

Syllabus
Chemistry 315
Instrumental Analysis
Fall 2007

Instructor:

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Office Hours:

M 2–3 PM
Th 3–4 PM

You are invited to set up an appointment at other times (preferred) or just to stop by my office.

Course Webpage:

Course page is on the Ursinus College Blackboard site (uonline.ursinus.edu).

- Input your username and password.
- Under course catalog go to CHEM315. FA2007

Class Meetings:

Pfahler 210
MWF 10-10:50

Catalog Description:

A study of instrument-based spectroscopic, separation, and electrochemical analyses. A framework that can be used to understand new and old techniques, the theory behind a variety of specific techniques, and the current practices used in chemical analysis will be discussed. In addition to the discussion of specific techniques, basic concepts in electronics and statistics will be presented. Prerequisite: either CHEM-151 or 206. Three hours per week. *Three semester hours.*

Primary Sources:

Required:

Skoog, Douglas A.; Holler, F. James; Nieman, Timothy A. *Principles of Instrumental Analysis*, 6th ed.; Thompson: Belmont, CA, 2007. <ISBN 978-0-495-01201-6>

Class Notes

Course Goals:

1. Develop a framework and the ability to quickly understand a new, chemical analysis technique (instrumental or traditional).
2. Understand the basics of chemical analysis, instrumental analysis, and statistics.

3. Understand when to use and the basic operation of common instrumental spectroscopic, separation, and electrochemical techniques.
4. Use the study of analytical chemistry and instrumental analysis to better understand basic concepts in chemistry and physics.
5. Develop your ability to critically read the primary, scientific literature.

A survey of practices and techniques in chemical analysis and of common spectroscopic, separation, electrochemical, and (tandem) instrumental methods will be provided. Although the course will primarily concentrate on how these techniques are used in analytical chemistry, examples from other sciences or subdisciplines of chemistry also will be provided. Interpretation of the output of these techniques will be briefly discussed, but the emphasis will be on the components within the instrumentation (inside the box), on the techniques used to obtain better output and better chemical knowledge from the output, and on the similarities between the different techniques. Besides covering a number of different instrumental techniques, selected fundamentals and applications of electronics, statistics, and sampling will also be introduced.

The goal is not to make you an expert in one or more of the covered techniques. Although many of you will later use these techniques or their output, just as many of you will use other techniques that are not covered in this course or are not yet commercially available. Hopefully by the end of this course (and CHEM315L), you will have a good understanding of the fundamentals that apply to all or a large number of instrumental techniques and of the approaches used to quickly understand and use new techniques. These tools and approaches will help you to understand more deeply what is occurring within the instrument, an understanding that can allow you to perform better analyses and to learn more quickly and easily new instrumental techniques.

Course Style:

Classes will primarily consist of lecture with some in-class discussion, some small-group work, and some demonstrations. Questions at any time during class are highly encouraged. Lectures will be accompanied with visual copies of the notes; I highly encourage you to buy the complete set of paper copies of these overheads and to make notes on them instead of trying to write separate, complete notes. Using this method will allow you to listen more carefully and the class to progress at a quicker pace. In addition to lectures, we will occasionally discuss papers from the primary, scientific literature. The intention of these sessions is to develop your ability to critically read the primary, scientific literature and to either deepen your knowledge of some of the techniques that we will discuss in more general terms during the semester or introduce related techniques. In addition to these sessions, each student will read a paper from a selected list of papers from the primary literature and answer questions about the paper in an individual, face-to-face meeting with me.

Much of the material will come from sources other than the textbook. The textbook is a good, general place to start your study of most of the topics that we will cover (and a good book to keep on your bookshelf for future reference), although we will often cover topics differently or at greater depth than is found within this book. Many additional, useful sources are on reserve. You are encouraged to read as many sources as possible because learning from several different viewpoints will deepen your knowledge and more closely simulate how you will learn new material in the future.

Problem sets will be given. Complete answers will be provided, but the answers will only be spot-checked.

Students in the past have commented on the fast pace. Unfortunately because of the limited time and the richness of instrumental techniques, we will only hit the high points of many techniques and quickly will move from one technique to another. Many of these "points" have proven useful to previous students in this course when they have gone onto further education or work. Many of the topics will be discussed more than once in slightly different forms, as there are many similarities between even seemingly dissimilar techniques.

Experience has shown that the students who attend class, read more references, and complete more problems do much better! To be successful you will have to spend a significant amount of time on this course outside of the class time.

Lecture Outline

Readings in textbook and other sources will be given in the Assignment and External Links sections of the Chem 315 Web page.

