Code: CHEM-102 **Title**: General Chemistry II

Division: Science & Health Sciences **Department:** Chemistry

Course Description: A continuation of CHEM 101, the student will investigate the areas of kinetics, equilibrium, nuclear reactions, thermochemistry, electrochemistry, carbon chemistry and transition metal and organic chemistry using a problem solving approach to bring about understanding.

Prerequisites: grade of "C" or higher in CHEM 101 and in MATH 151.

Corequisites: None

Prerequisites or Corequisites:

Credits: 5 **Lecture Hours:** 4 **Lab/Studio Hours: 3**

REQUIRED TEXTBOOK/MATERIALS:

Textbook: Chemistry: The Science In Context, 5th ed. by Gilbert, Kriss, Foster, et. al.,

Calculator: Any scientific or graphing calculator will suffice

Laboratory Materials:

- **Face-to-Face Students Only**:
  - *Lab Manual*
    - Laboratory Experiments for Chemistry: The Central Science, 14th ed by Brown, LeMay, et. al.
  - *Safety Goggles:* New Jersey state law requires that all students wear appropriate splash and impact proof safety goggles while performing laboratory experiments. Theyare available at the College Store
  - *Laboratory Coat:* Available at the College Store
- **Online Students Only:**
  - *Laboratory Kit*
    - http://www.esciencelabs.com/student

Additional Time Requirements:
For information on Brookdale's policy on credit hour requirements and outside class student work refer to Academic Credit Hour Policy.

CORE COMPETENCIES

The following objectives of the **Scientific Perspective,** the **Mathematical Skills Competency**, and the **Critical Thinking, Problem Solving Competency** are taught in this course.

Students will:

1.1 Identify a problem and analyze it
1.2 Recognize and construct logical forms of argumentation
1.1 Be able to analyze, discuss and use quantitative information
1.2 Be able to apply algebraic and/or geometric techniques to analyze and solve mathematical problems
1.3 Use appropriate problem solving technologies
5.1 Develop appropriate skills in observation and experimentation to solve problems
5.2 Be able to analyze and interpret scientific data
5.3 Be able to evaluate and apply appropriate technology

The course tests, quizzes, labs, and other assignments are used to assess student attainment of these competency objectives within the context of the course curriculum.

In addition, this course reinforces objective 1.1 of the **Communication Skills competency** that states the student will "communicate information and ideas clearly and effectively in written form." Students are required to write, using correct English, Mathematical and Chemical symbols, responses to lab and test questions requiring explanations, comparisons, and/or interpretation of results.

COURSE LEARNING OUTCOMES:

Upon completion of this course, students will be able to:

- Utilize critical thinking skills to learn fundamental chemical concepts from inorganic chemistry.
  (Critical Thinking)
- Perform chemistry-based problem solving. Reinforcement of chemical concepts will be made as hands-on skills are developed in the laboratory program. (Critical Thinking, Problem Solving, Mathematical Skills Competency)
- Determine the speeds at which reactions take place.
  (Mathematical Skills Competency, Problem Solving Competency)
- Calculate the pH at different points of a titration
  (Mathematical Skills Competency, Problem Solving Competency)
- Determine the enthalpy and entropy of a reaction

(Critical Thinking, Problem Solving, Mathematical Skills Competency)

- Name organic compounds (Critical Thinking, Problem Solving) Write nuclear reactions
- (Critical Thinking, Problem Solving

GRADING STANDARD:

A = 92 - 100%	**C+ = 76 - 78%**
A- = 89 - 91%	**C = 70 - 75%**
B+ = 86 - 88%	**D = 65 - 69%**
B = 82 – 85%	**F = <65%**
B- = 79 - 81%	

COURSE CONTENT:

Unit 1: Chemical Kinetics and Chemical Equilibrium
Unit 2: Acids and Bases and Acid-Base Equlibrium & Solubility Equilibrium
Unit 3: Thermochemistry, Entropy, Free Energy, and Electrochemistry
Unit 4: Organic Chemistry and Nuclear Chemistry

DEPARTMENT POLICIES:

1. Students must attend their regularly scheduled weekly laboratory section.
2. Students are not allowed to attend any other lab section for any reason.
3. Students must pass (65% or better) both the lecture and the laboratory portion of the course in the same semester or they will fail the course

COLLEGE POLICIES:

As an academic institution, Brookdale facilitates the free exchange of ideas, upholds the virtues of civil discourse, and honors diverse perspectives informed by credible sources. Our College values all students and strives for inclusion and safety regardless of a student's disability, age, sex, gender identity, sexual orientation, race, ethnicity, country of origin, immigration status, religious affiliation, political orientation, socioeconomic standing, and veteran status. For additional information, support services, and engagement opportunities, please visit www.brookdalecc.edu/support.

