

INSTRUMENTAL METHODS OF ANALYSIS – CHEM 323

Spring 2011 **Philadelphia University**

Instructor: Dr. Jeff Ashley **Office:** Room 304 Search Hall
Phone: 215-951-2779 **Dept. Secretary:** 215-951-2870
E-mail: ashleyj@philau.edu
Office Hours: Email me for an appointment.
Course WEB-SITE: <http://faculty.philau.edu/ashleyj/C193homepage.htm>
(there is no Blackboard site for this course)

INTRODUCTORY REMARKS

Overall, this course has two major goals: to provide you with **a comprehensive introduction to the use of instrumentation in the analysis of chemicals (both elements and compounds) and to further develop your analytical and research skills as they relate to chemical analyses.** My intention is to not only convey the fundamental concepts regarding the theory and operation of analytical instrumentation but to also supplement lectures with discussions about the application of these instrumental techniques in ‘the real world’. It is my intention to leave you with an enhanced appreciation of analytical techniques and the problem solving skills needed in any analytical application.

LECTURE OBJECTIVES

- 1) To become acquainted with numerous fundamental concepts behind many analytical instruments used today. This background will be helpful when combined with the hands-on experience you will gain during the lab portion of this course or in the future when you may face these instruments again.
- 2) To provide you with some insight into the applications of these instruments (*e.g.*, when do you use them and why).
- 3) To leave you with the language, terms and critical thinking/problem solving skills to use, understand, and perhaps trouble-shoot many of today’s analytical instruments (*e.g.*, UV-Visible spectrophotometer, infrared spectrometer, nuclear magnetic resonance spectrometer, flame atomic absorption spectrometer, gas chromatograph, high pressure liquid chromatograph, mass spectrometry, etc.).

TEXTS AND READING MATERIAL

There is no required text. Readings will be provided to you in class or distributed to you via your Philadelphia University email account.

STUDENT CODE OF CONDUCT

I assume that college students are mature, responsible individuals who agree to abide by the Student Code of Conduct. Any student violating the student code of conduct (*e.g.*, lying, cheating, plagiarism, disruption of instruction, *etc.*) will be referred to the appropriate disciplinary committee.

GRADING

Your grade for the lecture section will contribute **30%** to your final grade and be determined from the following:

Three Non-cumulative Tests (15 points total)
Assignments (5 points)
“Application Fridays” presentation (10 points)

The laboratory grade will contribute **70%** to your final grade for this course and will be determined from the following:

Periodic Short Lab Reports (10 points)
Manuscript for J. Young Investigators (5 points for each draft; 10 points for final; total 20 points)
Forensic Analysis Afternoon with High School Students + Murder Mystery Evening at Mutter Museum (20 points)
Poster and Presentation at a Local Scientific Conference (20 points)

Your final letter grade will be based on the following percent distributions:

<i>Letter Grade</i>	<i>Corresponding % Range</i>	<i>Letter Grade</i>	<i>Corresponding % Range</i>
A	94-100%	C+	77-79%
A-	90-93%	C	74-76%
B+	87-89%	C-	70-73%
B	84-86%	D+	60-69%
B-	80-83%	D	50-59%
		F	<50%

