Chemistry 221

Instrumental Analysis

Spring 2016

LECTURE:	• TueThur 1:15 - 2:30 p.m. • A161 Living/Learning
INSTRUCTOR:	• Joel Goldberg • 438 College Street, Room 200 • (802) 656-1273 • *Joel.Goldberg@uvm.edu* • *http://www.uvm.edu/~jgoldber/*
DESCRIPTION:	This course presents a survey of instrumental methods of chemical analysis. We will focus on understanding the fundamental principles underlying instrumental methods and their realization in modern instrumentation for chemical analysis. We will focus on the following broad methodological areas: • Electrochemistry, • Chromatography, • Optical Spectroscopy, and • Mass Spectrometry. This is *not* a "how-to" course; you will not learn how to operate analytical instruments nor will we cover specific analytical "recipes;" these change (sometimes quite quickly) with time as the discipline grows, so our focus on principles and concepts of implementation should provide greater insight both into how current instruments work as well as the basis for your understanding how they will work a decade from now. Lastly, we will pay attention to the chemical systems to which these methods are applicable and how best to obtain the chemical information desired using the most appropriate instrumental methods.
LEARNING OBJECTIVES:	You should develop an understanding of the analytical capabilities of a number of instrumental methods and be able to suggest suitable instrumental methods for particular analytical problems. In order to chose the best instrumental method for addressing an analytical problem, we will consider: • the property or quantity of the chemical system to be measured, • the physical and chemical principles upon which the measurement is based, • generation of a signal by a suitable detector (transducer) and the processing of the signal to convert it to a form appropriate for a readout device, and • the strengths and limitations of each particular instrumental method or approach. In order to make these kinds of assessments, you will need to understand: • the chemical and/or physical principles exploited during the measurement • how the instrument actually makes the measurement, and • some of the techniques used to improve analytical figures of merit (such as accuracy, precision and sensitivity).
OFFICE HOURS:	I am available (in my office at 438 College Street) this semester at the following days/times : • Mondays 2:00-3:30 pm I am available at other times as well (see me to make an appointment) and, of course, you are welcome to stop by my office at your convenience, but if I am busy we will have to reschedule for another time. Also, I am *virtually* available via email for your questions; I check my email regularly every day (even on weekends), so you should be able to get an email reply to a question within 12 hours of your posting it to me (barring any unforeseen technical difficulties!). ***Please put "CHEM 221:" as a prefix on the subject line in order to ensure my prompt attention.***
TEXT:	*Principles of Instrumental Analysis - 6th Edition* by Douglas A. Skoog, F. James Holler, and Stanley Crouch (ISBN 0-495-01201-7) - *recommended* NOTE: This is not an inexpensive book (a kind way of saying that it is expensive!), but it is an excellent reference book that will serve any practicing chemist or scientist who uses modern chemical instrumentation. It is, however, getting old (it was published in 2006-ish) and you can purchase versions (e.g., used or an "alternate" softcover version published with the title "Instrumental Analysis") from online book sellers. I am not having the UVM Bookstore stock this text. It is recommended that you order a copy online in time to have it in-hand in time for the start of the course (January 19th). Over the past few years, the availability of freely accessible, high-quality reference materials on the web has reached a point (for the topics covered in this class) that, in addition to providing links to "optional additional information", for each unit we cover, I plan on providing links to ***alternate readings*** that are available online. These ***alternate readings*** have been chosen carefully and serve as an alternate to the readings assigned in the text. I encourage you to explore both the readings in the text as well as those that I have identified on the web as ***alternate readings*** and to choose those that best suit your learning style as a primary "written" source. I still recommend that you purchase the text (either version identified above), but also hope you will find value in the ***alternate readings*** I've identified.
GRADING:	There will be three "hour" exams and one comprehensive Final Exam. The "hour" exams are ***tentatively scheduled*** for February 22nd, March 28th, and April 25th (all Mondays). These exams will be administered starting at 7:00 p.m. *(in Kalkin 004)* on those dates and, although you will be allowed as much time as you would like, they should take no more than two hours to complete. The Final Exam is scheduled for Tuesday, May 10th, 10:30 a.m.- 1:15 p.m. (*room TBD*).
	Your grade for the course will be determined as follows:

Exam I:	200 points
Exam II:	200 points
Exam III:	200 points
Final Exam:	400 points
TOTAL:	1000 points

