

Quantitative Chemical Analysis Lecture and Laboratory

CHE 310

Total Credit Hours 4 Lecture and Lab

Classroom: H415

Time: Lecture MW 9:00- 9:50

Lab MW 12:30-15:20

Instructor

Dr. Scoty Hearst

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Office Hours: Tuesday 9:00 - 3:00 pm, Thursday 9:00 am - 3:00pm, by appointment

Course Description

This laboratory intensive course presents the fundamental methods of exact chemical analysis and includes an introduction to the use of chemical instrumentation.

Rationale for Course

This course will provide practical experiences that will lead to a general understanding of analytical chemistry for chemistry majors. All chemists perform some aspects of analytical measure, where analytical analysis is a critical part of biochemistry, inorganic, organic, and physical chemistry. Development of problem solving and critical thinking skills will be stressed alongside statistics and error analysis.

Learning Objectives

Students will learn the fundamental laws and theories of chemistry and chemical calculations

Christian worldview: Helpful Bible Verses-

- If any of you lacks wisdom, you should ask God, who gives generously to all without finding fault, and it will be given to you. (James 1:5)
- But seek first the kingdom of God and his righteousness, and all these things will be added to you. (Matthew 6:33)
- Commit to the LORD whatever you do, and he will establish your plans. (Proverbs 16:3)

Prerequisites

Prerequisite for this course is CHE 141 and CHE 142.

Instructional Materials

Textbook: Quantitative Chemical Analysis 10th ed. by Daniel C. Harris. You will

need a scientific calculator, lab notebook, lab safety goggles, and any PPE required by the Chemistry Dept. Lab Pdfs will be provided. MS Excel is required.

Methods of Instruction

Quantitative Chemical Analysis is a course in which a high emphasis is placed on the principles of statistics, equilibrium thermodynamics, solution activity and instrumentation. As such, the course is calculation intensive and requires that the student is quite careful in all lecture exams and lab procedures. Toward this end, the student must maintain a current status in terms of reading the lecture material and other supplements. In this regard, the lecture supplements the laboratory rather than the laboratory supplementing the lecture as is the case in many other scientific laboratories. This course requires students to develop independence so that the burden of planning the experiments ultimately rest on their shoulders. Step by step guides will not be provided. Help is, however, always available from the instructor or the lab assistants. We will use the C.U.R.E. teaching (Course-based Undergraduate Research Experience) approach in our final lab. CURE labs, within the context of education, are designed to integrate research projects into undergraduate science courses, offering students hands-on research experience.

Methods of Evaluation

Three tests will be given during the semester, each with a value of 100 points. Lecture is 50% of the final grade; Laboratory is 50% of the final grade. Final grade is a Total of 100% of Total Points. Lecture will consist of Exams worth 100pts and Quizzes worth 10pts. Laboratory will consist of Lab Sheets worth 25pts and Lab reports worth 100pts. If assigned, Mid-Term and Final Exams for Lecture and Lab will be worth 100pts.

MC Syllabus Statement

The MC Syllabus contains all policies and procedures that are applicable to every course offered by Mississippi College, both on campus and online. The policies in the MC Syllabus describe the official policies of the University as they relate to instruction and will take precedence over those found elsewhere. It is the student's responsibility to read and be familiar with every policy. The MC Syllabus may be accessed at any time on the MC website at the following: <https://www.mc.edu/provost/mcsyllabus>.

MC Honor Code

A fundamental principle of academic, business, and community life is honesty. Mississippi College has adopted an Honor Code that applies to all members of our academic community. The code is as follows: "As a member of the Mississippi College community, I will live, speak, and work in a way that honors myself and others around me. I will hold myself and others to the highest standards of virtue and truth." Upon accepting admission to Mississippi College, a student immediately assumes a commitment to uphold the Honor Code, to accept responsibility for learning, and to follow the philosophy and rules of the Honor Code. As such, academic dishonesty is not tolerated. Students will be required to affirm this statement on examinations, research Academic Affairs—2.19 Academic Honesty 2 papers and other academic work. Ignorance of the rules does not exclude any member of the Mississippi College community from the requirements or the processes of the Honor Code. For additional information, please visit: <https://mc.edu/provost/honorcode>.

