

Course Syllabus

CHE 410 and 5410: Instrumental Analysis

Spring 2011

Course Credit: Four Semester Hours

Professor: Dr. Dale Rosado

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Office Hours: 9 to 11 am Monday - Friday

My website may contain course material (i.e. Lecture Notes, Homework Assignments, Syllabi, etc.)

Location: Lecture: MCC 421

Lab: Hederman Science 413

Textbook: "Undergraduate Instrumental Analysis", Sixth Edition (Required)

Authors: Robinson, Frame, and Frame

ISBN: 0-8247-5359-3

Prerequisites: CHE 310 and CHE 317

Course Description: This course will expose students to modern instrumental theory, operation of modern instruments, data analysis, and data interpretation currently used in qualitative and quantitative chemical analysis.

Rationale: The purpose of this course is to learn the theory behind the construction of modern instrumentation that is used in qualitative and quantitative chemical analyses and how said theory can be used to optimize instrumental performance. The students will also learn how to make conclusions based on the analysis of raw data.

Objectives: Upon completing this course students will be able to:

1. Handle samples from a variety of matrixes so that precise and accurate data can be obtained
2. Understand the basic principles and operation of chemical instrumentation
3. Interpret the output from chemical instrumentation
4. Have a solid understanding of data analysis, data manipulation, and error associated with chemical analysis
5. Make solid conclusions based on the results of analyses
6. Design analyses for specific problems with a variety of analytes

Suggested Materials:

Material may be supplemented from: "Principles of Instrumental Analysis" Sixth Edition

Authors: Skoog, Holler, and Crouch

ISBN: 0-495-01201-7

* This text is not required for CHE 410, but is a suggested purchase for students who plan to pursue a career in the chemical industry.*

A laptop computer with Microsoft Office® may be useful during some lectures and laboratory experiments. Microsoft Word®, Excel®, and Powerpoint® may be will be used for Analysis and/or presentation of data in problem sets and /or for laboratory reports. Let me know in person if you do not own a laptop.

Instruction: The course will consist of a lecture component, discussion of relevant topics, problem solving sessions, and a laboratory component. The general outline of the textbook will be followed, but will be supplemented with current material relevant to the topics of study. Handouts may be given from other text. Students should prepare for class by reading the assigned reading given at the end of the previous class period. Please bring your textbook to class.

Topics Covered:

1. Concepts of Instrumental Analysis
2. Introduction to Spectroscopy
3. Ultra Violet and Visible Spectroscopy
4. Infrared Spectroscopy
5. Nuclear Magnetic Resonance Spectroscopy
6. Mass Spectrometry
7. Principles of Chromatography
8. Gas Chromatography
9. Liquid Chromatography

Covered if Time Permits

10. Basic Concepts of Atomic Absorption and Emission Spectroscopy
11. X-Ray Spectroscopy
12. Electroanalytical Chemistry

Evaluation:

Quizzes: 10 quizzes will be given throughout the semester at the beginning of class on Friday that will cover the material from the previous lectures and will count as 10 points each (total 100 points). The question format could be multiple choice, short answer, problem solving, or discussion. Quizzes will not be given on the week of an exam. The questions from quizzes will be similar to problems worked during lecture, problems assigned at the end of each chapter, or topic covered in lab. Missed quizzes will not be made up.

Exams: 3 exams will be given during the semester and will count 100 points each. The questions on each exam will be composed of questions derived from problems discussed during lecture, practice problems from the end of each chapter, and textbook examples. The question format could be multiple choice, short answer, problem solving, or discussion. The exams will cover the

material from lectures that have been discussed since the last exam. The final exam will be comprehensive and will include all material covered during the semester.

Quizzes: 10 X 10 = 100 points

Exams: 3 X 100 = 300 points

Lab Problem Sets or Reports: 10 X 20 = 200 points

Lab Notebook: = 20 points

(CHE 5410 Presentation: = 50 points)

Final Exam: = 200 points

CHE 410 Total Points = 820 points

(CHE 5410 Total Points = 870 points)

Graduate Student Project: Oral presentations are an integral part of chemical research. Graduate students enrolled in CHE 5410 are required to prepare and present a 20 minute Powerpoint® presentation on an instrumental technique that is commonly used in an area of scientific study that is of interest to the student. The topic of the presentation must meet the approval of the instructor. A discussion of the chosen topic must take place by **Friday February 11, 2011**. Please make an appointment to discuss the topic during my office hours. This presentation will be worth 50 points.

