CHEMISTRY 431 – INSTRUMENTAL METHODS OF ANALYSIS
COURSE SYLLABUS
FALL 2008

INSTRUCTOR: Dr. Mark Jensen
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OFFICE HOURS:
M 8:45-9:45 am
T 8:45-9:45 am
W 8:45-9:45 am

TIME: *Lecture:* M W F 11:50-1:20; *Lab:* H 1:20-5:20, Ivers 362. Lab time will be adjustable when needed.

THEME: Analytical chemistry is the branch of chemistry that typically focuses on two questions: "What?" and "How Much?". This course will deal specifically with how these questions are answered using modern chemical instrumentation. We will do this in three ways:

- *Classroom lectures and discussion* – This is where we will deal with the core content of the course: the design and application of chemical instruments.
- *Laboratory* – The focus of the lab will often be on "methods development". In your previous chemistry classes, you have usually been expected to simply follow a pre-defined laboratory procedure. In this class it will often be up to you to design a detailed procedure for a given analysis.
- *Programming and Interfacing* – Each of you will gain practical experience in interfacing instruments to computers, and writing programs to acquire and analyze data from these instruments. We will accomplish this through an introduction to the LabVIEW programming environment.

COURSE WEB PAGE: www4.cord.edu/chemistry/jensen/chem431/ This page is directly accessible from my homepage (listed above). It will contain links to the course syllabus, lab handouts, and assignments. Every attempt will be made to keep this site as up-to-date as possible.

TEXTS: Required:
1) *Principles of Instrumental Analysis (6th Ed.),* by Skoog, Holler, and Crouch; Thomson Brooks/Cole, 2006.
2) *LabVIEW for Everyone (3rd Ed.),* by Jeffrey Travis and Jim Kring, Prentice Hall, 2006.

Supplemental:
1) *Microcomputers and Electronic Instrumentation: Making the Right Connections,* by Malmstadt, Enke, and Crouch, American Chemical Society, 1994. (on reserve in library)
2) *Encyclopedia of Analytical Chemistry, Volumes 1-15,* Wiley, 2000. (available in the reference section of the library; see the contents at: www.wiley.co.uk/eac/Home.html)

OTHER REQUIREMENTS:

Lab: Goggles are required, along with a laboratory notebook with numbered pages. I recommend buying a notebook from the Chem Club ($5), although a notebook from a previous class with *a lot* of empty pages is adequate.

Calculator: A scientific calculator is a must.

GRADES: The course grade will be based on the total points accumulated from the three regular exams, the laboratory, homework and quizzes, LabVIEW assignments, a final project, and the final exam. Each of these is weighted as follows:

Exams 1-3	30 %	(10 % each)
Lab	20	
Homework and Quizzes	15	
LabVIEW Assignments	15	
Final LabVIEW Project	10	
Final Exam	10	
	100 %	

The "guaranteed" grading scale is as follows: A- : 91% B- : 81% C- : 71% D- : 61%
The guarantee is that while these cutoffs MAY go down, they WILL NOT go up.

EXAMINATIONS: There will be three regular examinations. These will be given on or close to the following dates: **September 22**, **October 13**, and **November 7**. Exams are "take-home," but unless otherwise indicated, will NOT be open book. Once an exam has been made available it will generally be due in no less than 48 hours, and we will not meet during the next class period.

The comprehensive final exam will take place during finals week. Approximately 50% of the exam will be taken from material covered since the last exam. The remaining questions will be taken from previous exams and assignments.

LABORATORY: Laboratory projects in this class will vary from being quite well defined and structured, to being somewhat "open ended". These projects will typically be completed within groups. At the completion of each laboratory project, each individual (or group) will be asked to submit a report summarizing the approach, data, and results. These reports will either be in the form of a Word document, or may simply be the contents of your laboratory notebook. Each lab report will be worth a total of 25 points. Where applicable, points will be awarded according to the following four questions:

1) Were the experiments designed to meet the requirements?
2) Were the requirements met?
3) How well does the report communicate the work?
4) Does *each student's* lab notebook properly document the work?

The format of the laboratory notebook should follow the format outlined in Chem 232. That is, the steps of each process must be documented, and all data must be included. The motto is: "*If it's not written down, it never happened.*"

HOMEWORK AND QUIZZES: A short 5-point quiz will be given at the start of each class period. Quiz questions will be taken from the material covered in the previous lecture. At the

end of the semester the five lowest quiz scores will be thrown out. Homework assignments will also be given periodically.

DEPARTMENT SEMINARS: The chemistry department has instituted a seminar attendance policy in each of its courses. Each student in a chemistry course will be required to attend a certain number of chemistry seminars, the exact number of which is determined by the course instructor. I am asking that you attend three (3) chemistry seminars this semester. These will most likely be chemistry/physics colloquia, senior seminars, and honors seminars. Make sure your attendance is properly recorded. Each seminar will count as ten (10) points toward your homework and quiz grade.

LABVIEW ASSIGNMENTS: LabVIEW is very popular programming environment for interfacing computers to scientific instruments. Modern analytical chemists must be familiar the use of computers for acquisition and analysis of instrumental data. It is my feeling that proficiency with LabVIEW is one of the most useful and important skills you will develop in this course. I also think it will be a lot of fun.

Your instruction in LabVIEW will be self-paced. I will give you a list of programming assignments on the course website, along with the associated pages in the textbook. Each assignment must be completed by the specified due date, but feel free to work at a faster pace. Late work will be docked 10% per day.