Topics (*)
Introduction <ul style="list-style-type: none">• What is Analytical Chemistry?• The Black Box Problem• The Basic Approach to Learning A New Instrumental Technique• A Quick Introduction to Spectroscopy, Separations, and Electrochemistry
Spectroscopy <ul style="list-style-type: none">• Basic Spectroscopic Theory• Bulk Optical Atomic Spectroscopic Techniques• Bulk Optical Molecular Spectroscopic Techniques• Bulk Non-optical Spectroscopic Techniques• Surface Spectroscopic Techniques
Separations <ul style="list-style-type: none">• Basic Separation Theory• Gas Chromatography• High-Performance Liquid Chromatography
Electrochemistry <ul style="list-style-type: none">• Basic Electrochemical Theory• Voltammetry• Potentiometry
Tandem Techniques and Other Newer Techniques

* The order and the content may slightly vary from this list.

Grading:

Weight of Different Activities in Final Grade (1000 pts.)

First short midterm	50
Three full midterm exams	450
Paper Presentation	115
Problem sets	65
Final	300
Discretionary	20

Midterm Exams

The first exam will cover less material and will be taken over approximately half of a class period to allow you to adjust to my testing style. One midterm exam will be a take-home exam.

Paper Presentation

You will read a paper from the original literature and on an individual basis in my office answer questions about it. I may ask questions about background, vocabulary, interpreting figures within the paper, why activities were performed, and how results were interpreted. You can bring a marked-up copy of the paper in addition to any other materials that you find useful.

Problem Sets

Problem sets will be given at regular intervals. The answers will generally be collected but only spot-checked (one or two questions per problem set).

Final Exam

The final will consist of three parts. For the first section a paper from the literature will be given to you a week or two before the final. You can bring this paper and any notes that you have to help answer the questions in this part of the exam. The second section will consist of questions dealing with the material presented between the final and the material tested in the last midterm. The last section will be cumulative.

Discretionary

The discretionary points will be given for class participation. These points may be useful only in deciding between grades.

Guaranteed Grades

Letter grade	Percentage
Some sort of A	> 92 %
Some sort of B	82 - 92 %
Some sort of C	72 - 82 %
Some sort of D	62 - 72 %
F	52 - 62%

Exam and Other Important Dates

Date:	Topic:
W Sept. 12	First Midterm <Short>
M Oct. 1	Second Midterm
M Oct. 15	Mid-Term Break No Class
F Oct. 26	Take-Home Midterm Given
F Nov. 2	Take-Home Midterm Due
W Nov. 14	No Class: Classes to be rescheduled
W Nov. 21–F Nov. 23	Thanksgiving Break No Class
M Dec. 3	Fourth Midterm
M Dec. 10	Final 9–12

* – Note: One or more midterms will be given as a take-home. Exams may be scheduled in another room.

***LATE POLICY*:** All assignments are due by the beginning of the class period on the due date. Except under special circumstances and with prior agreement of the instructor, the following late policy will apply. Assignments delivered after the beginning of class but on the due date will have 5% of the total points deducted; assignments turned in the day after the due date will have 10% of the total points deducted; and assignments turned in two days after the due date will have 50% of the total points deducted. No assignments will be accepted more than two days late.

Course Policies

Attendance. You will be held to the attendance policy that is outlined in the *Ursinus College Student Handbook*.

Attendance at examinations is required. In general, make-up examinations will NOT be administered. Anyone who is absent from an examination will receive the grade "zero" for the exam, except in the case of an excused absence. A student who is legitimately ill must present a physician's excuse, stating not only that the physician saw the student but also that the student's illness made it impossible for her or him to sit for the examination. If a death in the immediate family occurs, documentation must be provided. Illness before an exam is generally not considered to be a legitimate excuse as you are expected to keep up-to-date with the material and not allow the bulk of your studying to be done immediately before the exam. Absences due to academic or Ursinus-sponsored events must be discussed with the instructor at least three days in advance of the exam date. A make-up exam may be given but will generally be given prior to the exam time. Only in extraordinary cases, at the discretion of the instructor, will a make-up exam be given. In cases of excused absence, those sections of the final examination that pertain to

material covered in the missed examination will be weighted more heavily. *This policy has been put in place to maximize the fairness to all students in the course.*

Regrades for all exams will be considered during the five days after the exam has been distributed to the class.

Individual exams will not be curved. Instead, you will be assigned an approximate grade based on your cumulative total during the semester, and I will provide you with approximate grades after each exam. Please feel free to discuss your grade with me at any time during the semester.

Academic Honesty. You are responsible to follow the academic honesty policy as outlined in the *Ursinus College Student Handbook*.

Other Policies. When appropriate, policies on other matters, such as grading will be posted on the class Blackboard site and announced in class.

Last Revision: 16 August 2007 EJW