

College of San Mateo
Official Course Outline

1. **COURSE ID:** CHEM 250 **TITLE:** Analytical Chemistry Quantitative Analysis
Semester Units/Hours: 5.0 units; a minimum of 48.0 lecture hours/semester; a minimum of 96.0 lab hours/semester
Method of Grading: Letter Grade Only
Prerequisite: CHEM 220

2. **COURSE DESIGNATION:**
Degree Credit
Transfer credit: CSU; UC
AA/AS Degree Requirements:
CSM - GENERAL EDUCATION REQUIREMENTS: E5a. Natural Science
CSU GE:
CSU GE Area B: SCIENTIFIC INQUIRY AND QUANTITATIVE REASONING: B1 - Physical Science
CSU GE Area B: SCIENTIFIC INQUIRY AND QUANTITATIVE REASONING: B3 - Laboratory Activity
IGETC:
IGETC Area 5: PHYSICAL AND BIOLOGICAL SCIENCES: A: Physical Science
IGETC Area 5: PHYSICAL AND BIOLOGICAL SCIENCES: C: Science Laboratory

3. **COURSE DESCRIPTIONS:**
Catalog Description:
This course builds upon a basic understanding of chemical equilibrium, acids and bases, buffers and electrochemistry. Topics include theory, calculations and practice of common analytical procedures - gravimetric and volumetric methods; colorimetric, potentiometric and other instrumental procedures. These topics are covered in Chem 220, the second semester of general chemistry. Extra supplies may be required.

4. **STUDENT LEARNING OUTCOME(S) (SLO'S):**
Upon successful completion of this course, a student will meet the following outcomes:
 - A. Choose the appropriate data analysis required including absolute error, per cent error, propagation of error, standard deviation, confidence limits, Q test and t test.
 - B. Determine the correct sample preparation technique.
 - C. From the techniques discussed in this course, identify the most appropriate analytical technique to use for a variety of samples.
 - D. Prepare standards and use a standard calibration curve to determine unknown concentrations.
 - E. Maintain a laboratory notebook.
 - F. Write formal lab reports including the procedure used, data tables, the calculations used to determine the results of the experiment, a statistical analysis of the data when appropriate, a discussion of possible systematic errors and the effect of each error on the final results.

5. **SPECIFIC INSTRUCTIONAL OBJECTIVES:**
Upon successful completion of this course, a student will be able to:
 - A. The student will write formal lab reports including the procedure used, data tables, the calculations used to determine the results of the experiment, a statistical analysis of the data when appropriate, a discussion of possible systematic errors and the effect of each error on the final results.
 - B. Extend student's knowledge of the chemical analysis of unknown samples.
 - C. Upon successful completion of this course the student will have a better understanding of analyses necessary for the determination of the desired analyte concentration in an unknown sample. This includes the determining the correct sample preparation technique, the most appropriate analytical technique to use, the preparation and use of standards for a variety of samples.
 - D. Understanding of the interpretation of data collected. Upon successful completion of this course the student will be able to choose the appropriate data analysis required including absolute error, percent error, propagation of error, standard deviation, confidence limits, t test and Q test.
 - E. The student will research an analytical technique on the internet and present a poster on the technique to the class.
 - F. The student will maintain a laboratory notebook.
 - G. Prepare standards and use a calibration curve to determine unknown concentrations.

H. Chemical analysis and instrumental techniques covered include gravimetric analysis, volumetric analysis: acid base titration and complex ion formation titration; chromatography: ion exchange chromatography, high performance liquid chromatography and gas chromatography; use of a pH meter, use a visible spectrophotometer, use of an atomic absorption spectrometer.

6. COURSE CONTENT:

Lecture Content:

Lecture topics covered: Introduction, Errors in chemical analyses, Random errors in analyses, Applications of statistics to data treatment and evaluation, Gravimetric methods of analysis, Titrimetric methods of analysis, Aqueous-solution chemistry, Effects of electrolytes on ionic equilibria, Theory of neutralization reactions, Titration curves for complex acid/base systems, Complex-formation titrations, An introduction to electrochemistry, Theory of potentiometry, An introduction to spectrochemical methods, Instruments for optical spectroscopy, Molecular absorption spectroscopy, Atomic spectroscopy based on ultraviolet and visible radiation, An introduction to chromatographic methods, Gas-liquid chromatography, GCMS.

Lab Content:

Possible labs covered; Lab safety, Lab notebooks, Scientific method lab, Calibration of glassware, Statistical analyses of data using pennies, Propagation of error using glass beads, Gravimetric analysis of an unknown chloride, Soda ash titration, EDTA titration of several different water samples, Investigation of the operation of the pH meter, Determination of the pH of hair products, $[\text{Fe}^{3+}]$ determination using a spectrophotometer, $[\text{Cr}^{3+}]$ and $[\text{Mn}^{2+}]$ mixture determinations using a spectrophotometer, Zinc in hair determination using Atomic Absorption, Ion exchange chromatography, Gas chromatography, GCMS

7. REPRESENTATIVE METHODS OF INSTRUCTION:

Typical methods of instruction may include:

- A. Lecture
- B. Lab
- C. Other (Specify): Lecture, lab, exams, content checks, poster presentation. If possible, we will go on a field trip to a nearby analytical lab.

8. REPRESENTATIVE ASSIGNMENTS

Representative assignments in this course may include, but are not limited to the following:

Writing Assignments:

Three in class exams. Comprehensive final exam. Seven to ten content checks. Ten to fifteen lab reports. Ten to fifteen class questions. Poster presentation. Homework assignment for each chapter covered in the textbook.

Reading Assignments:

Read all of the chapters covered in the textbook.
Read all of the lab procedures before coming to lab.

Other Outside Assignments:

Research information for the poster presentation

9. REPRESENTATIVE METHODS OF EVALUATION

Representative methods of evaluation may include:

- A. Exams/Tests
- B. Lab Activities
- C. Quizzes
- D. There are three in class exams and a comprehensive final exam. There are content checks which are short take home quizzes. There are class questions. There are lab reports. There is a lab notebook. There is a poster presentation.

10. REPRESENTATIVE TEXT(S):

Possible textbooks include:

- A. Harris, D. *Quantitative Chemical Analysis*, 8th ed. New York: W. H. Freeman and Company, 2010
- B. Holler, F., J., Crouch, S., *Fundamentals of Analytical Chemistry*, 9th ed. Belmont, California: Brooks/ Cole, 2014

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Course Originator: Charlotte Deline

