DeAnza College

Credit- Degree applicable
Effective Quarter: Fall 2014

I. Catalog Information

CHEM 1C General Chemistry and Qualitative Analysis 5 Unit(s)

(See general education pages for the requirement this course meets.)

Prerequisite: Chemistry 1B with a grade of C or better.

Advisory: English Writing 211 and Reading 211 (or Language Arts 211), or English as a Second Language 272 and 273.

Three hours lecture, six hours laboratory (108 hours total per quarter).

This is the third and final quarter in the year long General Chemistry sequence. In this class, advanced equilibrium concepts pertaining to solubility and buffers will be discussed. This will be followed with an introduction to electrochemistry, the chemistry of transition metals, and nuclear chemistry.

Student Learning Outcome Statements (SLO)

Apply the principles of equilibrium and thermodynamics to electrochemical systems.

Apply the principles of transition metail chemistry to predict outcomes of chemical reactions and physical properties.

Evaluate isotopic decay pathways.

II. Course Objectives

A. Examine advanced concepts in equilibrium pertaining to buffers and solubility.

B. Investigate the behavior and characteristics of solutions

C. Explore transition metal chemistry.

D. Investigate nuclear chemistry.

E. Apply fundamental principles of equilibrium to electrochemical systems.

III. Essential Student Materials

Safety goggles

IV. Essential College Facilities

Fully equipped chemical laboratory including, at a minimum, the following: consumable chemicals, chemical balances, glassware, molecular models, melting point apparatus, spectrophotometers, computer-controlled Fourier transform infrared spectrometer, fume hoods, chemical disposal facilities, lockable student storage areas, and laboratory technician.

V. Expanded Description: Content and Form

A. Examine advanced concepts in equilibrium pertaining to buffers and solubility.

1. Common ion effect

2. Buffers

a. pH of a buffer

b. Buffers in titration: weak acid/strong base and strong acid/weak base

3. Solubility

a. Precipitation

b. Solubility product constant

B. Investigate the behavior and characteristics of solutions

1. Expressions of solution concentration

a. Mass percent

b. Mole fraction

c. Molarity

d. Molality

2. Thermodynamics of solution formation

a. Enthalpy of solution

b. Enthalpy of hydration

3. Temperature and pressure effects on solubility

4. Colligative properties

a. Boiling point elevation

b. Freezing point depression

c. Osmotic pressure

d. Raoult's law

e. Vapor pressure

C. Explore transition metal chemistry.

1. Properties of transition metals

a. Review of electron configuration

- **b.** Review of oxidation states
- **c.** Atomic radii
- **d.** Physical properties

2. Coordination complexes

- **a.** Chelation
- **b.** Ligands
  - **1.** Monodentate ligands
  - **2.** Polydentate ligands
  - **3.** Common inorganic ligands
  - **4.** Common organic ligands

3. Isomerization

- **a.** Structural isomerization
- **b.** Stereoisomerization
- **c.** Geometric isomerization
- **d.** Optical activity
- **e.** Resolution of enantiomers

4. Bonding

- **a.** Review of molecular orbital theory
- **b.** Crystal field theory
- **c.** High-spin versus low-spin
- **d.** Magnetic properties
- **e.** Spectrochemical series

D. Investigate nuclear chemistry.

1. Structure of nucleus

- **a.** Review of isotopes
- **b.** Review of mass number and atomic number

2. Forms of radiation

- **a.** alpha
- **b.** beta
- **c.** gamma

3. Radioactive decay

- **a.** Mechanisms of decay
- **b.** Half-life calculations

4. Nuclear stability
    a. Proton/neutron ratio
    b. "Zone of stability"
    c. Binding energy
5. Radiochemical dating

E. Apply fundamental principles of equilibrium to electrochemical systems.
1. Oxidation-reduction reactions
    a. Oxidation states
    b. Oxidizing and reducing agents.
    c. Balancing red-ox reactions by the half-reaction method
2. Electrochemical cells
    a. Electrodes
    b. Salt bridges
    c. Half cells
3. Electrochemical potential
    a. Cell potential
    b. Standard hydrogen electrode
    c. Standard and non-standard cell potential
    d. Nernst equation
    e. Relationship between free energy and cell potential under standard and non-standard conditions
4. Concentration cells
5. Electrolysis
6. Corrosion

VI. Assignments

A. Reading
1. Required readings from the textbook in preparation for the scheduled lecture. This may include entire chapters or sections from the chapters covering topics included in this outline.
2. Required readings from the laboratory manual as a preparation for the scheduled experiment in order to provide students with familiarity about the specific laboratory protocols and related safety precautions necessary for successful completion of the experiment.