For information regarding:

- Brookdale's Academic Integrity Code
- Student Conduct Code
- Student Grade Appeal Process

Please refer to the **BCC STUDENT HANDBOOK AND BCC CATALOG.**

NOTIFICATION FOR STUDENTS WITH DISABILITIES:

Brookdale Community College offers reasonable accommodations and/or services to persons with disabilities. Students with disabilities who wish to self-identify must contact the Disabilities Services Office at 732-224-2730 (voice) or 732-842-4211 (TTY) to provide appropriate documentation of the disability, and request specific accommodations or services. If a student qualifies, reasonable accommodations and/or services, which are appropriate for the college level and are recommended in the documentation, can be approved.

ADDITIONAL SUPPORT/LABS:

See the Tutoring Center for information https://www.brookdalecc.edu/academic-tutoring/tutoring-center/.

MENTAL HEALTH:

- Mental Health Crisis Support: From a campus phone, dial 5555 or 732-224-2329 from an external line; off-hours calls will be forwarded to BCC police (2222 from a campus phone)
- Psychological Counseling Services: 732-224-2986 (to schedule an appointment during regular hours)

CHAPTERS: **13 and 14**

NAME OF UNIT: Chemical Kinetics and Introduction to Chemical Equilibrium

UNIT OBJECTIVE: To illustrate the importance of the speed of a chemical reaction and its impact on how old chemical bonds are broken and new bonds are made. Also to show the fundamentals of manipulating a the yield of chemical reaction that don't go to completion

Learning Objectives	Recommended Learning Experiences
1. Define chemical kinetics and describe the factors that influence the rate of chemical reactions	**READ**: 13.2 p 639-40 **DO:** 13.1-5, 15-16, 21-22,
2. Represent reactions with rate expressions and explain how to monitor the concentration of species in a reaction	**READ:** 13.2 p 640-5 **DO:** 13.17-20, 23-40
3. Explain the importance of and calculate, the rate law, the overall order of a reaction, and the rate constant	**READ:** 13.3 p. 645-50 **DO:** 13.41-66
4. Use the integrated rate law and graph data to calculate the concentration of reactants and products at a particular time during the reaction	**READ:** 13.3 p 650-9 **DO:** 13.67-76
5. Describe the relationship between the temperature and speed using the Arrhenius equation	**READ:** 13.4 **DO:** 13.77-90
6. Explain the parts of a reaction mechanism and how to determine if a mechanism is plausible	**READ:** 13.5 **DO:** 13.91-106

7. Draw reaction coordinates for reactions that have single and multiple elementary steps. Label the important parts of the graph	**READ:** 13.5 **DO:** 13.6-11, 118
8. Define a catalyst and describe its impact on chemical reactions and reaction coordinates	**READ:** 13.6 **DO:** 13.107-114
9. Distinguish between the differences between uni- and bi-directional chemical reactions. Define chemical equilibrium in terms of the dynamics occurring at the microscopic and macroscopic level	**READ:** 14.1 **DO:** 14.1, 7-9
10. Write equilibrium expressions for homo and heterogeneous chemical reactions. Convert between Kc and Kp	**READ:** 14.2 and 14.6 **DO:** 14.2, 10-32, 53-58
11. Define the relationship between the K's for each step in a chemical reaction and the overall K	**READ:** 14.3 **DO:** 14.43
12. Explain the importance of the reaction quotient (Q) in any reaction governed by equilibrium principles	**READ:** 14.5 **DO:** 14.45-52
12. Describe LeChatelier's Principle and how to use it to manipulate the yield of chemical reactions	**READ:** 14.7 **DO:** 14.6, 14.59-72
13. Predict the concentrations or pressures of reactants and products for a chemical equation at any time during the reaction.	**READ:** 14.8 **DO:** 14.75-92

Unit : #2 Acids, Bases and Solubility Equilibria. Chapters 15 and 16

LEARNING OBJECTIVES	RECOMMENDED PRACTICE EXERCISES
1. Identify conjugate acid-base pairs and their relative strengths for Bronsted Acids and Bases	Read: 15.2 Do: 15.15-15.18
2. Explore the acid-base properties of water using the ion product constant Kw	Read: 15.3 Do: 15.25-15.28
3. Calculate pH and pOH	Read: 15.3 Do: 15.31-15.34
4. Write ionization constant expressions for weak acids and weak bases. Calculate pH of weak bases, weak acids and % ionization	Read: 15.4 and 15.5 Do: 15.41, 15.43 Do: ODD 15.49-15.59
5. Write reactions, calculate pH for polyprotic acids	Read: 15.6 Do: 15.65 and 15.67
6. Determine the relationship between Molecular structure and the strengths of Acids.	Read: 15.7 Do: 15.73-15.75
7. Determine the acid-base properties of salt solutions through the use of hydrolysis reactions.	Read: 15.8 Do: 15.78-15.80

