

Course Outline for: CHEM 2041 Quantitative Analysis**A. Course Description**

1. Number of credits: 4
2. Lecture hours per week: 3
Lab hours per week: 3
3. Prerequisites: CHEM 1062
4. Corequisites: None
5. MnTC Goals: None

This is a lecture and laboratory course emphasizing the theory and practice of volumetric and instrumental analysis. Lecture 3 credits; 3-hour lab 1 credit.

B. Date last reviewed/updated: March 2023**C. Outline of Major Content Areas**

1. Measurement, error and statistics
2. Calibration
3. Sample collection and sample preparation
4. Applications of equilibrium calculations to complex systems
5. Titrimetric methods of analysis
6. Precipitation titrations
7. Theory of neutralization titrations
8. Titration curves for polyfunctional acids and bases
9. Electrochemistry
10. Oxidation/reduction and complex-formation titration
11. Introduction to spectroscopy
12. Introduction to chromatography

D. Course Learning Outcomes

Upon successful completion of the course, the student will be able to:

1. The student will learn chemical principles of quantitative analysis including (Goal 2a, 2c):
 - a. Stoichiometric relations
 - b. Evaluation of sources of error in analytical measurements
 - c. Principles of collection of statistically valid samples
 - d. Methods of sample preparation
 - e. Equilibrium and equilibrium calculations
 - f. Methods of end-point determination in volumetric analysis
 - g. Calculations associated with titrations
 - h. Precipitations, neutralization, and oxidation-reduction titrations
 - i. Electrochemistry
 - j. Fundamentals of spectroscopic measurements

2. The student will learn laboratory skills including:
 - a. Use of the analytical balance
 - b. Use of pipet and buret
 - c. Keeping of a laboratory notebook
3. The student will learn laboratory methods involved in typical volumetric, and instrumental analysis.
4. The student will carry out accurate quantitative analysis of unknown samples.
5. The student will evaluate data obtained from quantitative analysis and will report the percentage of the substance analyzed for in each sample.
6. The student will learn how to write both short and long formal lab reports.

E. Methods for Assessing Student Learning

Methods for assessment may include, but are not limited to, the following:

1. Exams (commonly, four 1-hour exams)
2. Quizzes and homework problems
3. Laboratory determinations, laboratory notebook, laboratory reports.
4. Project-based labs to allow the analysis of real-world samples with appropriate sample collection, and purification methods, which may include:
 - a. Calibration of volumetric glassware
 - b. Statistical analysis of laboratory data with spreadsheets
 - c. Spectrophotometric determination with calibration curves
 - d. Titrations using a pH electrodes, first and second derivative curves and Gran plots. (2 WEEKS)
 - e. Precipitation titrations (2 WEEKS)
 - f. Electrochemical analysis (2 WEEKS)
 - g. Spectrophotometric analysis using complexing agents (2 WEEKS)
 - h. Determination of calcium by atomic absorption spectroscopy
 - i. Chromatography experiment
5. Comprehensive final exam
6. Opportunities for field trips to local industrial analytical labs.

F. Special Information

None