COURSE SYLLABUS

LAST REVIEW	Fall 2022
COURSE TITLE	College Chemistry II and Lab
COURSE NUMBER	CHEM0112
DIVISION	Math, Science, and Business Technology
DEPARTMENT	Chemistry
CIP CODE	24.0101
CREDIT HOURS	5
CONTACT HOURS/WEEK	Class: 3 Lab: 4
PREREQUISITES	CHEM0111, College Chemistry I and Lab
COURSE PLACEMENT	Students must meet the correct placement measure for this course. Information may be found at: https://www.kckcc.edu/admissions/information/mandatory-evaluation-placement.html

COURSE DESCRIPTION
College Chemistry II is a continuation of College Chemistry I. It is designed for the student who needs more than five credit hours in chemistry or is going to take advanced chemistry courses or pre-professional programs, such as pre-med and pre-dentistry. Normally, in Chemistry II, the topics covered are chemical thermodynamics, chemical kinetics, chemical equilibrium, electrochemistry, nuclear chemistry, descriptive chemistry, introductory organic chemistry, and other topics if time permits.

KANSAS SYSTEMWIDE TRANSFER: CHM1020/1021/1022
The learning outcomes and competencies detailed in this course outline or syllabus meet or exceed the learning outcomes and competencies specified by the Kansas Core Outcomes Groups project for this course as approved by the Kansas Board of Regents.

TEXTBOOKS
http://kckccbookstore.com/

METHODS OF INSTRUCTION
A variety of instructional methods may be used depending on content area. These include but are not limited to: lecture, multimedia, cooperative/collaborative learning, labs and demonstrations, projects and presentations, speeches, debates, panels,

conferencing, performances, and learning experiences outside the classroom. Methodology will be selected to best meet student needs.

COURSE OUTLINE

I. Colligative Properties
   A. Describe the origins and relative magnitudes of intermolecular forces, including how it relates to phase behavior
   B. Define solution terms
   C. Understand and perform calculations using Henry's Law and Raoult's Law
   D. Calculate concentrations in molality, molarity, mole fraction, and percent composition as well as interconvert between these units.
   E. Explain colligative properties and perform calculations using these properties.
   F. Differentiate between the behaviors of ionizing and non-ionizing compounds in solution.

II. Kinetics
   A. Discuss the meaning of the rate of a reaction and explain the factors that affect reaction rates.
   B. Determine reaction order and determine a reaction rate law from experimental data.
   C. Determine reaction orders for reactants with changing concentrations.
   D. Use the rate law to determine the overall order of a reaction.
   E. Describe the relationship between order of reaction and molecularity.
   F. Use an integrated form of the rate expression to perform calculations relating reactant or product concentration with reaction time.
   G. Compare zero, first, and second order rate reactions.
   H. Discuss the collision theory of a reaction rate.
   I. Use the Arrhenius equation to illustrate the relationship between energy of activation and rate law constants.
   J. Describe the relationships among the mechanism, the overall reaction, and the elementary steps.
   K. Identify reaction intermediates and catalysts in the reaction mechanism.
   L. Draw and interpret energy diagrams and illustrate the effect of a catalyst on the energy diagram.

III. Equilibrium Principles
   A. Explain the relationship between the terms reversible reaction and dynamic equilibrium.
   B. Write the general equilibrium constant expression and explain its significance.
   C. Calculate Keq given equilibrium concentrations of reactants and products.
   D. Calculate equilibrium constants of reactants and products given the equilibrium concentration of other reactants and products.
   E. Calculate new equilibrium concentrations of reactants and products after an increase or decrease in the concentration of one of the reactants or products.
   F. Explain why the concentrations of pure liquids and solids are never used in equilibrium constant expressions.

G. Show how the numerical value of the equilibrium constant changes when the stoichiometric coefficients are changed or the reaction is reversed.
H. Explain the differences between the terms Kc and Kp and the relation of either to Qc.
I. Explain the difference between an equilibrium position and an equilibrium constant.
J. Given Keq and initial concentration of reactants and/or products, calculate the final concentrations of reactants and/or products.
K. List and explain the external factors that can affect equilibria.
L. Using LaChatelier's Principle, explain how changes in temperature, pressure, volume, or concentration affect the equilibrium position for a chemical reaction.