TENTATIVE LECTURE AND LAB SCHEDULE

Week Number	Lecture Topic(s)	Laboratory Experience
Week 1 Jan 12 & 14	Introduction to the Course and Laboratory What are “Analytical Chemistry” and “Instrumental Analysis”?	What is the “MINI RESEARCH PROJECT?” Outreach Project: Forensic Analysis Workshop for HS students + Murder Mystery Evening at Mutter Museum
Week 2 Jan 19 & 21	Evaluating Analytical Data Introduction to Statistics in Analytical Chemistry	Sample Extractions (soxhlet extraction, accelerated solvent extraction, microwave digestion)
Week 3 Jan 24, 26 & 28	Calibrations, Standardizations, and Blank Corrections Obtaining and Preparing Samples APPLICATION FRIDAY	Calibration Methods Analysis of SRM to evaluate Accuracy
Week 4 Mar 31, Feb 2 & 4	Introduction to Spectrometry APPLICATION FRIDAY	Analysis of Two Drugs in Dristan® Nasal Spray using UV-Visible Spectroscopy
Week 5 Feb 7, 9 & 10	UV/Visible Molecular Absorption Spectrometry APPLICATION FRIDAY	MINI RESEARCH PROJECT
Week 6 Feb 14, 16 & 18	Infrared Spectrometry TEST 1 – February 18	MINI RESEARCH PROJECT
Week 7 Feb 21, 23 & 25	Atomic Absorption Spectrometry & Atomic Emission Spectrometry Matrix Matching versus the “Standard Additions Method” APPLICATION FRIDAY	Determination of an Inorganic Fungicide in Tea Leaves using Flame Atomic Absorption Spectrometry.
Week 8 Feb 28, Mar 2 & 4	Theory of Chromatographic Separations APPLICATION FRIDAY	MINI RESEARCH PROJECT
Week 9 Mar 7, 9 & 11	Gas Chromatography Theory Applications using Gas Chromatography APPLICATION FRIDAY	MINI RESEARCH PROJECT
Week 10 Mar 14 -18	SPRING BREAK	SPRING BREAK
Week 11 Mar 21, 23 & 25	Liquid Chromatography Applications using Liquid Chromatography TEST 2 – March 25	MINI RESEARCH PROJECT
Week 12 Mar 28, 30 & Apr 1	MINI RESEARCH PROJECT APPLICATION FRIDAY	Analysis of drugs by HPLC – A forensic analysis. Cocaine Residue on Currency- Analysis by GC-MS

Week 13 Apr 4, 6 & 8	Introduction to Mass Spectrometry	PRACTICE PRESENTATIONS OF POSTERS April 8 (evening) - Presentation of Poster at Sigma Xi Scientific Research Symposium, St. Joseph's University
Week 14 Apr 11, 13 & 15	Preparation for Forensic Stations with High School Students and Murder Mystery Evening APPLICATION FRIDAY	Dry Run of Forensic Stations + Murder Mystery Evening
Week 15 Apr 18, 20 & 22	Practical Mass Spectrometry - Analysis of Simple Spectra APPLICATION FRIDAY	Forensic Analysis Afternoon with High School Students
Week 16 Apr 25, 27 & 29	The Future of Analytical Instrumentation TEST 3 - April 27	<u>None this week</u> Murder Mystery at Mutter Museum (April 28 th)

INSTRUMENTAL METHODS OF ANALYSIS, LABORATORY SECTION

It is my hope that you will not see this course as 'just fiddling with some knobs on an instrument'. Rather, I hope you will begin to recognize how instruments are vital in probing many issues in medicine, research, industry, forensics, etc.

LABORATORY OBJECTIVES

- 1) To become acquainted with numerous preparatory and analytical instruments used by chemists today.
- 2) To understand the essential role of analytical instrumentation in many occupational situations.
- 3) Through a mini-research project, present a poster at a scientific meeting. By the way, this is a great resume builder and something that future employers will likely ask you about during an interview! As well, you will prepare a manuscript of your research for potential publication the peer reviewed *Journal of Young Investigators*.

LAB NOTEBOOKS

Lab notebooks will be graded at the end of the semester. I do not expect you to keep detailed notes on every aspect of the lab. Prior to each lab, briefly summarize the objectives of the laboratory. While in the laboratory, record each step that you do...do not simply regurgitate what is given to you from the lab instructions. Take notes regarding the operation of the instrument. Who knows, one day these notes may come in handy when you are confronted with a similar instrument and asked to analyze a sample! The lab notebook should act as a cursory tool from which you will use to prepare formal or 'full' lab reports.

Lab notebooks will be inspected periodically, and at the end of the term, for such items as:

- written in ink
- errors crossed out, not blacked/scratched out
- table of contents
- numbered pages
- loose papers such as copies of data sheets or spectra should be neatly stapled or glued into book; originals will become part of the formal lab report
- overall organization, neatness, and legibility
- correct usage of significant figures
- all calculations shown
- notes on the general operation of an instrument

LAB REPORTS

You will be required to formally write-up many lab experiments (some 'partial', some 'full') and submit them **two weeks** after that lab experiment was conducted. Reports must be typed but calculations may be hand-written. Likewise, graphs and tables should be computer generated, never hand drawn. I will go over lab report expectations in class and provide you with an example of a complete report. Full lab reports should include:

