**CHEM 4451, CRN 27626, Advanced Analytical Chemistry**

**Spring 2021, University of Central Arkansas**

**General Information**

**Professor:** Dr. Robert Mauldin

**Contact Information:** Manion Hall 303C, rmauldin@uca.edu

**Office Hours:** E-mail any questions; will schedule Zoom appointments as needed.

**Lecture:** MWF 10:00 - 10:50 AM, online via BlackBoard Collaborate

**Laboratory:** W 2:00-4:50 PM, MH 302

**Required Course Materials**

**Textbook:** “Quantitative Chemical Analysis” by Daniel C. Harris, 9th edition.

**Labs:** Electronic copies of the lab handouts will be posted on our BlackBoard site.

**Calculator:** A scientific/graphing calculator.

**Safety Glasses:** A pair of safety glasses with side-shields, ANSI Z87 certified.

**Course Description and Objectives**

**Course Description:** The second course in a two-course analytical chemistry sequence expanding on the concepts presented in CHEM 3520 Quantitative Analysis but with a particular focus on instrumental methods, including the theory of relevant chemical and physical phenomena, components and applications of various instruments, and data analysis. Major topics of coverage include spectroscopy, electrochemistry, and chromatography as well as signal-to-noise ratios, data processing, and analytical figures of merit. The laboratory component of the course is designed to introduce students to the analytical process via hands-on operation of various instrumentation and the role and applicability of each instrument in chemical analysis. Additional emphasis in the lab is placed on sample and standard preparation and calibration methods. Three hours of lecture and three hours of laboratory per week. Prerequisite: Grade of C or better in CHEM 3520.

**Grading Policies**

**1. Grading Composition**

6 lab reports @ 50 points each = 300 points

Participation (includes the assignment of bringing one question to each lecture session, participation in lecture activities, as well as participation in lab) @ 100 points

Midterm Exam @ 100 points (Labs 1-3; Chapters 20, 21, 22)

Final Exam @ 200 points (Labs 1-6; Chapters 17, 20, 21, 22, 24, 25)

**2. Grading scale:** 90-100%=A; 80-89%=B; 70-79%=C; 60-69%=D; <60%=F

**3. Extra Credit, Dropped Grades:** No extra credit will be offered and no grades will be dropped.

**4. Attendance and Missed Work Policy:** You will not be allowed to complete the lab and you will get a zero on the lab report grade if: a) you are more than five minutes late to lab, b) you do not have safety glasses, c) you do not have a printed copy of the lab handout, d) you do not have your scientific/graphing calculator, e) you do not have your lab notebook, or f) you are not wearing close-toed shoes and long pants.

**5. Academic Misconduct Policy:** Each lab report and the midterm and final exams must be individual work, with unique tables, figures and text: DO NOT PLAGIARIZE! In the first instance of academic dishonesty, a zero will be assigned for the assignment. In the second instance, a failing grade will be assigned for the class.

**6. Laboratory Safety Policy:** You are responsible for abiding by general safety and waste disposal procedures covered at the beginning of the semester and specific procedures addressed at the start of each lab period.

**7. Deadline and Late Penalty for Lab Reports:** Lab reports are due by Monday at 5 PM after the lab has been completed on the Wednesday prior (except for the lab completed the week before spring break, in which case the lab report will be due by 5 PM the Monday after spring break). Lab reports must be uploaded as Word documents to the BlackBoard site for the course. If late, the penalty is 10 points per day late.

**UCA/State/Federal Policies**

**1. Academic Misconduct Policy:** The University of Central Arkansas affirms its commitment to academic integrity and expects all members of the university community to accept shared responsibility for maintaining academic integrity. Students in this course are subject to the provisions of theuniversity's Academic Integrity Policy, approved by the Board of Trustees as Board PolicyNo. 709 on February 10, 2010, and published in the Student Handbook. Penalties foracademic misconduct in this course may include a failing grade on an assignment, afailing grade in the course, or any other course-related sanction the instructor determinesto be appropriate. Continued enrollment in this course affirms a student's acceptance ofthis university policy. See the current Student Handbook for the procedure to appeal accusations of academic misconduct.

**2. Americans with Disabilities Act Policy:** The University of Central Arkansas adheres to the requirements of the Americans with Disabilities Act. If you need an accommodation under this act due to a disability, please contact the UCA Office of Disability Services, 450-3613. If you are pregnant, allergic to any chemicals, color-blind, or have any other condition that might impact work in a chemistry lab, tell me immediately so that we can make accommodations.

