

# Minnesota State University Moorhead

## CHEM 380: Analytical Chemistry I

### A. COURSE DESCRIPTION

Credits: 4

Lecture Hours/Week: 3

Lab Hours/Week: 3

OJT Hours/Week: \*.\*

Prerequisites:

CHEM 210 - General Chemistry II

Corequisites: None

MnTC Goals: None

Analytical applications of chemical equilibrium. Error analysis, chromatography, IR spectroscopy, UV spectroscopy, fluorescence and phosphorescence spectroscopic techniques in chemical analysis. Lab included.

**B. COURSE EFFECTIVE DATES:** 05/17/2001 - Present

### C. OUTLINE OF MAJOR CONTENT AREAS

1. Analytical Process and Measurements
2. Monoprotic Acid-base Equilibria
3. Acid-Base Titrations
4. Polyprotic Acids and Bases
5. Complexometric EDTA Titrations
6. Oxidation-Reduction Titrations
7. Spectrometry Fundamentals
8. Calibration Methods
9. Spectrometers, IR, UV, Fluorescence
10. Experimental Error
11. Statistical Evaluation of Data
12. Activity and Activity Coefficients
13. Equilibrium Calculations
14. Atomic Spectroscopy
15. Capillary Electrophoresis
16. Gas Chromatography

#### **D. LEARNING OUTCOMES (General)**

1. Appreciate of the unit operations involved from sampling to report generation in a chemical analysis. Express quantities in SI units. Use reaction stoichiometry in analytical calculations. Understand primary and secondary standards and their use. Understand the difference between end point and the equivalence point; titration error and correction of titration errors.
2. Correctly use and interpret significant figures in measurements. Identify nature and types of uncertainty (error) in measurements and the propagation of error. Understand the Gaussian distribution of replicate experimental measurements, expression of confidence intervals in analytical determinations. Use F-test, t- test, Grubs test and calculation of such statistical parameters using spreadsheets. Calculate least square analysis and calibration curves and the use of spreadsheets to calculate them.
3. Perform calculations involving chemical equilibria of monoprotic and multi-protic acid-base equilibria; buffers, chemical species compositions, iso-electric points, iso-ionic points.
4. Perform laboratory analysis using potentiometry, gas and liquid chromatography, IR, UV, fluorescence and atomic spectroscopy for quantification of analytes in solid or in aqueous states as pure form or as mixtures.
5. Perform quantification of acids, bases and metals via acid-base, redox and complexometric titrations. Apply the theory of indicators and principles behind the end point detection visually and by instrumental means. Understand the fundamentals of potentiometry.
6. Perform quantification of analytes using classical direct titrations; acid-base, redox, complexometric titrations and the variations of them such as back titrations. Use various types of visual indicators and sensing devices (instrumental) for equivalence point/end point detection.
7. Understand and use appropriate calibration methods, external calibration plots, standard addition, and internal standard methods.
8. Understand factors controlling the position of chemical equilibrium and its application for quantitative analysis such as solubility, complex formation, redox and acid-base reaction equilibria.
9. Understand selected separation techniques used in analytical chemistry, their underlying theory and utility in chemical analysis, including the principles behind the physical phenomena utilized in the separation and the instrumentation for chromatography (GC, LC).
10. Understand the concept of activity, be able to calculate and understand the utility of activity coefficients. Understand the effect of ionic strength of chemical equilibrium systems, with emphasis on the pH in aqueous systems. Elaborate calculations of equilibrium reaction compositions considering the multiple equilibria with a systematic protocol.
11. Understand the general scientific principles behind the construction of instrumentation of the commonly used spectroscopic techniques; infrared, ultraviolet, fluorescence, phosphorescence and atomic spectroscopy.
12. Use spectroscopic instruments in quantification of analytes via calibration methods; external standard, internal standard and standard addition procedures.
13. Use the proper technique of using common devices such as balances, volumetric glassware in the practice of unit operations such as quantitative transfers and measurements.

#### **E. Minnesota Transfer Curriculum Goal Area(s) and Competencies**

None

#### **F. LEARNER OUTCOMES ASSESSMENT**

As noted on course syllabus

#### **G. SPECIAL INFORMATION**

None noted