San Bernardino Valley College
Board of Trustees: 06/20/2019
Curriculum Approval: 05/13/2019
TOP Code: 1905.00 - Chemistry, General
Chancellors Office Approval: 11/08/2019
C-ID: N/A
Effective Date: Fall 2020
Course Identification Number: CCC000426228

## I. CATALOG DESCRIPTION:

A. Department Information:
Division: Science
Department: Chemistry
Course ID: CHEM 205
Course Title: Quantitative Chemical Analysis

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|---|---|
| Units: | 5 |
| Lecture: | 3 contact hour(s) per week<br>48 - 54 contact hours per semester |
| Laboratory: | 6 contact hour(s) per week<br>96 - 108 contact hours per semester |
| Expected Outside of Class Hours: | 6 hour(s) per week |

Prerequisite:
CHEM 151

B. Catalog Description:

This course explores the principles, calculations, and applications of volumetric, gravimetric, and instrumental analysis as well as provides practical experience in standardizing reagents and determining the composition of various mixtures pertaining to the chemical laboratory setting. It is designed for second year Chemistry and Biology majors and students pursuing professional careers.

C. Schedule Description:

This course explores the principles, calculations, and applications of Analytical Chemistry. It is designed for second year Chemistry and Biology majors and students pursuing professional careers.

## II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: 1

## III. STUDENT LEARNING OUTCOMES:

A. Students will employ theories of acid-base chemistry, solubility, and equilibria in order to calculate concentrations of compounds or ions in solution
B. Students will demonstrate laboratory proficiency in quantitative analysis by performing

experiments such as titrimetry, gravimetry, electrochemistry, and chromatography
C. Students will analyze or predict the results of quantitative measurements using graphical, statistical, and other mathematical approaches

**IV. COURSE OBJECTIVES FOR STUDENTS:**
**Upon successful completion of the course the student should be able to:**

A. Analyze statistical data
B. Deduce methods for solving advanced chemical calculations
C. Write clear, concise summaries of experimental results and describe the theories and mechanisms for observed phenomena in the laboratory
D. Apply principles of analytical chemistry to actual laboratory conditions
E. Distinguish between various analytical laboratory techniques
F. Conduct laboratory experiments using modern instrumentation (e.g., chromatography, spectroscopy) to quantitatively analyze unknown samples

**V. COURSE CONTENT:**

**LECTURE**

A. Calibration methods/graphing
    1. External standardization
    2. Internal standard
    3. Standard addition
B. Experimental error
    1. Significant figures and precision
    2. Types of errors
    3. Propagation of uncertainty
    4. Gaussian distribution
C. Statistics in chemistry
    1. Mean
    2. Standard deviation and relative standard deviation
    3. Confidence intervals
    4. Grubbs or Q test
D. Stoichiometric and equilibrium calculations
    1. Complex formation
    2. Ionic strength and activity coefficients
    3. Acid base equilibrium
    4. Solubility dependence on pH
E. Gravimetric analysis
    1. Precipitation processes
    2. Filtration
    3. Purity and product composition
F. Acid base titrimetry
    1. Neutralizations
    2. Buffers
    3. Polyprotic systems
    4. Fractional composition equations and plots
G. Electrochemistry
    1. Galvanic cells
    2. Standard and cell potentials
    3. Nernst equation
    4. Electrodes
        a. Reference electrodes

   b. Indicator electrodes
   c. Ion-Selective electrodes
H. Electroanalytical methods
   1. Potentiometry
   2. Coulometric analysis
   3. Voltammetry
   4. Redox titrations
I. Spectroscopy
   1. Properties of light
   2. Absorption of light
   3. Spectrophotometers (UV, Vis, IR)
   4. Molecular spectroscopy
   5. Atomic spectroscopy
J. Analytical separations
   1. Gas chromatography
   2. Liquid chromatography
   3. Ion-Exchange chromatography

**LABORATORY**

A. The Laboratory notebook
B. Data analysis using spreadsheets
C. Calibration methods
   1. External standardization
   2. Internal standard
   3. Standard addition
D. Volumetric glassware
E. Gravimetric determination
F. Preparing standard acid and base solutions
G. Analysis of mixtures
H. Acid-Base titration
I. Redox titration
J. Potentiometric determinations using pH and/or ion-selective electrodes
K. Spectrophotometric determinations
L. Gas chromatography (GC)
M. Gas chromatography-mass spectrometry (GC-MS)
N. High-performance liquid chromatography (HPLC)

## VI. METHODS OF INSTRUCTION (May include any, but do not require all, of the following):

A. Lecture
B. Guest speakers
C. Class and/or small group discussion
D. Use of written materials: texts, journals, etc.
E. Classroom demonstrations
F. Field trips
G. Guided practice
H. Laboratory
I. Instructor generated handouts

## VII. TYPICAL OUT-OF-CLASS ASSIGNMENTS:

A. Reading assignments are required and may include (but are not limited to) the following:

   Read the chapter on gravimetry, and be prepared to discuss in class the experimental conditions leading to a high-quality precipitate.

B. Writing assignments are required and may include (but are not limited to) the following:

   Use your laboratory notebook to complete a formal five-page laboratory report for the experiment titled "Determination of Water Hardness using EDTA Titration." Be sure your report includes your tabulated data, calculations, detailed conclusions that interpret your data and an analysis of potential sources of error in the experiment and how those errors may have effected your results.

C. Critical thinking assignments are required and may include (but are not limited to) the following:

   Analyze experimental data using spreadsheets for calculations and/or graphing, to determine the concentration of the analyte in the unknown sample. Report the mean, standard deviation, relative standard deviation, and 95% confidence interval. Discuss the qualitative and quantitative aspects of errors in this experiment.

## VIII. METHODS OF EVALUATION

A. Examinations
B. Homework
C. Lab work
D. Presentations (oral or visual)
E. Projects
F. Written papers or reports
G. Quizzes
H. Cumulative finals or certifications

## IX. TYPICAL TEXT(S):

A. Christian, Gary D. Analytical Chemistry. 7th ed. Wiley, 2014.
B. Harris, Daniel C. Quantitative Chemical Analysis. 9th ed. McMillan, 2016.
C. Skoog, Douglas A., Donald M. West, et al. Fundamentals of Analytical Chemistry. 9th ed. Brooks Cole, 2014.

## X. OTHER SUPPLIES REQUIRED OF STUDENTS:

A. USB Flash Drive
B. Non-graphing, non-programmable scientific calculator with scientific notation and logarithms
C. Closed-foot shoes
D. Goggles
E. Lab Coat