College of San Mateo
Official Course Outline

1. **COURSE ID:** CHEM 220 **TITLE:** General Chemistry II **C-ID:** CHEM 120S (CHEM 210 & CHEM 220)
   Units: 5.0 units **Hours/Semester:** 48.0-54.0 Lecture hours; 96.0-108.0 Lab hours; and 96.0-108.0 Homework hours
   Method of Grading: Letter Grade Only
   Prerequisite: CHEM 210

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 is the second semester of a two-semester sequence class in general chemistry intended for students pursuing physical sciences, biological sciences, engineering and pre-professional majors. It includes a study of chemical kinetics, chemical equilibria, acid-base chemistry, chemical thermodynamics, electrochemistry, coordination chemistry and nuclear chemistry with an emphasis on critical thinking and problem solving skills. This course also includes laboratory study of these concepts, experimental techniques and the analysis and interpretation of experimental findings. A materials fee as shown in the Schedule of Classes is payable upon registration.

4. **STUDENT LEARNING OUTCOME(S) (SLO'S):**
   Upon successful completion of this course, a student will meet the following outcomes:
   1. Demonstrate an understanding of the basic principles of chemical reactions and reaction processes through explanations and appropriate calculations.
   2. Demonstrate an understanding of the energy associated with chemical reactions through explanations and appropriate calculations.
   3. Demonstrate a basic knowledge of atomic and molecular stability and the formation of various stable products through explanations and appropriate calculations.

5. **SPECIFIC INSTRUCTIONAL OBJECTIVES:**
   Upon successful completion of this course, a student will be able to:
   1. Demonstrate understanding and perform the basic principles of chemical reactions and perform appropriate calculations for reaction processes.
   2. Appreciate and where appropriate calculate the energy associated with chemical reactions.
   3. Demonstrate a basic knowledge of atomic stability and chemical behavior in chemical reaction processes.

6. **COURSE CONTENT:**
   Lecture Content:
   1. A. Kinetics. Develop an understanding of reaction rates and factors affecting reaction rates. Study rate constants and the rates of zero, first and second order reactions. Graphing and calculations of various reaction orders. Catalysts and their affect on reaction rates and activation energy. Presentation of typical reaction mechanisms and their connection to the reaction rate law.
   2. Chemical Equilibrium. Understanding of the equilibrium constants for gas and liquid reactions. Le Chatelier's principle and the concept of shifting equilibrium by changes in concentrations, pressure, and temperature. Relationships between Gibb's Free energy and the equilibrium constant. Study solubility equilibria and solubility product constant calculations. Calculations involving the common ion effect.

3. Acids and Bases. Understanding Kw and simple acid base theories such as Arrhenius, BronstedLowry and Lewis theories. Practice setup of acid base equilibium expressions and calculations involving weak acids and bases, common ions (buffers), and hydrolysis of salts in solution. Study of various acid base reactions, titrations, titration curves and acid-base indicators.
4. Thermodynamics. Understanding of the basic laws of thermodynamics. Concepts of free energy, entropy, and reaction spontaneity. Calculations of entropy for phase changes. Calculations to show the realationships between free energy, enthalpy and entropy.
5. Redox Reactions and Electrochemistry. Understanding basic redox principles such as oxidizing and reducing agents, oxidation numbers, and equation balancing using half reactions. Voltaic cells and chemical thermodynamics. Relationships between cell potentials, free energy and equilibrium constants. Nemst equation calculations for non-standard cell conditions. Electrolytic cells and electroplating applications. Examples of industrial uses of electrochemical cells. Chemical explanation of corrosion and the environmental impact of various electrochemical reactions.
6. Chemistry of Transition metals and coordination compounds. Understanding basic concepts such as complex ions, ligands, chelating agents and coordination numbers. Valence bond and ligand field theories of coordination compounds. Study the naming, magnetism and color in coordination compounds.
7. Nuclear Chemistry. Understanding the basic types of radiation and radioactive processes. Practice calculations with half-life and decay rates. Learning to balance nuclear equations with fundamental nuclear particles. Comparison of fission and fusion processes. Applications of radioactive materials and typical uses of radioactive processes.

Lab Content:

1. Analysis of data: errors, accuracy and precision
2. Acids and Bases: an introduction to pH
3. Analysis of sea water: ion exchange column chromatography
4. Rates of chemical reactions
5. Le Chatelier's Principle
6. Paper chromatography
7. Determination of an equilibrium constant
8. pH titration curves and the determination of the Ka of a weak acid
9. Hydrolysis
10. Buffers
11. Ksp
12. Qualitative analysis
13. Energy versus entropy
14. Oxidation reduction
15. Nernst equation
16. Electrochemical cells
17. Analysis of a coordination compound
18. Poster presentation

7. **REPRESENTATIVE METHODS OF INSTRUCTION:**

Typical methods of instruction may include:

A. Lecture
B. Lab
C. Other (Specify): Lecture style presentation of material. Video programs and computer programs. A minimum of two in class exams and a comprehensive final. Six hours of laboratory per week. Group work on problems in lecture and experimental procedures in lab. Short quizzes in lecture and in lab. Homework assignments from the chapter questions and/ or handouts. Design a lab procedure and check to see if it works.

8. **REPRESENTATIVE ASSIGNMENTS**

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

Writing Assignments:

Homework assignments from the chapter questions and/or handouts.
Content checks.
Formal lab reports.
Class questions.
In class exams and final exam.

Reading Assignments:

Research material for the poster presentation.

Read chapters in the textbook.
Read handouts.
Read articles from journals.

Other Outside Assignments:

View youtube videos and either answering questions or writing a summary of the video.
Use LearnSmart to check on comprehension of material covered in class.

9. **REPRESENTATIVE METHODS OF EVALUATION**

Representative methods of evaluation may include:

A. Exams/Tests
B. Final Performance
C. Homework
D. Lab Activities
E. Quizzes
F. A minimum of two in class exams and a comprehensive final exam. Short quizzes in lecture and in lab. Laboratory experiment reports. Homework assignments from the chapter questions and/ or handouts.

10. **REPRESENTATIVE TEXT(S):**

Possible textbooks include:

A. Silberberg, M.. *Principles of General Chemistry*, 3rd ed. Mc Graw-Hill, 2013
B. Tro.. *Principles of Chemistry*, ed. -, 2010

Other:

A. Chem 220 lab manual Spring 2010

Origination Date: September 2020
Curriculum Committee Approval Date: October 2020
Effective Term: Fall 2021
Course Originator: John Dao