Effective Implementation date: Spring 2018, 201830

Required Syllabus Information – all must be included in the course syllabus

CHE 112
Course Title: Gen College Chem II/Lab: SC1
Course Credits: 5
Course Description: Presents concepts in the areas of solution properties, chemical kinetics, chemical equilibrium, acid-base and ionic equilibrium, thermodynamics, and electrochemistry. This course emphasizes problem solving skills and descriptive contents for these topics. Laboratory experiments demonstrate qualitative and quantitative analytical techniques.

GT Pathways Requirements:

Guaranteed Transfer (GT) Pathways Course Statement:
The Colorado Commission on Higher Education has approved CHE 112 for inclusion in the Guaranteed Transfer (GT) Pathways program in the GT- SC1 category. For transferring students, successful completion with a minimum C– grade guarantees transfer and application of credit in this GT Pathways category. For more information on the GT Pathways program, go to http://highered.colorado.gov/academics/transfers/gtpathways/curriculum.html.

NATURAL & PHYSICAL SCIENCES (N&PS) CONTENT CRITERIA – GT-SC1

1. The lecture content of a GT Pathways science course (GT-SC1)
    a. Develop foundational knowledge in specific field(s) of science.
    b. Develop an understanding of the nature and process of science.
    c. Demonstrate the ability to use scientific methodologies.
    d. Examine quantitative approaches to study natural phenomena.

2. The laboratory (either a combined lecture and laboratory, or a separate laboratory tied to a science lecture course) content of a GT Pathways science course (GT-SC1)
    a. Perform hands-on activities with demonstration and simulation components playing a secondary role.
    b. Engage in inquiry-based activities.
    c. Demonstrate the ability to use the scientific method.
    d. Obtain and interpret data, and communicate the results of inquiry.
    e. Demonstrate proper technique and safe practices.

COMPETENCIES & STUDENT LEARNING OUTCOMES FOR GT-SC1

Inquiry & Analysis:

4. **Select or Develop a Design Process**
    a. Select or develop elements of the methodology or theoretical framework to solve problems in a given discipline.
5. **Analyze and Interpret Evidence**

    a. Examine evidence to identify patterns, differences, similarities, limitations, and/or implications related to the focus.
    b. Utilize multiple representations to interpret the data.
6. **<u>Draw Conclusions</u>**
    a. State a conclusion based on findings.

<u>Quantitative Literacy</u>:

1. Interpret Information
    a. Explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words).
2. Represent Information
    a. Convert information into and between various mathematical forms (e.g., equations, graphs, diagrams, tables, words).

SYSTEM REQUIREMENTS:

REQUIRED COURSE LEARNING OUTCOMES

1. Recognize, define, and apply the vocabulary, symbolism, and nomenclature of chemistry.
2. Interpret the computed outcome of a chemical calculation to determine its validity.
3. Apply knowledge of chemical principles to real world situations.
4. Analyze and evaluate experimental observations, statements, and data using deductive reasoning and problem solving skills.
5. Use experimental observations and data to formulate predictions, propose trends, and identify patterns of physical or chemical behavior.
6. Synthesize and apply multiple chemical principles to solve complex problems including kinetics, equilibrium, thermodynamics, and solution behavior.
7. Convert descriptive, conceptual, and experimental information into mathematical equations, graphs, diagrams, and tables and use these results to formulate conclusions and discuss implications and limitations.
8. Convert mathematical equations, graphs, diagrams, and tables into descriptive or conceptual explanations, and use these results to formulate conclusions.
9. Demonstrate problem solving ability by selecting or developing the methodology or theoretical framework to solve a variety of chemistry problems.
10. Use the principles of kinetics, equilibrium, thermodynamics, and solution behavior to formulate predictions, propose trends, and identify patterns of physical or chemical behavior.
11. Write and speak clearly and logically in presentations, essays, and/or lab reports about topics related to chemistry.
12. Demonstrate the ability to select and apply appropriate forms of technology to solve problems or compile information in the study of chemistry.
13. Perform hands-on chemistry activities and labs with observations of demonstrations and simulations playing a secondary role.

