Miami Dade College

Course Competencies Template – Form 112

GENERAL INFORMATION	
Course Prefix/Number: CHS 2311C	Course Title: Analytical Chemical Instrumentation
Number of Credits: 4 (2 hour lecture; 4 hour lab)	
Degree Type	☐ B.A. ☐ B.S. ☐ B.A.S ☒ A.A. ☒ A.S. ☐ A.A.S. ☐ C.C.C. ☒ A.T.C. ☐ V.C.C
Date Submitted: 10/12/06	Effective Year/Term: 2007-01
☒ New Course Competency ☐ Revised Course Competency	
Course Description (limit to 50 words or less): An introduction to a variety of chemical instrumentation commonly employed in the chemical and pharmaceutical industries. The course will combine lecture and discussion with laboratory experiences to present the principles of instrumental analysis as well to provide extensive hands-on experience with instrumentation commonly used in the chemical and pharmaceutical industries.	
Prerequisite(s): CHM 2200, CHM 2002L, CHM 2120c, or 2210, 2210L, 2211, 2211L	Corequisite(s): None

Course Competencies: (for further instruction/guidelines go to: http://www.mdc.edu/asa/curriculum.asp)

Competency 1: The student will demonstrate knowledge of the classification and use of chemical instrumentation by:

1. Classifying the various types of analytical methods.
2. Describing instruments used in chemical analyses.
3. Selecting the appropriate instrument for a given chemical analysis.

Competency 2: The student will demonstrate knowledge of the application of electromagnetic radiation to chemical analyses by:

1. Describing the electromagnetic spectrum and the properties of light in each region of the spectrum.
2. Defining the wave properties of light and how they apply to instrumental methods of analysis.
3. Differentiating between diffraction and transmission of radiation.
4. Describing the quantum-mechanical properties of light and their application to atomic and molecular absorption and emission methods.

Competency 3: The student will demonstrate knowledge of various types of electromagnetic instrumentation by:

1. Identifying the various components of optical instruments including: radiation sources; wavelength selectors; sample containers; radiation detectors; and signal processors.
2. Drawing schematic diagrams of the following optical instruments: ultraviolet/visible (UV/VIS) spectrophotometers; spectrofluorometers; spectrophosphorimeters; atomic

Revision Date: 10/13/06

Approved By Academic Dean Date: _____ Reviewed By Director of Academic Programs Date: _____

absorption (AA) spectrophotometers; infrared (IR) spectrophotometers; nuclear magnetic resonance (NMR) spectrometers; and X-ray spectrometers.

3. Describing the application of various optical techniques to qualitative and quantitative analysis.
4. Describing the properties of chemical species that can absorb in the UV/VIS range.
5. Describing the properties of fluorescent and phosphorescent chemical species.
6. Identifying various energy sources for AA spectrophotometry including: flame; plasma; arc; and spark atomizers.
7. Differentiating among the methods and applications of mid-, near-, and far-infrared spectroscopy.
8. Describing the theory of nuclear magnetic resonance.
9. Differentiating between the methods and applications of proton and carbon-13 NMR, and describing the application of NMR to other nuclei.
10. Describing the fundamental principles of X-ray spectroscopy.
11. (OPTIONAL) Describing the application of UV/VIS, NMR, and X-ray spectroscopy to biological samples.

Competency 4: The student will demonstrate knowledge of mass spectrometry by:

1. Describing the theory of mass spectrometric analysis.
2. Defining various types and uses of sample ionization sources including: electron ionization (EI); chemical ionization (CI); fast atom bombardment (FAB); matrix-assisted laser-desorption ionization (MALDI); electrospray ionization (ESI); thermospray ionization; and inductively coupled plasma (ICP) ionization.
3. Describing the quantitative and qualitative applications of mass spectrometry.
4. Drawing schematic diagrams of mass spectrometers.
5. Illustrating the use of mass spectrometry to identify unknown pure compounds.
6. Describing the use of tandem mass spectrometry (MS/MS) to identify components of mixtures.
7. Describing the methods and applications of gas chromatography mass spectrometry (GC/MS) and liquid chromatography mass spectrometry (LC/MS).
8. (OPTIONAL) Describing the application of mass spectrometry for the analysis of biomolecules including nucleic acid and protein sequencing.

Competency 5: The student will demonstrate knowledge of electroanalytical methods by:

1. Describing the theory and applications of potentiometric methods.
2. Describing the theory and applications of coulometric methods.
3. Describing the theory and applications of voltammetry.

Competency 6: The student will demonstrate knowledge of chromatographic methods by:

1. Describing the theory of chromatography.

Revision Date: 10/13/06

Approved By Academic Dean Date: _____ Reviewed By Director of Academic Programs Date: _____

2. Defining factors affecting the efficiency of chromatographic separations including: band broadening; column efficiency; theoretical plates; stationary and mobile phases; column resolution; and retention time.
3. Describing the technique of gas chromatography (GC).
4. Describing the qualitative and quantitative applications of GC.
5. Outlining the components of a GC including: gas supplies; injection systems; columns; column ovens; and detection systems.
6. Describing the technique of high performance liquid chromatography (HPLC).
7. Describing the qualitative and quantitative applications of HPLC.
8. Defining components of HPLC including: mobile phase and mobile phase reservoirs; pumping systems; columns; and detection systems.
9. (OPTIONAL) Describing the use of HPLC for the separation of biological samples.

Competency 7: The student will demonstrate the appropriate use of chemical instrumentation by:

1. Demonstrating appropriate sample preparation and injection techniques for all methods of analysis.
2. Calibrating instruments to accurately perform quantitative analyses.
3. Defining the concept of signal-to-noise ratio and outlining methods to improve signal-to-noise ratios in chemical analyses.
4. Selecting the appropriate instrument for qualitative sample analysis.
5. Selecting the appropriate experimental conditions for sample separation using GC and/or HPLC.
6. Identifying an unknown pure sample using UV/VIS, AA, IR, NMR, and/or X-ray spectroscopy, and/or mass spectrometry.
7. Separating and identifying components of an unknown mixture using GC or LC, or GC/MS, LC/MS, or MS/MS.

Competency 8: The student will demonstrate knowledge of laboratory safety and good laboratory practices by:

1. Identifying and applying standard chemistry laboratory safety procedures.
2. Maintaining a scientific notebook.
3. Turning in required reports and successfully completing laboratory work in a timely fashion.
4. Maintaining instruments in good working order by proper calibration and clean-up techniques.