CHE 410 Grading: Grading will be conducting using the total of points earned and will be based on the following scale:

A: 738 – 820

B: 656 – 737

C: 574 – 655

D: 492 – 573

F: 0 – 491

CHE 5410 Grading: Grading will be conducting using the total of points earned and will be based on the following scale:

A: 783 – 870

B: 696 – 782

C: 609 – 695

D: 522 – 608

F: 0 – 521

* To calculate your grade as a percentage divide the sum of your grades by the total points that have been assigned to date and multiply by 100.*

Spring 2011 Exam and Quiz Schedule (Tentative):

First Day of Class: Wed January 12

Quiz 1: Friday January 14

Quiz 2: Friday January 21

Quiz 3: Friday January 28

Exam 1: Wednesday February 2

Quiz 4: Friday February 11

Quiz 5: Friday February 18

Quiz 6: Friday February 25

Quiz 7: Friday March 4

Exam 2: Friday March 11

Quiz 8: Friday March 25

Quiz 9: Wednesday March 30

Quiz 10: Friday April 8

Graduate Student Presentations: Friday April 15

Exam 3: Friday April 22

Review for Final Exam: Wednesday April 27

Final Exam: Saturday April 30, 2-4 pm

Instrumental Analysis Laboratory

Text: No text is required for the lab. Handouts and suggested reading will be given for each experiment.

Lab Notebook: A laboratory notebook will be kept for the Instrumental Analysis Laboratory. A composition notebook will suffice (not spiral bound). This note book must be kept in a professional manner. All entries **must** be made in **ink**. There are no exceptions to this rule! The first three pages of the notebook will be left blank for use as a table of contents. Number each page as it is used. Write the title and page number of the experiment each time you begin a new experiment. Only write on the right-hand page for each of your entries and use the left-hand side for notes taken during the pre-lab lecture and for quick calculations. Each entry should include

- The Title of the experiment,
- Date,
- Partner's Name,
- All Data, Observations,
- Necessary Calculations Made During the Experiment (do not forget units and significant figures!).
- Conclusions (bullets are sufficient)

The absence of any of these will result in a reduction of points from your notebook grade. Tape or paste any graphs, spectra, or chromatograms into you lab notebooks in an appropriate place. If you make a mistake, mark through it with a single line (~~mistake~~). DO NOT use liquid paper to correct mistakes or tear pages from you notebook. Both will result in the deduction of points from your notebook grade.

Lab Reports: Unless otherwise noted, a formal lab report will be turned in for all experiments. The format of the formal lab reports will be the same format used in the composition of a scientific article.

A scientific article or report is composed to report the results of experiments. This is the method that we use to tell the “story” of our work. We follow some of the same general guidelines that are used to create a plot in a story. Certain questions have to be answered to help the audience understand the context of the “story” such as: 1) Who wrote it?, 2) Why did you write it?, 3) How did you conduct the experiments?, 4) What were the results?, 5) What do the results mean?, 6) What are the take-home points from the experiment?, and 7) Did you use the work of anyone else to help you explain or conduct the experiment? No scientific experiment or project is complete without a report of the results.

Formatting: Times New Roman Font, Size 12 Font, Double Spaced

Title of Experiment

Your Name and the Name of Your Lab Partner

Date

Mississippi College

Abstract: A one paragraph summary of the reason you did the experiment, the methods, results, and conclusions

Introduction: Why was the experiment important? Explain the purpose and background of the experiment to the audience using proper references. The textbook and other books or journal articles can be used as reference material.

Experimental: How did you perform the experiment? This section should include the details of the methods used for data collection (*i.e.* conditions, solvents, instruments).

Data and Results: What did the analysis show? This includes the raw data and all calculated results from the experiment and should include error and other statistical analyses. Show sample calculations when warranted. Common equations such as mean or standard deviation need not be included. If you are unsure if an equation should be included, please ask the Professor. Graphs and Tables should be given a title and labeled (with units) on both axes. The slope, y-intercept, and regression values should be given for all linear plots. A short explanation should accompany each table or figure. Label each table or figure as such and number them as they appear in the text. This will make it easier to refer to figures and tables in the text.

