

SYLLABUS, Chemistry 250 and 251
Basic Instrumental Analysis (Lecture and Laboratory), Spring 2005

Instructor Dr. Glenn V. Lo, Office: Beauregard 212, Phone: 448-4547, 448-4502
Email: Glenn.Lo@nicholls.edu

Consultation Hours Daily 8:30am-11:45am, 12:45pm-4:30pm, except when I'm in a meeting. If I'm not in my office, look for me in one of the computer labs (Beau 129 or 245B) or in the PChem lab (Beau 132), check with the department secretary in Beau 210.

Meeting time and place TBA (by appointment)

Catalog Description.

CHEM 250. Basic Instrumental Analysis. 3-3-0. Corequisite: CHEM 202. Instrumental methods of analysis including Gas Chromatography, Atomic Absorption Spectrophotometry, High Pressure Liquid Chromatography, UV-visible Spectrophotometry. (40.0502)

CHEM 251. Basic Instrumental Analysis Laboratory. 2-0-6. Corequisite: CHEM 250. Modern instrumental analyses using separation and/or dilution techniques utilizing modern instrumentation. (40.0502)

Prerequisite. CHEM 202.

Textbook No textbook is required. Students are encouraged to refer to their Quantitative Analysis textbook (D.A. Skoog, D.M. West, F.J. Holler & S.R. Crouch. *Analytical Chemistry*, 7th edition. Harcourt Brace College Publishers, Philadelphia, Penn., 1999) as needed.

Supplements Computer-based and video training modules from Academy SAVANT (Sloane Audio-Visuals for Analysis and Training. Atomic Absorption (AA-101 and CAA-10), Gas Chromatography (CGC-10), High Performance Liquid Chromatography (CLC-10), UV-Vis (UV-101). These are available in Beauregard 231.

Course Goal. The goal of this course is to introduce students to the basic concepts involved in the theory and practice of modern instrumental analysis.

Student Outcome Objectives. The student will be able to achieve the following industrial workplace competencies and skills for chemistry-based technicians, which are listed in the Voluntary Industry Standards developed by the American Chemical Society.
(<http://acswebapplications.acs.org/applications/volindstandards/default.html>)

**LT4 PERFORMING INSTRUMENTAL ANALYSIS : 06 MOLECULAR SPECTROSCOPY I -
ULTRAVIOLET-VISIBLE SPECTROSCOPY**

01	Write a description of the principles of UV-Visible spectroscopy, including an explanation as to what makes it useful as an analytical tool.
02	Sketch a simple diagram of a UV-Visible spectrometer. identifying the radiation

	source(s), the monochromator (grating), and the detector(s) used.
03	Identify the ultraviolet (UV) and visible portions of the spectra, using their respective ranges of wavelength..
04	Using Beers's law, solve equations relating concentration to spectral absorbance in the UV and visible ranges.
05	Describe the kinds of compounds that absorb in the UV region of the spectra.
06	List possible areas of error in UV-vis spectroscopy.
07	Demonstrate proper care of cells used for analysis.
08	Carry out several analyses using UV and/or Visible absorption from calibration through final analysis on known materials.
09	Provide examples of uses of ultraviolet-visible (UV-vis) spectroscopy in local industry.

LT4 PERFORMING INSTRUMENTAL ANALYSIS : 12 ATOMIC SPECTROSCOPY III - ATOMIC ABSORPTION

01	Write a description of the principles of atomic absorption (AA) spectroscopy, including an explanation as to what makes it useful as an analytical tool.
02	Identify requirements for calibration and corrections for interference for elemental analysis using AA.
03	Use an AA method to analyze for elements in a mixture, including sample preparation, dilution, calibration, analysis, and calculation of results with accuracy and precision included.
04	Provide examples of at least four applications of AA in local industry.
05	Compare a variety of AA techniques commonly used in industry, including flame, graphite furnaces, and vapor generation.

LT4 PERFORMING INSTRUMENTAL ANALYSIS : 13 CHROMATOGRAPHY I - GAS CHROMATOGRAPHY

01	Write a description of the principles of gas chromatography (GC) as a separation technique, including an explanation as to what makes it useful as an analytical tool.
02	Identify the components of a gas chromatograph.
03	Relate the effects of column length and gas flow rate to separation efficiency.
04	Determine the gas flow rate in a GC system.
05	Demonstrate the set-up of parameters for a recorder, integrator, and/or recording

	computer for the production of reliable, readable, and repetitive chromatograms.
06	Describe, install, use, and maintain a variety of chromatographic columns including packed, capillary, glass, etc., utilizing a variety (polar vs non-polar) of stationary phases.
07	Use a variety of gas chromatographs (including computer controlled) to analyze known and unknown mixtures, setting up all operational parameters, running pertinent calibrations, and carrying out all data analyses.
08	Identify examples of at least six applications of GC in local industries.
09	Identify three major vendors of gas chromatographic instruments.
10	Describe various GC detectors, including thermal conductivity (TCD), flame ionization (FID), and electron capture (ECD) in terms of their use, detection limits, and special characteristics; list advantages and disadvantages.
11	Characterize a variety of injection ports (direct, split-septum, purge & trap, headspace, etc.) and the usefulness of each for gases and liquids.
12	Develop a gradient program to enhance a GC separation.
13	Utilizing measured parameters on chromatograms, identify analytical and/or instrumental "problems".
14	Perform a calibration using "internal standards" and describe the value of the technique.