I. Abstract

II. Introduction

- state the purpose of the experiment
- give a brief description of the instrument(s) used
- give a brief explanation of any theory, equations used, etc.
- provide a general schematic of the instrument and briefly state how it works

III. Experimental

- give the manufacturer and model of the instrument
- briefly outline the experimental procedure followed, solutions and concentrations, sources and purity of chemicals (if known)...All in the third person past tense (in paragraphs)

IV. Results and Discussion

- tabulate data (and label each table)...be sure to refer to these tables in the discussion
- include figures (labeled)
- explain the results and draw inferences and conclusions from the data set
- briefly comment on improvements to the experiment or further work

V. References

Course Policies:

If you miss a test or quiz due to an excused absence, your remaining grades will be averaged for your final grade (**NO MAKE-UP TESTS ARE GIVEN**). If your absence is not excused, you will receive a grade of zero for that test or quiz.

Student Code of Conduct:

Please familiarize yourself with the **Student Code of Conduct** as it appears in the **Student Handbook for Philadelphia University**.

Gutman Library (www.philau.edu/library)

The home page of the Gutman Library provides students with a variety of information resources, including databases and research guides. Librarians are available online and in person at the information desk to help students with research.

The Learning and Advising Center (www.philau.edu/learning)

The Learning and Advising Center provides one-on-one tutoring assistance for writing, study strategies, and test taking. To make a tutoring appointment, students should stop by the Learning and Advising Center in Haggar Hall or call (215) 951-2799. Academic resources, including information on citation and documentation, note taking, and study strategies are available on the Center's website.

Technology assistance (<http://www.philau.edu/OIT/>)

For assistance with technology issues, students should contact the Technology Help Desk at (215) 951-4648 or send an email to helpdesk@philau.edu. General purpose computing facilities are available in Search Hall and Gutman Library.

“APPLICATION” FRIDAY PRESENTATIONS

As a future scientist, one of your biggest challenges may well be presenting scientific content in an articulate and interesting manner. Developing these skills early in your career is highly desirable. To give you the opportunity to hone these oral and visual skills, and to enlighten your classmates to an ‘application’ of instrumentation, a 20-30 minute PowerPoint presentation will be required. There will be 15 minutes after each presentation for questions and discussion.

There are numerous topics to choose from (below) but students are encouraged to be creative and may choose a different topic. Each student will sign up for a particular topic. The instructor will go over what is required, including a hand-out of what to include, what not to include, and a grading rubric.

In your presentation, you will highlight the instruments/analytical techniques used in any of the following realms:

art authentication/forgery/restoration/conservation (e.g., provide some examples of how instruments help authenticate art objects)

airport security (e.g., swipe tests for bomb residues, full body scanners, etc)

dating archaeological artifacts (e.g., how can scientists ‘date’ samples)

DNA analysis (e.g., how do companies who market ‘DNA testing’ analyzing their samples)

monitoring air pollution (how are potentially toxic compounds detected in the air and how are they monitored)

aspects of forensic chemistry

medical instrumentation (e.g., after you get your blood drawn for diagnostic testing, what instruments are used?)

organic chemistry (e.g., the use of NMR to determine structure of organic compounds after synthesis)

fragrance/personal care products

food science and safety (e.g., analysis of toxins in shellfish)

planetary science (e.g., instruments used for detection of elements and compounds on other planets or atmospheres)

IMPORTANT DATES

EVENT	DATE
Test 1	Friday, Feb 18
Test 2	Friday, March 25
Test 3	Wednesday, April 27
Abstract for Conference Due	Friday, March 18
Poster Presentation at St. Joe's University	Friday, April 8 Approximately 5:30 to 9:00 pm
Forensic Afternoon with High School Students	Wednesday, April 20 Afternoon or During Lab Period
Murder Mystery Night at Mutter	Thursday, April 28 Approximately 5:00 pm to 9:00 pm
1 st Draft Version of Manuscript Due	Sunday, April 17 by 5 pm
2 nd Draft Version of Manuscript Due	Sunday, April 24 by 5 pm
Final Version of Manuscript Due	Friday, May 6 by 5 pm

