

**Texas State Technical College Waco  
Course Syllabus**

*Course Rubric & Number:* CTEC 2431

*Lecture/Lab Hours:* 2- 8

*CIP Code:* 400505138

*Course Title:* **Applied Instrumental Analysis II**

**Course Description:** Study of advanced topics in instrumental analysis. Topics include atomic absorption, inductively coupled plasma, nuclear magnetic resonance, gas chromatography/mass spectrometry, liquid chromatography, and infrared spectroscopy.

*Prerequisites:* CHEM 2325, CHEM 2125 or SCIT 2402

*Instructor:*

*Office Phone Number:* 254-867-4859

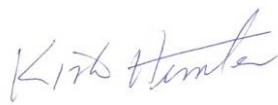
*Email Address:* richard.wheet@tstc.edu

*Office Fax Number:* 254-867-2973

*Building & Office Room Number:* TSC - Office

*Department Chair:*

Kirk Hunter



*Date:* 29 June 2010

*Approved by CIP Committee:*



*Date:* April 30, 2010

***End-of-Course Learning Outcomes:***

CO1: Calibrate, operate, troubleshoot, and maintain analytical instruments

CO2: Prepare and analyze samples

CO3: Interpret data; describe the operating principles of chemical instrumentation

***Resources:***

Tools & Materials Students Purchase

Quantity	Item Description
	No book

***TSTC Grading Policy:***

(Grades for all Major courses must be C or better)

Grade	Percent	Description	Grade Points
A	90-100	Excellent/Superior Performance Level	4
B	80-89	Above Required Performance Level	3
C	70-79	Minimum Required Performance Level	2
D	60-69	Below Required Performance Level	1
F	Below 60	Failure to meet Performance Requirements	0
IP	--	In Progress	
W	--	Withdrawal	0
CR	--	Credit	0
AUD	--	Audit of Course	0
See College Catalog for complete descriptions.			

***Instructor's Participation Policy:***

The student must be present for all tests, quizzes, and assignments. Failure to attend will result in a grade of zero for that particular test, quiz, laboratory or assignment.

***Students with Disabilities:***

If you have a documented disability that will impact your work in this class, please contact the Office of Deaf and Disabled Student Services (D/DSS) so that appropriate arrangements for your accommodations can be made. In accordance with the federal law, a student requesting accommodations must provide documentation of his/her disability to D/DSS. For information, visit D/DSS in the Fentress Center or call (254) 867-3600.

Once you and a D/DSS representative have signed a Letter of Special Accommodations, take the accommodations letter to each class for which an accommodation has been determined. Meet individually with each class instructor to discuss accommodations letter. Have the instructor sign and keep a copy of the letter. Take the original letter, signed by the instructor, back to D/DSS so they are aware that the instructor has been officially informed of the need for accommodations.

**Course Assessments & Grading Scheme:**

<i>Assessments</i>		<i>% of Final Grade</i>
Test 1 - Electronics and Atomic Absorption	100 points	10%
Test 2 - ICP	100 points	10%
Test 3 - Nuclear Magnetic Resonance	100 points	10%
Test 4 - Infrared	100 points	10%
Test 5 - Mass Spec	100 points	10%
Lab - Electrical Circuits	100 points	4.55%
Lab - Intro to AA	100 points	4.55%
Lab - Calibration of AA	100 points	4.55%
Lab - Standardization of AA	100 points	4.55%
Lab - Dilution for AA	100 points	4.55%
Lab - Analysis of Brass by AA	100 points	4.55%
Lab – Analysis of NMR Spectra	100 points	
Lab - IR using a liquid - 1	100 points	4.55%
Lab - IR using a liquid - 2	100 points	4.55%
Lab - IR using a a pellet	100 points	4.55%
Lab - MS intro	100 points	4.55%
Lab - Using the MS	100 points	
Lab - MS analysis of an alcohol	100 points	4.55%
Final Course Grade		100%