B. Writing
1. Homework assignments based on classroom discussion/lecture may include answering questions from end-of-chapter exercises or other sources as deemed appropriate by the

instructor.

2. Periodic quizzes and mid-term examinations based on material discussed in lectures and/or reading assignments

C. Laboratory assignment

1. Pre-lab exercise: The pre-lab assignment for the scheduled laboratory experiment to be completed prior to beginning of each new experiment. This assignment may be identical to that provided in the laboratory manual or substituted with other appropriate assignments determined by the instructor.
2. Report: Data obtained in laboratory exercises are to be entered in the assigned laboratory manual or a laboratory notebook. Necessary calculations required to obtain the final results from the experiment must be completed in the manual or the notebook as to be determined by the instructor. Detailed lab reports incorporating results and discussions from the experiment will be required.

VII. Methods of Instruction

Lecture and visual aids
Discussion of assigned reading
Discussion and problem solving performed in class
Quiz and examination review performed in class
Homework and extended projects
Collaborative learning and small group exercises
Laboratory experience which involve students in formal exercises of data collection and analysis
Laboratory discussion sessions and quizzes that evaluate the proceedings weekly laboratory exercises

VIII. Methods of Evaluating Objectives

A. Homework assignments based on end-of-chapter problems from the primary text will be evaluated for completion to test comprehension of lectures.

B. Periodic quizzes will be used to test the comprehension of topics covered during the lecture and will be evaluated for accuracy of responses.

C. A minimum of two mid-term examinations will be used to evaluate the ability of students to a) solve problems, b) outline various concepts covered in the lecture, and c) demonstrate an understanding of reading assignments. These will be evaluated for accuracy to assess student progress in achieving various learning outcomes.

D. A comprehensive final examination in any chosen format (multiple choice questions or free response) will be based on all the course material covered during the entire quarter and evaluated for accuracy of responses.

E. Pre-lab assignments will be evaluated for completeness and level of preparedness required for safe and timely execution of laboratory protocols and experiments.

F. Report sheets and/or laboratory reports will be evaluated for successful completion of laboratory experiments as well as accuracy of data analysis and interpretation.

G. A comprehensive laboratory examination or periodic quizzes will be used to evaluate the student understanding of the various concepts discussed in the different experiments performed during the course. Concepts evaluated will include: a) general laboratory protocol b)

comprehension of data analysis and interpretation and c) critical thinking as it pertains to the scientific method.

IX. Texts and Supporting References

A. Examples of Primary Texts and References

1. Silberberg, M.L., Chemistry: The Molecular Nature of Matter and Change, 6th edition, ISBN: 0073402656, Year: 2012
2. Szafran, Zvi et al. Microscale General Chemistry Laboratory. De Anza Edition. New York: John Wiley, 2005. ISBN 0-471-77762-5

B. Examples of Supporting Texts and References

1. Kotz, John et al. Study Guide for Kotz/Treichel/Weaver's Chemistry and Chemical Reactivity, 6th edition. Brooks/Cole, 2006. ISBN 0-534-99851-8
2. Silberberg, M.L., Student Solutions Manual for Silberberg Chemistry: The Molecular Nature of Matter and Change, ISBN: 0077340213, Year: 2012

X. Lab Topics

A. Laboratory methodology

1. Maintaining a laboratory notebook
2. Writing laboratory reports

B. Chemical safety

1. Materials safety data sheets (MSDS)
2. Chemical disposal
   a. Separation of waste streams
   b. Proper disposal methods
   c. Environmental hazards of improper waste disposal
3. Laboratory environment
   a. Maintaining laboratory cleanliness
   b. Chemical labeling
   c. Segregation of chemicals by hazard
   d. Secondary containment
4. Personal safety
   a. Safety goggles
   b. Limiting chemical exposure
   c. Safety shower
   d. Eyewash stations
   e. Proper use of fire extinguishers

5. Emergency situations
    a. Fires
    b. Earthquakes
    c. Evacuation procedures

C. Transition metal complexes
1. Complexometry
    a. Calculation of ion concentration through complexometric titration
    b. Standardization of a complexometric titrant
2. Synthesis and isomerization of a transition metal complex
3. Assessment of metal complex geometry through infrared spectroscopy

D. Qualitative analysis
1. Separation and identification of cations by solubility properties
2. Identification of cations and anions through qualitative chemical reactions

E. Electrochemical cells

F. Buffers and solubility equilibrium