Grading Policy

The final exam schedule is published by Mississippi College. Any changes to the exam schedule must be approved by the Dean of the College.

The grading scale for this course is based on the percentage of total points earned in the course, and is as follows:

A range	$\geq 90\%$
B range	80-89%
C range	70-79%
D range	60-69%
F range	$< 60\%$

Do not contact the instructor at the end of the course to request an extra assignment, bonus opportunity, or grade change for any reason except an error in the calculation of the final grade. Grade appeals should follow the process outlined in MC Policy 4.20.

Right to Modify the Course:

Should COVID conditions change, Mississippi College reserves the right to modify this class at any point during the term. Potential changes include the implementation of safety protocols, the mode of course delivery, or any other aspects of the course which may become reasonably necessary. Faculty have the right to require students to wear masks inside the classroom and labs.

General Agreement:

Enrollment in this and other classes at MC affirms your agreement to abide by the rules, regulations, mission and standards of Mississippi College, including requirements and limitations implemented at any time for health and safety. Failure to abide by the rules, regulations, and limitations may result in suspension from the class, the university, or termination of enrollment.

Attendance: Your attendance at all class meetings is expected. Please refer to the 2022-2023 Mississippi College Undergraduate Bulletin for a discussion of the university's attendance policy. An accumulation of 8 absences results in an automatic F in the course. If a regular class meeting is missed, it is the student's responsibility to obtain any assignments or instructions that were given by the instructor. Missing a class is not an excuse for not preparing for the next class meeting or not having an assignment ready on time. Do not miss a scheduled test! In the event of an extreme emergency and an excused absence, a make-up test will be given. The test must be made up prior to the graded tests being returned to the class. Make-up tests are usually different from the regular test and may be more difficult. If the student cannot return to class until after the tests have been returned, the grade on the final exam may be substituted for the missing grade if the absence was excused.

Tardiness: If you are late to class, you may miss a quiz given at the beginning of class. Quiz grades are not made up. In regards to exam days, tardiness is completely prohibited! In addition, if you leave before the class is dismissed, you will receive an absence. If a quiz is given on that day you will receive a zero. In other words, you cannot just come take the quiz and leave.

Classroom Policies:

No one other than the students enrolled in this class will be allowed to come to class. This includes parents. If a sibling or prospective student is interested in attending a class meeting, you must get permission from first. Your grade will not be discussed with anyone else or your parents. If your parents want to know your grades, that is your responsibility to report this information to them. Cellphones are a distraction to both you and me. Do not have your phone out and/or in use during class or exams. Do not ask for extra credit if you are not satisfied with your grade, you can start

today working toward the grade you want. We do not give extra credit opportunities to a single student. If there is an extra credit opportunity, we will announce it in class to everyone.

Course Outline:

Lecture Outline * any changes will be announced	
Chapter 0	The Analytical Process
Chapter 1	Chemical Measurements
Chapter 2	Tools of the Trade
Chapter 3	Experimental Error
Chapter 4	Statistics
Chapter 5	Quality Assurance and Calibration Methods
Exam 1	
Chapter 6	Chemical Equilibrium
Chapter 7	Let the Titrations Begin
Chapter 8	Activity and the Systematic Treatment of Equilibrium
Chapter 9	Monoprotic Acid-Base Equilibria
Chapter 10	Polyprotic Acid-Base Equilibria
Chapter 11	Acid-Base Titrations
Exam 2	
Chapter 14	Fundamentals of Electrochemistry
Chapter 15	Electrodes and Potentiometry
Chapter 16	Redox Titrations
Chapter 17	Electroanalytical Techniques
Exam 3	
Chapter 18	Fundamentals of Spectrophotometry
Chapter 20	Spectrophotometers
Chapter 21	Atomic Spectroscopy
Chapter 22	Mass Spectrometry
Chapter 24	Gas Chromatography
Chapter 25	High-Performance Liquid Chromatography
Exam 4	
Final Exam	Comprehensive Final Exam