A = 90-100%

B=80-89%

C=70-79%

D=60-69%

*Description of Graded Elements of the Course:*

<i>End-of-Course Learning Outcomes</i>	<i>Assessment Measure(s)</i>	<i>Submittal of Assessment</i>	<i>Grading Criteria</i>	<i>% of Final Grade</i>
CO3: Interpret data; describe the operating principles of chemical instrumentation	Test 1 - Electronics and Atomic Absorption	Written using a writing instrument	Correct answers based on scientific fact	10%
CO3: Interpret data; describe the operating principles of chemical instrumentation	Test 2 - ICP	Written using a writing instrument	Correct answers based on scientific fact	10%
CO3: Interpret data; describe the operating principles of chemical instrumentation	Test 3 - Nuclear Magnetic Resonance	Written using a writing instrument	Correct answers based on scientific fact	10%
CO3: Interpret data; describe the operating principles of chemical instrumentation.	Test 4 - Infrared	Written using a writing instrument	Correct answers based on scientific fact	10%
CO3: Interpret data; describe the operating principles of chemical instrumentation	Test 5 - Mass Spec	Written using a writing instrument	Correct answers based on scientific fact	10%
CO1: Calibrate, operate, troubleshoot, and maintain analytical instruments CO2: Prepare and analyze samples CO3: Interpret data	Lab 1 - Electrical Circuits	Written using a writing instrument	Correct answers based on scientific fact	3.85%
CO1: Calibrate, operate, troubleshoot, and maintain analytical instruments CO2: Prepare and analyze samples CO3: Interpret data	Lab 2- Intro to AA	Written using a writing instrument	Correct answers based on scientific fact	3.85%
CO1: Calibrate, operate, troubleshoot, and maintain analytical instruments CO2: Prepare and analyze samples CO3: Interpret data	Lab 3- Calibration of AA	Written using a writing instrument	Correct answers based on scientific fact	3.85%

<b><i>End-of-Course Learning Outcomes</i></b>	<b><i>Assessment Measure(s)</i></b>	<b><i>Submittal of Assessment</i></b>	<b><i>Grading Criteria</i></b>	<b><i>% of Final Grade</i></b>
CO1: Calibrate, operate, troubleshoot, and maintain analytical instruments CO2: Prepare and analyze samples CO3: Interpret data	Lab 4 - Standardization of AA	Written using a writing instrument	Correct answers based on scientific fact	6.67%
CO1: Calibrate, operate, troubleshoot, and maintain analytical instruments CO2: Prepare and analyze samples CO3: Interpret data	Lab 5 - Dilution for AA	Written using a writing instrument	Correct answers based on scientific fact	3.85%
CO1: Calibrate, operate, troubleshoot, and maintain analytical instruments CO2: Prepare and analyze samples CO3: Interpret data	Lab 6 - Analysis of Brass by AA	Written using a writing instrument	Correct answers based on scientific fact	3.85%
CO1: Calibrate, operate, troubleshoot, and maintain analytical instruments CO2: Prepare and analyze samples CO3: Interpret data	Lab 7 - Analysis of NMR Spectra	Written using a writing instrument	Correct answers based on scientific fact	3.85%
CO1: Calibrate, operate, troubleshoot, and maintain analytical instruments CO2: Prepare and analyze samples CO3: Interpret data	Lab 8 - IR using a liquid - 1	Written using a writing instrument	Correct answers based on scientific fact	3.85%
CO1: Calibrate, operate, troubleshoot, and maintain analytical instruments CO2: Prepare and analyze samples CO3: Interpret data	Lab 9 - IR using a liquid - 2	Written using a writing instrument	Correct answers based on scientific fact	3.85%
CO1: Calibrate, operate, troubleshoot, and maintain analytical instruments CO2: Prepare and analyze samples CO3: Interpret data	Lab 10 - IR using a a pellet	Written using a writing instrument	Correct answers based on scientific fact	3.85%

<i>End-of-Course Learning Outcomes</i>	<i>Assessment Measure(s)</i>	<i>Submittal of Assessment</i>	<i>Grading Criteria</i>	<i>% of Final Grade</i>
CO1: Calibrate, operate, troubleshoot, and maintain analytical instruments CO2: Prepare and analyze samples CO3: Interpret data	Lab 11 - MS intro	Written using a writing instrument	Correct answers based on scientific fact	3.85%
CO1: Calibrate, operate, troubleshoot, and maintain analytical instruments CO2: Prepare and analyze samples CO3: Interpret data	Lab 12 - Using the MS	Written using a writing instrument	Correct answers based on scientific fact	3.85%
CO1: Calibrate, operate, troubleshoot, and maintain analytical instruments CO2: Prepare and analyze samples CO3: Interpret data	Lab 13- MS analysis of an alcohol	Written using a writing instrument	Correct answers based on scientific fact	3.85%

***Course Policies:***

*Late Work:*

Late work receives a zero.

*Electronic Devices:*

All cell phones, pagers, computers and other electrical communication devices will be turned off completely during class (this includes no vibrate mode). Failure to comply with this requirement will result in the student being required to leave the class for the rest of the class period during which the violation occurs. Any work missed may not be made up.