Discussion of Results: What do the results mean? Discuss the results presented in the Data and Results section. Relate the results to the purpose of the experiment. Discuss the error associated with the results. Relate to results to literature on the topic.

Conclusions: Make conclusions based on the data collected. How do these conclusions apply to the literature and to this specific area of experimentation?

References: In the format used by the *Journal of the American Chemical Society* (paste link here) Wikipedia is not a primary literature source and is not to be used as a reference!

Lab reports will be due two weeks after the completion of the experiment unless otherwise note by the professor.

Experiments:

Lab Period 1: Safety and Instrumental Analysis Laboratory Setup

Lab Period 2: Scientific Writing: Preparation of a Formal Lab Report

Experiment 1: Statistical Analysis and Interpretation of a Data Set

Experiment 2: Quantitation of Acetaminophen in Over-the-counter pain killer by UV/Vis

Experiment 3: Identification of Functional Groups in a Series of Unknowns by Infrared Spectroscopy

Experiment 3: Compound Identification by ^1H - and ^{13}C - Nuclear Magnetic Resonance Spectroscopy and/or NMR Problems

Experiment 4: Mass Spectrometry Problems

Experiment 5: Thin Layer and Column Chromatography

Experiment 6: Quantitation of Caffeine in Soda by High Performance Liquid Chromatography

Experiment 7: Liquid Carbon Dioxide Extraction of Lemon Peel Oil: GC / MS Identification of the Essential Oils

Electronic Devices Other than Laptops: Cell phones must be turned off during lecture and labs. See me in the event of an emergency that requires monitoring of a cell phone. Use of the cell phone or other unauthorized devices during exams or quizzes will be construed as cheating. A graphing calculator or a scientific calculator with logarithm and exponential function capabilities may be used.

Course Withdrawal: The last day to drop a class without loss of tuition is January 20, 2011, after which there will be no tuition refund. The last day to drop a class without academic penalty is March 25, 2011. See the Mississippi College Academic Calendar for further information (<http://www.mc.edu/resources/publications/schedules.php>).

Attendance Policy: Attendance is expected for each class meeting. Absence during a lecture may result in the student missing material that is important for subsequent lectures or labs. The student is responsible for obtaining any lecture notes or assignments from days missed.

Attendance during exams is mandatory. Students who miss an exam will receive a zero for the exam. A make-up exam may be given at the discretion of the professor if circumstances warrant.

Otherwise, the attendance policy set forth in pages 33 - 34 of the 2010 – 2011 student handbook (Mississippi College Tomahawk) and Academic Affairs Policy 2.10: Class Attendance in the “Mississippi College Policies and Procedures Manual” will be followed.

Academic Integrity: An honor pledge will be signed and turned in with each exam. Otherwise, the academic honesty policy set forth in pages 35 - 36 the 2010 – 2011 student handbook (Mississippi College Tomahawk) and Academic Affairs Policy 2.19: Academic Honesty in the “Mississippi College Policies and Procedures Manual” will be followed.

Special Accommodations: In order for a student to receive disability accommodations under Section 504 of the Americans with Disabilities Act, he or she must schedule an individual meeting with the Director of Student Counseling Services **immediately upon recognition of their disability** (if their disability is known they must come in before the semester begins or make an appointment **immediately** upon receipt of their syllabi for the new semester). The student must bring with them written documentation from a medical physician and/or licensed clinician that verifies their disability. If the student has received prior accommodations, they must bring written documentation of those accommodations (example Individualized Education Plan from the school system). Documentation must be current (**within 3 years**). The student must meet with SCS **face-to face** and also attend two (2) additional follow up meetings (one mid semester before or after midterm examinations and the last one at the end of the semester). Please note that the student may also schedule additional meetings as needed for support through SCS as they work with their professor throughout the semester. Note: Students must come in **each semester** to complete their Individualized Accommodation Plan (example: MC student completes fall semester IAP plan and even if student is a continuing student for the spring semester they must come in again to complete their spring semester IAP plan).

Student Counseling Services is located in Alumni Hall Room #4 or they may be contacted via email at christia@mc.edu or rward@mc.edu. You may also reach them by phone at **601-925-7790**.

*** The professor reserves the right to modify this syllabus to better meet the needs of this course. This includes the schedule and the grading scale. However, the grading scale may be lowered but will not be raised.***