CHEM 441-01E: Instrumental Analysis

Instructor: Laurence Angel   **Office:** Science 341   **Email:** Laurence.Angel@etamu.edu
Phone: 903-886-5391   **Office Hours:** Mon- Fri: 4:00 – 5:00pm
Class Meetings: Tuesday/Thursday 9:30am-10:45am   **Location**: STS 313
Laboratory Section: Tuesday 2:00p-5:50p   **Location**: STC 313

Course Description: This course will have two lectures each week and labs in the chemistry department covering the principles and practical applications of electrochemistry, ultraviolet and visible spectroscopy, fluorescence spectroscopy, atomic emission spectroscopy, mass spectrometry, high performance liquid chromatography, and gas chromatography.
Student Learning Outcomes: Students will gain a broad and in-depth knowledge of a range of instrumental techniques for accurately measuring the quantity and identity of atomic and molecular species in a sample.

1. The student will understand the theory and practical application of these instrumental techniques and be able to explain the concepts to their peers.
2. Students will demonstrate broad knowledge of and successful problem solving skills in instrumental analysis as examined by lab work, lab reports and exams.
3. Students will demonstrate knowledge for choosing an instrumental method that can be applied to solve a specific analytical chemistry problem.

This is what you'll learn during the course	This will help you learn how to have	This is what you'll do to learn how to do this	This is how you'll show me that you've learned this
You will understand the theory and practical application of a range of instrumental techniques and be able to explain these concepts to your peers	A broad knowledge of instrumental analysis techniques	Attend and participate in class. Complete all reading and homework assignments. Conduct instrumental analyses techniques. Apply data analyses methods and write concise lab reports.	You will demonstrate broad knowledge of instrumental techniques and successful problem-solving skills in instrumental analysis as examined by lab work, lab reports and exams.
Choose an instrumental method, or combination of methods, that can be applied to solve a specific analytical	An in-depth knowledge of instrumental analysis techniques	Complete a range of instrumental analyses techniques and apply the correct data analysis to present in your lab reports.	You will accurately determine the quantity or identify the chemical species in a sample. Be evaluated by a

chemistry problem			comprehensive exam.

Class Material: *Quantitative Chemical Analysis*, 8th edition, Daniel C. Harris. ISBN: 9781429254366.

Credits: 4 credit hours for class and laboratory.

Laboratory Experiments: The course site will provide laboratory procedures throughout the semester. You will need a *laboratory notebook*, *safety goggles*, and a *non-programmable* calculator. The experiments will closely correlate with the class material.

Prerequisite: The student must have completed CHEM 340 in order to enroll in CHEM 441. It is also desirable to have completed CHEM 351 and CHEM 352.

Evaluation:

Mid-term exams: 4 exams will be held during the semester (11% each, 44% total)

12-Laboratory reports: Graded laboratory reports (3% each, 36% total)

Final American Chemical Society Exam: 2-hour comprehensive final exam (20%)

Grading: General grade range of A: > 86%, B: 75-86%, C: 63-74%, D: 50-62%, F: <50%

Laboratory Procedures and Requirements: We shall go over laboratory safety, lab books and report writing in the first week. The laboratory experiments will follow the theory of the instrumentation covered in class. Each experiment will be graded out of 100% based on your lab performance (40%), the accuracy of your final result and whether it includes the "true" value, its relative error in parts per thousand, or the correct identifications (30%), and the quality of the presented data in the report including any computer analysis (30%).

Relative Error	Grade /80
0-5 ppt	80
5-15	72
15-25	64
25-40	56
40-70	48
70-100	40
100-150	32
>200ppt	16

$$\text{relative error} = \frac{\text{exp. value} - \text{known value}}{\text{known value}} \times 1000$$

Preparation for the lab is required: Your lab book should be prepared in the way described in the lab handout. *5 points of the grade will be deducted if the pre-lab assignments are not finished before the lab. Writing on scraps of paper during lab will result in 5 points deducted from your grade. All the experimental results should be written in your* **lab book** *and this should be well organized and clearly presented. See the lab report handout and grading rubric for details on proper presentation and recording of your experiments. Unsafe or poor conduct during the lab will also result in 20 points deduction.*

Late work will not be accepted, and makeup exams or labs will not be given. If you miss an exam, without a proven medical reason, the points for the missed exam will be placed on your final exam, making your final exam count for a greater percentage of your grade. The final exam will be comprehensive. Laboratory Portion: 36% of course grade. Twelve laboratory reports will be required. Any additional missed labs will result in a zero for that lab unless a proven medical issue is provided.