*Make-up work:*

Make-up work receives a zero

***Course Schedule:***

Week # 1: Review course syllabus		
Laws of Electricity Ohm's Law , Kirchoff's Law and Power Law Basic Direct Current Circuits - series and parallel Current, Voltage, and Resistance Measurements		
	Lab-1	Lab - Electrical Circuits

Week # 2: Atomic Absorption		
Introduction Ground and Excited State Atoms Theory of Atomic Absorption Principles of Operation Source Lamps Applications		
	Lab-2	Lab - Intro to AA

Week # 3: Atomic Absorption Components		
Source Lamps Applications Source Lamps Nebulizers and Atomizers Monochromator Systems Detectors Single Beam and Double Beam Spectral Interferences		
	Lab-3	Lab - Calibration of AA
	Lab-4	Lab - Standardization of AA

Week # 4: Atomic Absorption Applications		
Sample Preparation		

Standard Curves and Calculations		
	Lab-5	Lab - Dilution for AA
Laws of Electricity Ohm's Law , Kirchoff's Law and Power Law Basic Direct Current Circuits - series and parallel Current, Voltage, and Resistance Measurements Introduction Ground and Excited State Atoms Theory of Atomic Absorption Principles of Operation Source Lamps Applications Source Lamps Nebulizers and Atomizers Monochromator Systems Detectors Single Beam and Double Beam Spectral Interferences Sample Preparation Standard Curves and Calculations	Test - 1	Electronics and Atomic Absorption

Week # 5: Induced Coupled Plasma		
Principles of Operation		
	Lab-6	Lab - Analysis of Brass by AA
Principles of Operation	Test 2	ICP

Week # 6: Proton Magnetic Resonance Spectrophotometry		
Introduction and Theory Apparatus and Sampling The Chemical Shift The NMR Spectrum		

	Lab-7	Lab - Analysis of NMR Spectra
Week # 7: Proton Magnetic Resonance Spectrophotometry		
Spin Spin Coupling The Anisotropic Effect Protons on Heteroatoms The Karplus Equation Long Range Spin Spin Splitting		
	Lab-7	Lab - Analysis of NMR Spectra
Introduction and Theory Apparatus and Sampling The Chemical Shift The NMR Spectrum Spin Spin Coupling The Anisotropic Effect Protons on Heteroatoms The Karplus Equation Long Range Spin Spin Splitting	Test 3	Nuclear Magnetic Resonance
Week # 8: Infrared		
Introduction and Theory Instrumentation Sampling Handling and Preparation IR Spectra of Paraffins (Normal, ISO and cyclic)	Lab 8	Lab - IR using a liquid - 1
Week # 9: Infrared		
Olefins and Acetylenes Aromatic Compounds Alcohols and Phenols Aldehydes, Ketones, Esters and Acids	Lab 9	Lab - IR using a liquid - 2
Week # 10: Infrared		
Aromatic Compounds Alcohols and Phenols Aldehydes, Ketones, Esters and Acids	Lab 10	Lab - IR using a pellet
Introduction and Theory	Test 4	Infrared

Instrumentation Sampling Handling and Preparation IR Spectra of Paraffins (Normal, ISO and cyclic) Olefins and Acetylenes Aromatic Compounds Alcohols and Phenols Aldehydes, Ketones, Esters and Acids Ethers and Epoxides Acid Halides and Anhydrides Amines, Amides and other Nitrogen Compounds Organic Sulfur Compounds		
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--	--

Week # 11: - Mass Spectrophometry		
Introduction and Instrumentation		
	Lab 11	MS Introduction

Week # 12: Mass Spectrophometry		
Introduction and Instrumentation		
	Lab 12	Using the MS

Week # 13: Mass Spectrophometry		
Fragmentation		
Mass Spectra of Some Chemical Classes		
Alkanes		
Iso-paraffins		
Cycloparaffins		
Alkenes (olefins)		
McLafferty Rearrangement		
Aromatic Compounds		
The Tropylium Ion		
Allylic, Vinylic and Benzylic Cleavage		
Alcohols, Ethers and Amines		
Aldehydes, Ketones, Esters and Acids		

	Lab 13	Analysis of Alcohol
--	--------	---------------------

Week # 14: Mass Spectrophometry Details of the McLafferty Rearrangement More Chemical Classes Halogen Compounds Nitro compounds Mercaptans		
Introduction and Instrumentation Fragmentation Mass Spectra of Some Chemical Classes Alkanes Iso-paraffins Cycloparaffins Alkenes (olefins) McLafferty Rearrangement Aromatic Compounds The Tropylium Ion Allylic, Vinylic and Benzylic Cleavage Alcohols, Ethers and Amines Aldehydes, Ketones, Esters and Acids Details of the McLafferty Rearrangement More Chemical Classes Halogen Compounds Nitro compounds Mercaptans	Test 5	Mass Spectrophometry

Week # 15: Course Review and Lab Cleanup
------------------------------------------

***Modification of the syllabus:***

This syllabus is intended as a tentative set of guidelines for this course and is not a contract. At any time during the semester, the instructor reserves the right to make modifications in content, schedules and requirements as deemed necessary to promote the best education possible within the prevailing conditions and circumstances affecting this course.