Lab Outline * any changes will be announced		S=Lab Sheet	R=Lab Report	TBD = to be decided
Lab 1-S	The Analytical Balance			
Lab 2-S	Calibration of Volumetric Glassware			
Lab 3-S	Buret Calibration			
Lab 4-S	Pipet Standardization			
Lab 5-S	Titration of Potassium Biphthalate			
Lab 6-S	Titration of Calcium Carbonate			
Lab 7-S	Gravimetric Determination of Nickel			
Lab 8-R	Spectrometric vs Hydrometric Determination of Ethanol Production			
Lab 9-R	Determination of an Unknown's Concentration using HPLC or TBD*			
Lab 10-R	Chemical Analysis of Environmental Samples from Choctaw Trails or TBD*			
Lab 11-R	Soil or Fish Analysis Lab or TBD*			
Lab 12-R	Lab Final Exam CURE Lab*			

Formal Lab Report:

(1) Title and statement of purpose. These should be on a cover page. Your name, as author, should also be in this page, along with a list of your partner. The statement of purpose should be one sentence.

(2) Introduction. This should briefly give background information relevant to your purpose or your hypothesis.

(3) Materials and Methods section. This should be a brief description of performed standard laboratory techniques such as pipetting fluids or weighing substances. Do not list instructions.

(4) Results section. This should report the results only, not discuss them. Numerical results should be given in the form of tables and graphs. Tables and graphs should be neatly done, clearly labeled and explained. All your raw data should be included. Figure Legends are required for each figure.

(5) Discussion section. This is a very important part of your report. This should relate back to the purpose of the experiment and it should contain a thorough analysis of your results, literature comparison and future applications.

(6) Literature Cited. You are required to cite at least two references. Internet web page is not a source.

Outdoor Lab Sampling: Portions of this Lab will require outdoor environmental sampling. Attendance to these outdoor lab sessions are encouraged, but not required. We will collect biological samples at Choctaw Trails as a part of the class or other locations. When performing field research at Choctaw Trails, students must sign a liability waiver before riding on the Chemistry Department's UTV.

Use of Analytical Lab Equipment: Students must properly use analytical equipment and clean-up after each use. Make sure to turn off equipment when applicable.

Early Alert System:

Mississippi College has adopted the practice of finding students early in the semester who may be exhibiting behaviors that could ultimately have a negative impact on their academic progress. These behaviors are often called "red flag" behaviors and include, but are not limited to, excessive absences, poor test grades, and lack of class participation or evidence of non-engagement. Identifying these behaviors early gives the instructor the opportunity to raise the "red flag" on behalf of a particular student so that the student can take the appropriate action to redirect his/her progress. The system alerts the student, the student's advisor, and the Office of Student Success. These messages are intended to help a student recognize an area of concern and to encourage him/her to make some choices to improve the situation. When a student receives an Early Alert message, the student should quickly make an appointment to talk with his/her professor about the situation. Also, students can make full use of the Office of Student Success to set academic goals and connect to campus resources.

Students with Disabilities:

Mississippi College is committed to creating a learning environment that meets the needs of its diverse student body. If you have a disability or think you may have a disability, please contact the office of Student Counseling and Disability Services to request an official accommodation. You can find more information about Student Counseling and Disability Services, including contact information, here: <https://www.mc.edu/offices/counseling/>.

Academic integrity:

Mississippi College students are expected to be scrupulously honest. Dishonesty, such as cheating or plagiarism, or furnishing false information, including forgery, alteration or misuse of University documents, records or identification, will be regarded as a serious offense subject to severe penalty, including, but not limited to, loss of credit and possible dismissal. See the Mississippi College Student Handbook or University Policy 2.19 for specific information regarding penalties

associated with dishonest behavior at Mississippi College. Copies of the Mississippi College Student Handbook are available in the Office of the Vice President for Enrollment Management and Student Affairs, Nelson 313. Copies of University policies are available on the Mississippi College web site.

Disclaimer

The instructor reserves the right to modify the schedule proposed in the syllabus as necessary. Modifications will be provided in writing.