REQUIRED TOPICAL OUTLINE

I. Solutions

    a. Calculations involving measures of concentration: molarity, molality, mass percent and mole fraction
    b. Calculation using colligative properties: freezing point depression, boiling point elevation, vapor pressure depression and osmotic pressure
    c. Use of colligative properties to find the molar mass of an unknown

II. Chemical kinetics
    a. Reaction rates
    b. Factors affecting reaction rate
    c. Rate law: rate equation
        i. Zero order
        ii. First order
        iii. Second order
        iv. Half-lives
    d. Reaction rate and temperature
        i. Arrhenius equation
    e. Reaction rates and reaction mechanisms
    f. Deducing reaction mechanisms from rate Laws
    g. Catalysis

III. Chemical equilibrium
    a. Reverse reactions
    b. Equilibrium constant, Kc
    c. Equilibrium constant, Kp
    d. Calculations involving chemical equilibrium in gaseous, aqueous, and heterogeneous phases
    e. Applications of equilibrium constants
    f. Le Chatelier's Principle
    g. Chemical equilibrium and chemical kinetics

IV. Aqueous equilibria: acids and bases
    a. Acid-base concepts: Bronsted-Lowry theory and Lewis acid/base theory
    b. Acid and base strength
    c. Ionization of water
    d. pH scale and measurement of pH
    e. Equilibria in solutions of weak acids and bases
    f. Calculating equilibrium concentrations in solutions of weak acids and bases
    g. Relationship between Ka and Kb
    h. Acid/base properties of salts
    i. Common ion effect and buffer solutions
    j. pH titration curves
        i. Strong acid-strong base
        ii. Weak acid-strong base
        iii. Weak base-strong acid

V. Solubility equilibria
    a. Solubility
    b. Solubility product constant, Ksp
    c. Calculations involving Ksp
    d. Factors affecting solubility
    e. Precipitation and separation of ions

VI. Thermodynamics

a. Terminology
b. Laws of thermodynamics
c. Calculation of entropy changes
d. Calculation of free energy changes
e. Free energy under standard and non-standard conditions
f. Free energy and chemical equilibrium

VII. Electrochemistry
a. Terminology
b. Balancing redox reactions using half-reaction method under acidic and basic conditions
i. Electrolysis
ii. Electrolytic and voltaic cells
iii. Cell potentials and electrode potentials
iv. Effect of concentration on cell potentials: The Nernst equation
v. Standard cell potentials and equilibrium constants
vi. Applications of electrochemistry

REQUIRED TOPICAL OUTLINE IN EITHER CHE 111 OR CHE 112

I. Thermochemistry
a. Thermochemistry terminology
b. The first law of thermodynamics
c. Calorimetry
d. Hess's law

II. Condensed states (Intermolecular forces)
a. Description of the liquid state
b. Description of the solid state
c. Intermolecular forces
d. The phase diagram
e. Vapor pressure

RECOMMENDED TOPICAL OUTLINE

The required topical outline information MUST be included in the syllabi. It may be incorporated using one of the following variations: copying the topical outline as written below, integrating the topics within the assignment schedule, or listing the topics to be covered.

I. Condensed states (Intermolecular forces)
a. Crystal solids

II. Nuclear chemistry
a. Nuclear reactions and radioactivity
b. Types of radioactive decay
c. Rate of radioactive decay and half-life
d. Nuclear stability
e. Energy change in nuclear reactions
f. Fission and Fusion
g. Detecting and measuring radioactivity

h. Biological effects of radiation
i. Applications of nuclear radiation

III. Organic chemistry
a. Hydrocarbons: alkanes, alkenes, alkynes, cycloalkanes, cycloalkenes
b. IUPAC Nomenclature for the hydrocarbons listed above
c. Isomerism: structural, geometric and optical
d. Functional groups

Syllabi requirements, including legal compliance information must be included. Individual College syllabi guidelines may include additional information. Please contact your VPI/CAO for specific College requirements.