous work reported in the literature that has led up to the work being reported in this paper. In a lab report the nature of the introduction section is a little bit different than in a research article. In a lab report you should focus the introduction on the learning goals of the experiment. Discuss how the experiment is designed to achieve these learning goals and how the experiment fits in with the broader curriculum of the corresponding lecture course.

Methods:
This section should provide the details of how the experiment was carried out. It should not be written as a recipe but more as a journal entry; a fairly detailed account of what was done in lab. A description of how the data was processed should also be part of the Methods section.

Data and Analysis
When appropriate you data should be displayed in Tables and Figures. The figures and tables should have captions that describe what they are illustrating. You should also prepare sentences that introduce the tables and figures and describe what they show. To an extent these sentences and the captions will be and should be somewhat redundant.

Discussion
In some papers these are combined and in other they form two different sections. We will combine them in this course. The discussion section will discuss the significance of the findings from the data analysis section. It is also in this section the questions that are being asked are addressed in the context of a well-written paragraph.

Conclusion
Finally, a sentence or two is needed that summarizes what was accomplished in this experiment in a broad sense. What did you find? And were the learning goals met?

References
Number your references, put them in the AChem format. Use a subscript to indicate the text of the document where the reference is applicable.

Writing style: One of the most challenging things for most students when they get to college is learning the art of writing in the passive voice. Lab report writing is a form of technical writing. It is not like other works you are used to producing, such as email messaging, letter writing or even English composition papers. In science, the experimenter is immaterial. The experimental details and results are what is important. So, never use any pronouns. Also, do not waste words. For instance, "~~In this lab we~~……~~or the goal of this experiment was~~…..~~or we determined the~~…. Good science writing is written in relative short, clear and concise sentences. It should read a lot more like a newspaper article than a novel.

Here are examples of a poorly-written and a well-written abstract for the first lab in General Chemistry Lab.

Poorly written abstract: In this lab we determined the density of a polystyrene ball. We measure the volume using three different methods and we measured its mass using two different balances. We used the measured volume and mass to calculate the density. We also combined the uncertainties in these measurements to get the error in the density. We compared the data obtained from the different methods.

What is wrong with the above abstract?

Well-written abstract: The density of a small polystyrene ball was determined using its measured volume and its measured mass. The precisions of three different strategies for measuring the volume of the sphere and four different strategies for obtaining the average mass of a polystyrene ball were measured and compared. It was found that measuring the volume of ten balls by the water displacement method provided the best precision in measuring the average volume of the polystyrene balls. It was also found that measuring the mass of ten balls using an analytical balance provided the best precision in measuring the average mass of the polystyrene balls. The density was calculated to be 1.129 ± 0.006 g/mL by propagating the uncertainties in the average volume and mass of the polystyrene balls. The precision in the density of the polystyrene ball was limited by the precision in the measurement of its volume. This experiment provided a good framework for gaining a deeper understanding of the concepts of mass, volume, density, precision and error propagation.