**3. Title IX Disclosure Policy:** If a student discloses an act of sexual harassment, discrimination, assault, or other sexual misconduct to a faculty member (as it relates to "student-on-student" or "employee-on-student"), the faculty member cannot maintain complete confidentiality and is required to report the act and may be required to reveal the names of the parties involved. Any allegations made by a student may or may not trigger an investigation. Each situation differs and the obligation to conduct an investigation will depend on the specific set of circumstances. The determination to conduct an investigation will be made by the Title IX Coordinator. For further information, please visit: <https://uca.edu/titleix>. *\*Disclosure of sexual misconduct by a third party who is not a student and/or employee is also required if the misconduct occurs when the third party is a participant in a university-sponsored program, event, or activity.*

**4. Student Evaluations of Teaching Effectiveness Policy:** Student evaluations of a course and its professor are crucial elements in helping faculty achieve excellence in the classroom and the institution in demonstrating that students are gaining knowledge. Students may evaluate courses they are taking starting on the Monday of the twelfth week of instruction through the end of finals week by logging in to myUCA and clicking on the Evals button on the top right.

**5. Emergency Matters Policy:** An Emergency Procedures Summary (EPS) for the building in which this class is held will be discussed during the first week of this course. EPS documents for most buildings on campus are available at http://uca.edu/mysafety/bep/. Every student should be familiar with emergency procedures for any campus building in which he/she spends time for classes or other purposes.

**Course Schedule**

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| **Week** | **MWF 10 AM Lecture Material and Lab Discussion** | **W 2-5 PM Lab** |
| 1/19-1/22 | Introduction to Course, Chapter 21, Atomic Spectroscopy. *Review Chapter 18, Fundamentals of Spectrophotometry.* | Safety, Lab Discussion (online) |
| 1/25-1/29 | Chapter 21 | Group A Lab #1 Flame AA Analysis of Molybdenum in Waste from the Molybdenum Blue Method for the Analysis of Phosphate: Calibration Curve vs. Standard Addition |
| 2/1-2/5 | Chapter 21 | Group B Lab #1 |
| 2/8-2/12 | Chapter 20, Spectrophotometers | Group A Lab #2 UV-Visible Absorption Spectroscopy versus Fluorescence Spectroscopy: Linear Dynamic Ranges and Detection Limits |
| 2/15-2/19 | Chapter 20 | Group B Lab #2 |
| 2/22-2/26 | Chapter 22, Mass Spectrometry | Group A Lab #3 Matrix-Assisted Laser Desorption/Ionization Time of Flight (MALDI-TOF) Mass Spectrometry: Calibration with Polyethylene Glycol (PEG) and Evaluation of Accuracy via Analysis of C60 Buckyballs |
| 3/1-3/5 | Chapter 22 **Midterm Exam on 3/5, on Chapters 20-22 and Labs 1-3.** | Group B Lab #3 |
| 3/8-3/12 | Chapter 24, Gas Chromatography. *Review Chapter 23, Introduction to Analytical Separations.* | Group A Lab #4, Analysis of Nicotine in E-Cigarette Oil using Gas Chromatography-Mass Spectrometry and an Internal Standard |
| 3/15-3/19 | Chapter 24 | Group B Lab #4 |
| 3/22-3/26 | Spring Break Week! | Spring Break Week! |
| 3/29-4/2 | Chapter 25, High Performance Liquid Chromatography | Group A Lab # 5 Liquid Chromatography-Mass Spectrometry of Caffeine in Coffee with a Calibration Curve |
| 4/5-4/9 | Chapter 25 | Group B Lab #5 |
| 4/12-4/16  **Note: 4/12 is the Drop (W) Deadline** | Chapter 17, Electroanalytical Techniques. *Review Chapter 14, Fundamentals of Electrochemistry*. | Group A Lab # 6 Cyclic Voltammetry of Ferrocyanide/Ferricyanide Redox Couple: Determination of Reduction Potential, Number of Electrons, Reaction Reversibility and Effect of Scan Rate |
| 4/19-4/23 | Chapter 17, continued. | Group B Lab #6 |
| 4/26-4/29 (4/30 is Study Day) | To be determined | To be determined |
| 5/3-5/7 | **Final Exam on 5/3, 8-10 AM. Covers Chapters 17, 20, 21, 22, 24, 25, and Labs 4-6** | No lab (final exam week) |

**Chapter** **Assigned Exercises, Problems**

21 Problems 1, 2, 3, 4, 5, 6, 7, 13 (J/atom not J/molecule), 16, 20, 26, 27, 28, 29

20 Exercises A(a-c), B; Problems 1, 2, 3, 4 (first question only), 5, 6, 7a-b, 11a-c, 12

22 Exercises A, B, H; Problems 1, 2, 3, 4, 5, 6, 25, 26, 29, 31, 32, 33, 34, 35, 36

24 Problems 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 15a, 16a, 17, 18, 25, 28, 29

25 Problems 1, 2, 3, 4, 6, 7, 8a, 10, 12a, 17, 23

17 Exercise G; Problems 29, 30, 33, 37, 38