LT4 PERFORMING INSTRUMENTAL ANALYSIS : 14 CHROMATOGRAPHY II - HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY

01	Write a description of the principles of high-performance liquid chromatography (HPLC) as a separation technique, including an explanation as to what makes it useful as an analytical tool.
02	Identify and characterize components of a high-performance liquid chromatograph.
03	Identify the parameters (temperature, mobile phase flow rate and viscosity, polarity, etc.) of an high-performance liquid chromatograph that might influence the chromatogram.
04	Select appropriate high-purity solvents, based on polarity, and correctly prepare HPLC mobile phases of appropriate "strength" for various separation needs.
05	Use a variety of HPLC's (including computer controlled) to analyze known and unknown mixtures, setting up all operational parameters, performing appropriate calibrations, and and carrying out all data analyses.
06	Provide examples of at least four uses of HPLC as used in local industry.
07	Identify major vendors of HPLC equipment.

08	Demonstrate the integration process for calculating chromatographic peak areas.
09	Describe various HPLC detectors, including diode array, ultraviolet [UV], fluorescence, conductivity, refractive index (RI), and mass spectrometry [MS) in terms of their usage and special characteristics; list advantages and disadvantages.
10	Describe, install, use, and maintain a variety of stationary phase types of HPLC columns. (Normal phase, reverse phase, ion pair, ion exchange, size exclusion, etc.)
11	Develop a gradient program to enhance an HPLC separation.
12	Maximize the performance of an HPLC by adjusting parameters to optimize peak width and resolution and minimize tailing.
13	Utilizing measured parameters on chromatograms, identify analytical and/or instrumental "problems".

Course Content

CHEM 250. Principles of the following instrumental methods: UV-Visible spectrophotometry, Atomic Absorption Spectrophotometry, Gas Chromatography, High Performance Liquid Chromatography.

CHEM 251. Practicum at an industrial analytical laboratory or on campus must include hands-on experience in sample preparation and utilization of the four instrumental methods covered in CHEM 250.

Course Requirements and Methods of Evaluation

CHEM 250

- **Computer and Video-based trainings.** These are available in Beauregard 231. Student must submit a weekly progress report, which shall include an Executive Summary of lessons learned correlated with the VIS standards and a printout of the self-test results. All modules should be completed by mid-semester. (50%)
- **Tests.** Test 1 will cover AA and UV. Test 2 will cover GC and HPLC. (50%)

CHEM 251

- **Reports (50%).** Two written lab reports are required: one for AA and UV, and one for GC and HPLC. A 15-minute PowerPoint presentation based on one of the lab reports must be presented at the end of the semester (Thursday, April 28 at 4:30 pm in Beauregard 237). The lab report should include the following sections: Introduction (brief description of principles and purpose of the analysis), Experimental Procedure (detailed), and Results (description of how data was analyzed and a summary of the results in tables and/or figures).
- **Lab Performance (50%).** At each on- or off-campus site where the student is assigned to work, the student will be graded by the industrial supervisor and/or faculty mentor on the following: job knowledge, quality of work, productivity, adaptability and flexibility, initiative and problem solving, cooperation and teamwork, dependability, and interpersonal skills.

Each category above is graded on a 0-100% scale. Course grades will be assigned according to your average grade as follows: A: 90-100%, B: 80-89%, C: 70-79%, D: 60-69%, F: <60%

Make-up Policy You must have a valid verifiable excuse to make up missed requirements.

Academic Honesty Policy Cheating will not be tolerated and will be dealt with as detailed in the NSU Code of Student conduct.

Attendance Policy Student works independently for CHEM 250; computer-based training logs serves as attendance record. Student must make an appointment to meet with the instructor at least once a week to discuss progress. Student in CHEM 251 must work in on- or off-campus laboratory for at least 72 hours, at times mutually agreed upon by the student and supervisor(s).

Semester Withdrawals. The last day to drop with an automatic grade of W is Thursday, April 7, 2005

Disabilities Policy If you have a documented disability that requires assistance, you will need to register with the Office of Disability Services for coordination of your academic accommodations. The Office of Disability Services is located in Peltier Hall, Room 100-A. The phone number is (985) 448-4430 (TDD 449-7002)

THIS SYLLABUS IS NOT A CONTRACT AND IS SUBJECT TO CHANGE.