



5. **Class Schedule Description** (Include prerequisites/corequisites/recommended preparation. For format, please see model course outline.)  
 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. Prerequisite: Completion of CHEM 210 with a grade of C or higher or equivalent. Plus 16 hours by arrangement per term. Extra supplies may be required. A \$ ---- materials fee is payable upon registration. (AA: Area E5a, CSU: Area B1/ Area B3, UC: Area 5A)
6. **Student Learning Outcomes** (Identify 1-6 expected learner outcomes using active verbs.)  
 Upon successful completion of the course, the 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.
7. **Course Objectives** (Identify specific teaching objectives detailing course content and activities. For some courses, the course objectives will be the same as the student learning outcomes. In this case, "Same as Student Learning Outcomes" is appropriate here.)  
 Same as Student Learning Outcomes.
8. **Course Content** (Brief but complete topical outline of the course that includes major subject areas [1-2 pages]. Should reflect all course objectives listed above. In addition, a sample course syllabus with timeline may be attached.)
- 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.
- B. 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.
- C. Acids and Bases. Understanding  $K_w$  and simple acid base theories such as Arrhenius, Bronsted-Lowry and Lewis theories. Practice setup of acid base equilibrium 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.
- D. 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 relationships between free energy, enthalpy and entropy.
- E. 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. Nernst 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.

- F. 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.
- G. 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.

9. **Representative Instructional Methods** (Describe instructor-initiated teaching strategies that will assist students in meeting course objectives. Describe out-of-class assignments, required reading and writing assignments, and methods for teaching critical thinking skills. **If hours by arrangement are required, please indicate the additional instructional activity which will be provided during these hours, where the activity will take place, and how the activity will be supervised.**)

Some but not necessarily all of the following methods are employed when teaching this course to assist the students in achieving the course objectives.

Lecture style presentation of material.

Video programs and computer programs.

Games to challenge the student's comprehension of the material.

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.

Chemistry 220 Hours by Arrangement

Each student will be required to complete an additional 16 hours by arrangement. Assignments will be given and collected that will add up to a total 16 hours. These assignments will consist of one of the following depending on the lecture material being covered and may be completed at the Integrated Science Center or during an instructors' office hours.

Watching a video and turning in your notes on the video or answering questions about the video.

Researching a topic on the internet and turning in your results.

Completing and turning in a handout with additional practice problems.

Completing a Mastering Chemistry assignment online.

10. **Representative Methods of Evaluation** (Describe measurement of student progress toward course objectives. Courses with required writing component and/or problem-solving emphasis must reflect critical thinking component. If skills class, then applied skills.)

Some but not necessarily all of the following methods are employed when teaching this course to assist the students in achieving the course objectives.

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.

11. **Representative Text Materials** (With few exceptions, texts need to be current. Include publication dates.)

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