CHEM 541-01W: Advanced Analytical Chemistry

Instructor: **Dr. Laurence Angel** Office: Science 341
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Phone: 903-886-5391 Office Hours**:** Mon-Fri 4:00 – 5:00 pm

This is a web-based class delivered through the MyLeo online platform D2L, with recorded online lectures, weekly reading and homework assignments, end-of-week Excel assignments and tests, which will count towards your final grade. Class runs through the 16-weeks of Fall 2025 (8/25/2025 through 12/12/2025).

Course Book: Quantitative Chemical Analysis, 8th Ed., Daniel C. Harris, W.H. Freeman and Co. ISBN-13: 978-1-4292-5436-6

You will need access to the Excel program, preferably Excel 2016 or newer.

Student Learning Outcomes: To familiarize the student with the methods and techniques of quantitative chemical analysis for accurately determining the quantities of a chemical species in a sample. The student will be expected to understand the theory and application of advanced analytical techniques and be able to develop high quality Excel spreadsheets to provide results to the instructor. Material of the following will be covered.

1) Quality assurance and the validation of analytical procedure.
2) Volumetric analysis, titration calculations, solubility product, titration of a mixture, titration involving silver ion.
3) Equilibrium and thermodynamics, solubility product and complex formation.
4) Protic acids and bases, pH, strength of acids and bases, weak acid and base equilibrium.
5) Activity and the systematic treatment of equilibrium, ionic strength and solubility, activity coefficients, charge and mass balance.
6) Acid-base equilibria, buffers, Henderson-Hasselbalch equation, preparing buffers, buffer capacity,
7) Polyprotic acids and bases, amino acids, pH of diprotic systems, principal species, titrations of polyprotic systems, proteins, fractional composition, isoelectric focusing.
8) Acid-base titrations, titration curves, determining the end point, acid-base indicators, Kjeldahl nitrogen analysis, and the levelling effect.
9) Metal-chelate complexes, EDTA, metal ion indicators, EDTA titrations, pH-dependent EDTA equilibrium, auxiliary complexing agents, EDTA titration curves.
10) Advanced topics in equilibrium, general approach to acid-base systems, activity coefficients, dependence on solubility on pH, analyzing acid-base titrations.
11) Fundamentals of electrochemistry, electrode potentials, redox chemistry and electricity, galvanic cells, standard potentials, Nernst equations, reference electrodes.

12) Cells as chemical probes, why biochemists use E^{O}, reference electrodes, silver indicator electrode, junction potentials, ion-selective electrodes, glass electrode, solid state chemical sensors.

Student Learning Outcomes: By the end of the course, the student will be able to select and apply an analytical technique suitable for solving a given quantitative analytical problem. Knowledge of advanced quantitative chemical analysis techniques is essential for a wide range of potential employment positions in industry, government and academia.

Evaluation: Weekly evaluation will include assignments, advanced equilibrium techniques, and online tests, which are open books/notes and must be completed in the scheduled time-frame. You must complete the assignments and advanced equilibrium techniques individually and from scratch. Students working together or submitting duplicate files, including from previous semesters, will receive a zero. Tests will be made available at the scheduled time and once entered students will have the allotted time to complete the test. All tests must be completed individually. Evidence of students working together will receive an F for the class.

Weekly assignments and tests: Each week the test and/or assignments will be due at the end of each week, (70% total, ***open books/notes*** *must be done individually*)
Final exam: 2.0-hour comprehensive exam held at the end of the semester (30% total, ***open books/notes*** *must be taken individually)*

Grading: A: > 90%, B: 80-89.9%, C: 70-79.9%, D: 60-69.9%, F: <60%

Tentative Class Schedule and Reading Assignments from Quantitative Chemical Analysis 8th Ed., Daniel C. Harris, W.H. Freeman and Co. ISBN-13: 978-1-4292-5436-6

Week	Chapter and Topics
1	Chapter 5: Quality Assurance and Calibration Methods
2	Chapter 6: Chemical Equilibrium, Solubility and Ion Pairs
3	Chapter 6: Monoprotic Acid-Bases
4	Chapter 7: Activity Coefficients
5	Chapter 7: Systematic Treatment of Equilibrium
6	Chapter 8: Acid-Base Equilibria
7	Chapter 8: Buffers
8	Chapter 9: Polyprotic Acid-Base Equilibria
9	Chapter 10: Acid-Base Titrations
10	Chapter 11: Metal-Chelate Complexes and EDTA Titrations
11	Chapter 12: Advanced Equilibrium Topics
12	Chapter 12: Advanced Equilibrium Topics
13	Chapter 13: Electrochemistry
14	Chapters 14: Electrodes and Potentiometry (Thanksgiving)
15	Chapters 14: Electrodes and Potentiometry
16	Finals week**:** **Final Comprehensive Exam**

TECHNOLOGY REQUIREMENTS

LMS

All course sections offered by East Texas A&M University have a corresponding course shell in the myLeo Online Learning Management System (LMS). Below are technical requirements

LMS Requirements:
https://community.brightspace.com/s/article/Brightspace-Platform-Requirements

LMS Browser Support:
https://documentation.brightspace.com/EN/brightspace/requirements/all/browser_support.htm

Zoom Video Conferencing Tool
https://inside.tamuc.edu/campuslife/CampusServices/CITESupportCenter/Zoom_Account.aspx?source=universalmenu

ACCESS AND NAVIGATION

You will need your campus-wide ID (CWID) and password to log into the course. If you do not know your CWID or have forgotten your password, contact the Center for IT Excellence (CITE) at 903.468.6000 or helpdesk@tamuc.edu .