In carrying out your activities, you may use the version of LabVIEW on the CD-ROM included with the book; this must be installed on your own computer, but it will only work for a limited period of time. LabVIEW is installed on all the laboratory computers in the chemistry department, and you may use these whenever they are available. Each of you must do your assignments on your own. You may consult with classmates regarding how to solve a particular problem, and you may look at each other's code. But each of you must ALWAYS do your own programming.

The due dates are as follows:

Assignment #	Due Date	Assignment #	Due Date
1	First lab	6	Mon, 10/13
2	Mon, 9/15	7	Mon, 10/27
3	Mon, 9/22	8	Mon, 11/3
4	Mon, 9/29	9	Mon, 11/10
5	Mon, 10/6	10	Mon, 11/17

FINAL PROJECT: Each of you will design, complete, and present a major project using LabVIEW. I will work with you to design a project that is suitable. Previous projects have included:

"Simulation of a Capillary Electrophoresis Experiment"
"Theoretical Acid/Base Titration Curves"
"Simulation of Noisy Light Spectroscopy"
"Potentiostat Control for Cyclic Voltammetry"

You must give me the title of your project in writing by Friday, Nov. 21. Presentations will take place during lab time on Thursday, Dec. 11 and the grade will be based on the state of the project at the time of presentation.

ACADEMIC INTEGRITY: Each student is expected to adhere to the policies outlined in the college's academic integrity handbook. Cheating of any kind will not be tolerated. As in all my classes, students will be asked to consider an integrity pledge on each quiz/exam. This pledge reads as follows:

> "I affirm that I have neither committed nor witnessed a violation of academic integrity in the completion of this quiz/examination."

Any student found to have violated academic integrity will be subject to the following:

First Offense:	A drop of one whole letter grade in the final course grade, and a report filed to the Academic Dean's Office.
Second Offense:	Removal from the course, automatic failure in the course, and a report filed to the Academic Dean's Office.

DEPARTMENT GOALS: The Chemistry Department faculty has agreed upon the following list of goals that graduating seniors are to develop by the time they complete the chemistry major. The goals of particular relevance to this course are shown in *italics*.

A chemistry major should:

1. *Have a firm understanding of the core principles of chemistry as they apply to each of the major subdivisions of the discipline.*
2. *Be able to effectively communicate their knowledge of the field, both through writing and speaking.*
3. *Be comfortable and competent in the use of modern technology for the acquisition, analysis, and presentation of chemical data and information.*
4. *Possess good problem-solving skills, and be able to apply these skills both independently and collaboratively.*
5. *Be able to gather experimental data safely and accurately using a wide variety of laboratory instruments and methods.*
6. *Be able to apply their knowledge of chemistry to the explanation and interpretation of new or unfamiliar chemical information.*
7. *Be able to select, interpret, and utilize relevant scientific literature from a variety of sources including libraries, electronic databases, and the Internet.*
8. Understand and honor the ethical issues related to the use and misuse of chemical information and materials.
9. Be able to apply their knowledge and skills to professional experiences such as teaching, conducting research, and participating in internships.
10. *Gain an understanding of the relationship of chemistry to other sciences and to the needs of society as a whole.*

TENTATIVE COURSE SCHEDULE:

Date		Topic	Chapter(s)	Pages	Laboratory
Aug.	29	Introduction to course	1	1-26	---
Sept.	1	Circuit Analysis	2	26-42	Introduction to LabVIEW
	3				
	5	Operational Amplifiers	3	59-73	
	8				Operational Amplifiers
	10				
	12	A/D and D/A Conversions	4	80-90	
	15	Signals and Noise	5	110-123	Operational Amplifiers (cont.)
	17	**NO CLASS – Fall Symposium**			
	19	Electrochemistry Fundamentals	22	628-653	
	22	**EXAM #1 – Ch 1,2,3,4,5**			Introduction to Voltammetry
	24				
	26				
	29	Potentiometry	23	659-665, 671-683	pH Dependence of a Redox Reaction
Oct.	1	Coulometry	24	697-707	
	3	Voltammetry	25	716-742, 748-750	
	6				RDE Voltammetry of Glucose
	8				
	10	Introduction to Separations	26	762-783	
	13	**EXAM #2 – Ch 22,23,24,25**			LC-PED Analysis of Fruit Drinks
	15				
	17	Gas Chromatography	27	788-806	
	20	**NO CLASS - Mid-Semester Break**			FIA Determination of Iron
	22	High Performance Liquid Chromatography	28	816-830, 836-848	
	24				
	27	Capillary Electrophoresis	30	867-879, 882-884	FIA Determination of Iron (cont.)
	29				
	31	Mass Spectrometry	11,20	281-290, 550-576	
Nov.	3				GC-MS Determination of Phenol
	5	Properties of Electromagnetic Radiation	6	132-159	
	7	**EXAM #3 – Ch 26,27,28,30,11,20**			
	10				GC-MS Determination of Phenol (cont.)
	12	Components of Optical Instruments	7	164-211	
	14				
	17				Spectroscopic Analysis of Dristan®
	19	Atomic Spectroscopy	8,9,10	215-228, 230-240, 254-269	
	21				
	24				**NO LAB**
	26	**NO CLASS - Thanksgiving Break**			
	28	**NO CLASS - Thanksgiving Break**			
Dec.	1	UV-VIS Spectroscopy	13	336-343, 348-362	Work on LabVIEW projects
	3				
	5	Infrared Spectroscopy	16	430-452	
	8				LabVIEW Projects Due
	10	Surface Chemistry	21	589-603, 608-621	
	12	Catch Up/Review			
	15	**FINAL EXAM**			