Tentative Class Schedule Topics:

Week	Topics	
1	Fundamentals of Electrolysis	
2	Electrogravimetric analysis	
3	Coulometry/Voltammetry	
4	Spectrophotometry Instrumentation and Applications	
5	Mechanisms of absorption of light, Luminescence	**Exam 1**
6	Lasers	
7	Introduction and Methods of Atomic Spectroscopy	
8	Inductively Coupled Plasma Emission Spectroscopy	
9	Inductively Coupled Plasma Mass Spectrometry	**Exam 2**
10	Spring Break	
11	Mass Spectrometry Instrumentation and Techniques	
12	Analytical Separations and Gas Chromatography	
13	Gas Chromatography – Mass Spectrometry Techniques	**Exam 3**
14	High Performance Liquid Chromatography	
15	HPLC Techniques	
16	Chromatographic Methods/ Capillary Electrophoresis	
17	Review	**Exam 4**
18	**Final ACS comprehensive Exam**	

Tentative Laboratory Schedule

Week	Laboratory
2	Lab safety / Lab books
3	Electrodeposition of Copper
4	Spectrophotometric Analysis: Caffeine and Benzoic Acid in Mountain Dew
5	Spectrophotometric Measurement of an Equilibrium Constant: The Scatchard Plot
6	Solvent Effects on the Absorption and Fluorescence Spectrum of Perylene
7	Mn^{2+} Standardization by EDTA
8	Measuring Manganese in Steel by Spectrophotometry with Standard Addition
9	Measuring Manganese in Steel by Atomic Emission Using a Calibration Curve
10	Spring Break
11	Electron Ionization - Mass Spectrometry of Organic Molecules
12	Gas Chromatography - Mass Spectrometry
13	Gas Chromatography: Retention Indexes for Common Stationary Phases
14	High Performance Liquid Chromatography Analysis of Oligopeptides
15	Analysis of Analgesic Tablets by High Performance Liquid Chromatography
16	Lab checkout

CHEM 441 lab report grade   Name_____

	Far Exceeds Standards	**Exceeds Standards**	**Meets Standards**	**Fails to Meet Standards**
Completeness of the report with the correct conversion of raw data to final data (30%)	Superior completeness and conversion of data; student's lab report was extraordinarily complete **(30)**	Complete; student's lab report and conversion was mostly complete **(25)**	The lab report and conversion of data had some issues **(20)**	The lab report and conversion of data was incomplete and had issues **(10)**
Accuracy of final result in PPT and whether the uncertainty included the "true" value (40%)	The final result was accurate and included the "true" value using the correct sig. figs and units **(40)**	The final result was accurate using correct sig. figs and units but did not include the "true" value **(35)**	The final result was inaccurate and did not include the "true" value **(30)**	The final result was inaccurate and the units and sig figs were incorrect. **(20)**
Lab performance and whether pre-lab and the proper use of lab book was complete (15%)	Lab performance was exemplary **(15)**	Prelab *or* lab notebook not properly completed before class or used during class **(10)**	Pre-lab *and* lab book not properly completed or used during class **(5)**	Lab performance was poor, pre-lab not completed and lab book not properly used **(0)**
Quality of presented report including any computer analyses. (15%)	Lab report was extraordinarily formatted following the guidelines. **(15)**	Lab report was formatted following the guidelines. **(10)**	Lab report was mainly formatted following the guidelines. **(5)**	Lab report was poorly formatted not following the guidelines. **(0)**

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@etamu.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

STUDENT RESPONSIBILITIES FOR COURSE

CWID and Password
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@etamu.edu.

Technology-Related Issues
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.

TECHNOLOGY REQUIREMENTS AND SUPPORT

Minimal Technical Skills Needed
Students will need reliable computer and internet access for this course. Students must be able to effectively use myLeo email, myLeo Online D2L, and Microsoft Office.

Learning Management System (LMS) – D2L

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 the technical requirements:

- View the Learning Management System Requirements Webpage.
- Learn more on the LMS Browser Support Webpage.

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 on the Brightspace Support Webpage.

COMMUNICATION AND SUPPORT

Interaction with Instructor Statement
If you have any questions or are having difficulties with the course material, please contact your instructor. Correspondence will always be through university email (your "myLeo" mail) and announcements in myLeo online (D2L). You will not RECEIVE email through D2L, so be sure to check your ETAMU email for communication. Students are encouraged to check university email daily.

Include the Following in Emails with Instructor:

- Course name and subject in the subject line
- Salutation (Good afternoon, Dr. Jackson)
- Proper email etiquette (no "text" emails – use proper grammar and punctuation)
- Student name and CWID after the body of the email (possibly add to student signature on email)

COURSE AND UNIVERSITY 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.

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 online in the Student Guidebook.

Students should also consult the Rules of Netiquette Webpage for more information regarding how to interact with students in an online forum.

ETAMU Attendance
For more information about the attendance policy, please view the Attendance Webpage and the Class Attendance Policy

Academic Integrity

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

Undergraduate Academic Dishonesty University Procedure 13.99.99.R0.03
Undergraduate Student Academic Dishonesty Form
Graduate Student Academic Dishonesty University Procedure 13.99.99.R0.10
Graduate Student Academic Dishonesty Form

Use of Artificial Intelligence

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

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@etamu.edu
Website: Office of 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 East Texas A&M University 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 ETAMU 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.

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

East Texas A&M Supports Students' Mental Health – Counseling Services

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.

As an Institutional Member of the National Association of Schools of Music, East Texas State A&M University supports the Association's commitment to student health and wellness. The following web address provides links to information for resources related to physical and mental well-being, as well as assists in offering preventative measures that students can take to avoid serious and/or chronic conditions: [Musician Health and Safety - East Texas A&M University](#)