Note: Personal computer and internet connection problems do not excuse the requirement to complete all course work in a timely and satisfactory manner. Each student needs to have a backup method to deal with these inevitable problems. These methods might include the availability of a backup PC at home or work, the temporary use of a computer at a friend's home, the local library, office service companies, Starbucks, a ETAMU campus open computer lab, etc.

COMMUNICATION AND SUPPORT

If you have any questions or are having difficulties with the course material, please contact your instructor.

Technical Support

If you are having technical difficulty with any part of Brightspace, please contact Brightspace Technical Support at 1-877-325-7778. Other support options can be found here:

https://community.brightspace.com/support/s/contactsupport

Interaction with Instructor Statement – Primary and preferred communication is through email.

COURSE AND UNIVERSITY PROCEDURES/POLICIES

Course Specific Procedures/Policies

Syllabus Change Policy

The syllabus is a guide. Circumstances and events, such as student progress, may make it necessary for the instructor to modify the syllabus during the semester. Any changes made to the syllabus will be announced in advance.

University Specific Procedures

Student Conduct

All students enrolled at the University shall follow the tenets of common decency and acceptable behavior conducive to a positive learning environment. The Code of Student Conduct is described in detail in the Student Guidebook.
https://inside.tamuc.edu/admissions/registrar/documents/studentGuidebook.pdf .

Students should also consult the Rules of Netiquette for more information regarding how to interact with students in an online forum: https://www.britannica.com/topic/netiquette

ETAMU Attendance

For more information about the attendance policy please visit the Attendance webpage and Procedures 13.99.99.R0.01
http://www.tamuc.edu/admissions/registrar/generalInformation/attendance.aspx

Academic Integrity

Students at East Texas A&M University are expected to maintain high standards of integrity and honesty in all of their scholastic work. For more details and the definition of academic dishonesty see the following procedures:

Undergraduate Academic Dishonesty 13.99.99.R0.03
Undergraduate Student Academic Dishonesty Form

http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/documents/13.99.99.R0.03UndergraduateStudentAcademicDishonestyForm.pdf

Graduate Students Academic Integrity Policy and Form

Graduate Student Academic Dishonesty Form

https://inside.tamuc.edu/aboutus/policiesProceduresStandardsStatements/rulesProcedures/13students/graduate/13.99.99.R0.10.pdf

Students with Disabilities-- ADA Statement

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you have a disability requiring an accommodation, please contact:

Office of Student Disability Resources and Services
East Texas A&M University
Velma K. Waters Library Rm 162
Phone (903) 886-5150 or (903) 886-5835
Fax (903) 468-8148
Email: studentdisabilityservices@tamuc.edu

Website: Student Disability Services
https://www.etamu.edu/student-disability-services/

Nondiscrimination Notice

East Texas A&M University will comply in the classroom, and in online courses, with all federal and state laws prohibiting discrimination and related retaliation on the basis of race, color, religion, sex, national origin, disability, age, genetic information or veteran status. Further, an environment free from discrimination on the basis of sexual orientation, gender identity, or gender expression will be maintained.

Campus Concealed Carry Statement

Texas Senate Bill - 11 (Government Code 411.2031, et al.) authorizes the carrying of a concealed handgun in Texas A&M University-Commerce buildings only by persons who have been issued and are in possession of a Texas License to Carry a Handgun. Qualified law enforcement officers or those who are otherwise authorized to carry a concealed handgun in the State of Texas are also permitted to do so. Pursuant to Penal Code (PC) 46.035 and A&M-Commerce Rule 34.06.02.R1, license holders may not carry a concealed handgun in restricted locations.
For a list of locations, please refer to the Carrying Concealed Handguns On Campus document and/or consult your event organizer.
Web url:
http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/34SafetyOfEmployeesAndStudents/34.06.02.R1.pdf

Pursuant to PC 46.035, the open carrying of handguns is prohibited on all A&M-Commerce campuses. Report violations to the University Police Department at 903-886-5868 or 9-1-1.

East Texas A&M University Supports Students' Mental Health

The Counseling Center at East Texas A&M University, located in the Halladay Building, Room 203, offers counseling services, educational programming, and connection to community resources for students. Students have 24/7 access to the Counseling Center's crisis assessment services by calling 903-886-5145. For more information regarding Counseling Center events and confidential services, please visit www.tamuc.edu/counsel

Mental Health and Well-Being

The university aims to provide students with essential knowledge and tools to understand and support mental health. As part of our commitment to your well-being, we offer access to Telus Health, a service available 24/7/365 via chat, phone, or webinar. Scan the QR code to download the app and explore the resources available to you for guidance and support whenever you need it.

http://telusproduction.com/app/5108.html

AI use policy [Draft 2, May 25, 2023]

East Texas A&M University acknowledges that there are legitimate uses of Artificial Intelligence, ChatBots, or other software that has the capacity to generate text, or suggest replacements for text beyond individual words, as determined by the instructor of the course. Any use of such software must be documented. Any undocumented use of such software constitutes an instance of academic dishonesty (plagiarism).

Individual instructors may disallow entirely the use of such software for individual assignments or for the entire course. Students should be aware of such requirements and follow their instructors' guidelines. If no instructions are provided the student should assume that the use of such software is disallowed.

In any case, students are fully responsible for the content of any assignment they submit, regardless of whether they used an AI, in any way. This specifically includes cases in which the AI plagiarized another text or misrepresented sources.

Undergraduate Academic Dishonesty 13.99.99.R0.03

Graduate Student Academic Dishonesty Form