IV. Equilibrium of Aqueous Solutions
A. Use the definition of acids and bases to distinguish between strong and weak acids and bases, equilibrium relationships among them, and the aqueous properties of their salts.
B. Use the concepts of pH, pOH, Ka, and Kb to calculate the pH of aqueous solutions of acids, bases, and their salts.
C. Determine the specific species present in an aqueous solution and the concentrations of those species.
D. Describe the shape of acid-base titration curves for strong acid-strong base, weak acid-strong base, strong acid-week base and weak acid-weak base titrations.
E. Describe the effect of common ions and calculate concentrations of all species present in solutions of weak acids and bases.
F. Describe the ionization of polyprotic acid in aqueous solution.
G. Explain the buffer effect, predict the influence of added acids and bases on buffers, and calculate the concentrations of species in solution (using acid or base dissociation constant expressions, or Henderson-Hasselbach equation).
H. Calculate the pH of a buffer solution outside of the buffer region.
I. Identify titration curves for strong, weak, and polyfunctional acids and bases.
J. Understand the use of volumetric methods to determine the concentrations of species in solution.
K. Understand application of indicators in titration.
L. Write an equation to express the relationship between a solid solute and its constituent ions in a saturated solution. m. Calculate the Ksp from molar solubility and molar solubility from Ksp.
M. Calculate the effect of a common ion on the molar solubility of a salt.
N. Predict whether precipitation will occur when salt solutions are mixed and determine the concentration of ions remaining in solution after precipitation

V. Thermodynamics
A. Explain the similarities and differences between such terms as enthalpy, entropy, and free energy.
B. Explain how the First, Second, and Third Laws of Thermodynamics apply to chemical and physical processes.

C. Predict whether the entropy change in a given process is positive, negative, or near zero.
D. Use data tables to determine enthalpy, entropy, and free energy changes.
E. Explain how knowledge of ΔH°, ΔS°, and ΔG° allows one to predict the conditions under which a reaction will occur and how they relate to reaction spontaneity.
F. Describe and calculate the relationship between the standard free energy of reaction and the equilibrium constant.
G. Calculate ΔG for a chemical reaction that occurs under nonstandard conditions.

VI. Electrochemistry
A. Describe galvanic and electrolytic cells and their operation, including the identification of half reactions at the anode and cathode.
B. Write half reactions given a balanced redox reaction, and generate a balanced redox reaction given redox half reactions.
C. Calculate cell potentials and determine spontaneity of oxidation/ reduction reactions.
D. Understand and use-Faraday's Law.
E. Understand and apply the relationship of thermodynamics to electrochemistry.
F. Understand and use the Nernst Equation.
G. Understand the relationship between the cell potential E and ΔG, and use this relationship in problem solving.
H. Give examples of natural and/or commercial applications of electrochemical processes
I. Use the activity series of metals (optional).

VII. Optional Topics
A. Biochemistry
B. Coordination chemistry
C. Descriptive chemistry
D. Nuclear and Radiochemistry
E. Organic chemistry
F. Solid state chemistry

VIII. Work in the laboratory in accordance with good laboratory practices.
IX. Gather and record qualitative and quantitative data accurately.
X. Handle and evaluate data in logical, productive, and meaningful ways.
XI. Correlate laboratory work with principal topics in College Chemistry II lecture.

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the student will:

A. Describe the effects of intermolecular forces in chemical systems and perform calculations involving solution concentrations and colligative properties.
B. Apply the concepts of chemical kinetics to evaluate rates and to describe the energetics and mechanisms of chemical reactions.
C. Apply and demonstrate an understanding of equilibrium concepts to predict qualitative and quantitative properties of a chemical system.

D. Define acids and bases and evaluate using chemical equilibrium concepts.
E. Perform calculations involving pH, titrations, and buffers to describe acid/base and solubility equilibria.
F. Evaluate data and perform calculations involving thermodynamic quantities for a process, demonstrate the relationship between these quantities, and use the relationship to predict the spontaneity of chemical reactions.
G. Describe an electrochemical cell and utilize reduction potentials to predict the outcome of a given redox reaction.
H. Execute laboratory skills in accordance with proper laboratory and chemical safety practices.
I. Collect, evaluate, and interpret qualitative and quantitative data from laboratory procedures in a productive and meaningful manner.

ASSESSMENT OF COURSE LEARNING OUTCOMES
Student progress is evaluated through both formative and summative assessment methods. Specific details may be found in the instructor's course information document.

COLLEGE POLICIES AND PROCEDURES
Student Handbook
https://www.kckcc.edu/files/docs/student-resources/student-handbook-and-code-of-conduct.pdf

College Catalog
https://www.kckcc.edu/academics/catalog/index.html

College Policies and Statements
https://www.kckcc.edu/about/policies-statements/index.html

Accessibility and Accommodations
https://www.kckcc.edu/academics/resources/student-accessibility-support-services/index.html.