LECTURE:	A tentative lecture schedule is available with links to detailed lecture/reading/problem lists for each unit that we cover. It is important to realize that it is not possible to learn all that you need to know about Instrumental Analysis from just the text, lectures, supplemental readings, or problem sets. Rather, attention must be paid to *all* of these areas as the material covered in each is designed to be complementary. I think that you will find that the problems in the problem sets (and exams!) will be easier to solve if you've attended the lectures and done the assigned readings. I encourage you to come to lecture having already read the assigned material as I would prefer to spend as much of our class time *discussing* the material, answering your questions about the material and asking *you* questions about the material. Obviously, our time in class will only be meaningful if you've already read the assigned readings for that particular unit. Your attendance in class is, of course, expected - if there is a class that you know you will not be able to attend, please let me know ahead of time so that I am aware of your absence. The assigned readings and problems for the material we are covering are listed on the web page for the course (www.uvm.edu/~jgoldber/courses/chem221). Additionally, you will find direct links on that site to lecture slides for each class. It is my intention to at have the lecture slides for each class uploaded and available on the web at least 24 hours *prior* to each class, so that it should be possible to print out a copy of them for you to use as a reference during class.
COMPUTERS/CELL PHONES in the CLASSROOM:	I expect your full attention and participation during class and, so, require that all cell phones be put into "airplane" mode (or turned off) during classtime. Receiving or sending texts during class is disruptive to your classmates (and to me!) as are phones ringing or buzzing during class. My expectation is that you will put your phone away during class and either turn it off or put it in "airplane" mode so that it will not send/receive texts or phone calls during classtime. Use of notebook/tablet computers during class is allowed, but ONLY for appropriate class use (e.g., taking notes, viewing lecture slides, etc.). Computer use for other purposes during class (e.g., email, messaging, Facebook, tweeting, etc.) will result in the revocation of your computer use in class.
PROBLEM SETS:	Problem sets will not be collected and are not "due" at any particular time -- it is in your best interests, however, to work the problem sets contemporaneously with the lecture material. Detailed solutions to the problems sets will be made available online at the course website. Problems just like or very similar to those on the problem sets have a habit of finding their way onto exams, so it would be prudent of you to ensure that you can work the relevant problem set problems before you take one of the exams.
THE WEB:	The website (www.uvm.edu/~jgoldber/courses/chem221) for this course is an integral tool for this class -- you **must** have web and email access in order to obtain all of the assignments and materials for this course. All materials relevant to this course will be made available online at the course website. All reading and problem set assignments and solutions will be made available ONLY on the course website (i.e., I will not hand out hardcopies during the semester -- you will need to go online to the website to get them). All PowerPoint lecture slides will be made available online as will old exams (from Spring 2015) and solutions to this year's exams. If you do not currently have access to the web, please see me as soon as possible so that I can assist you in getting online so that you can access all of the materials available for this course!

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E-MAIL

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Instrumental Analysis Course Schedule

Spring 2016

Ok, realize that this is only a *tentative* schedule and can change at a moment's notice (with the update indicated here, of course!).

Approximate Dates	***Topics***	***Assignments***	***Exams***
January 19, 21, 26, 28	*Introduction; Signals and Noise*	Readings Problems	-
January 28 February 2, 4, 9	*Electrochemistry*	Readings Problems	-
February 9, 11, 18	*Optical Spectroscopy I:* Intro/Background	Readings Problems	***Exam #1*** ***7:00 pm*** ***Monday*** ***February 22nd***
February 23, 25 March 3, 15	*Optical Spectroscopy II:* Instrumentation	Readings Problems	-
March 15, 17, 24	*Optical Spectroscopy III:* IR Molecular Absorption	Readings Problems	-
March 24, 29, 31 April 5	*Optical Spectroscopy IV:* Atomic Absorption and Emission	Readings Problems	***Exam #2*** ***7:00 pm*** ***Monday*** ***March 28th***
April 7, 12, 14	*Optical Spectroscopy V:* Molecular Luminescence and Raman	Readings Problems	-

April 14, 21, 26	*Mass Spectrometry*	Readings Problems	***Exam #3*** ***7:00 pm*** ***Monday*** ***April 25th***
April 26, 28 May 3	*NMR Spectroscopy*	Readings Problems	-
			Final Exam ***10:30 am*** ***Tuesday*** ***May 10th***

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