8. Identify, calculate the pH of, and describe how to prepare buffer solutions	Read 16.2, 16.3 Do: ODD: 16.11-16.29
9. Calculate pH during acid-base titrations	Read: 16.4 Do: ODD 16.43-16.51
10. Understand how indicators function and Select appropriate indicators for a given titration.	Read: 16.4 Do: 16.37-16.39
11. Identify Lewis Acids and Bases	Read: 16.5 Do: 16.55-16.58
12. Understand the formation of Complex Ions and why hydrated metal ions act as acids	Read 16.6-16.8
13. Understand solubility equilibria and Solve related problems	Read 16.8 Do: 16.87, 16.89 16.95, 16.97. 16.99 16.101, 16.103, 16.107 16.109, 16.115

Unit III

Chapters: 5, 17 (including Ch 4.9).& 18

Name of Chapters: Thermochemistry, Thermodynamics and Electrochemistry

Student will be able to:

1. Define give units for and perform calculations dealing with Energy, Energy changes in chemical reactions.	Problems: 5.5, 5.7, 5.9, 5.10, 5.130 Read: 5.1 & 5.2
2. State and perform calculations relating to the First law of thermodynamics. and enthalpy of chemical changes.	Problems: 5.15, 5.27, 5.29, 5.37, 5.48, 5.49, 5.51, 5.555.123 Read: 5.3 & 5.4
3. State definitions for and perform calculations for Calorimetry	Problems: 5.57, 5.61 5.63, 5.65, 5.69 Read: 5.6
4. Explain and apply Hess' Law	Problems: 5.74, 5.75, 5.775.127 Read: 5:7
5. Explain Standard enthalpy of formation and perform solve problems applying it to reactions.	Problems: 5.81, 5.82, 5.83, 5.87, 5.89 5.91, 5.93, 5.125 Read: 5.8
6. Define terminology and solve problems . applying energy concepts to Food and Fuel.	Problems: 5.99, 5.101, 5.108, 5.112, Read: 5.9

Student will be able to explain and perform calculations relating to

7. Explain how to determine whether a reaction. (process) is Spontaneous processes and explain and apply definitions of entropy	Problems: 17.6 -- 17.9, 17.11, 17.15, 17.19 Read: 17.1, 17.2
8. State the third law of thermodynamics & Be able to calculate entropy changes	Problems: 17.21, 17.23, 17.27, 17.29, 17.31 (Do your answers agree with your expectation?), 17.89, 17.90 Read: 17.4 & 17.4
9. Define and solve problems involving Gibbs free energy (Gibbs Function)	Problems: 17.43, 17.45, 17.47, 17.97 Read: 17.5
10. Use Gibbs Free Energy to determine. when a reaction will be spontaneous.	Problems: 17.35, 17.36, 17.39, 17.40, 1 17.43, 17.47, 17.49,

	17.51 -- 17-53, 17.55, 17.57 Read: 17.6
11. Use Gibbs Free Energy to predict when a system is in Chemical Equilibrium	Problems: 17.59, 17.63, 17.65, 17.67 Read: 17.7 & 17.8

Student will be able to explain and perform calculations relating to

12. Balance Redox Equations Read: 4.9, 18.1 & Handouts	Problems: 4.99, 4.101, 4.103 18.11-18.17, 18.19, 18.21, 18.23, 18.25
13. Diagram, write cell reactions and perform calculations relating Electrochemical Cells (Galvanic Cells) using Standard EMFs.	Problems: 18.1, 18.2, 18.7, 18.10, 18.31, 18.35, 18.37, 18.41, 18.43, Read: 18.2, 18.3
14. Determine Spontaneity of redox reactions using Standard & Hydrogen EMF's	Problems: 18.49, 18.53 Read: 18.4 , 18.5
15. Use the Nernst Equation to determine the impact of concentration on cell EMF	Problems: 18.55-18.56, 18.59, 18.61 18.91, 18.99 Read: 18.6
16.Describe batteries. Use the Nernst Equation To determine the battery's potential.	Problems: 18.81, 18.83, 18.91, 18.93 Read: 18.7
17. Describe Electrolysis & Fuel Cells and Calculate their cell potentials.	Problems: Sample Exercises: 18.7-18.8 Read: 18.9, 18.10

Unit IV

Number of Chapters: 19, 20 & alternate text: http://wwnorton.com/ebooklite/chemistry-atoms-2e-ch19/welcome.asp

Name of Chapters: Nuclear Chemistry and Organic Chemistry

LEARNING OBJECTIVES		RECOMMENDED QUESTIONS & PROBLEMS
1.	Calculate mass defect and nuclear binding energy	Read: 19.1 Do: 19.15
2.	Identify stable and unstable nuclei	Read: 2.9, 19.2 Do: 19.17
3.	Identify and balance different types of nuclear reactions	Read: 19.2 Do: 19.25, 19.26, 19.91, 19.95
4.	Describe how instruments measure radiation	Read: 19.3 Do: 19.35
5.	Calculate the rate of radioactive decay	Read: 19.4 Do: 19.33, 19.37
6.	Describe how radiometric (radioactive) dating occurs	Read: 19.5 Do: 19.39, 19.45, 19.99
7.	Discuss the biological effects of radiation	Read: 19.6 Do: 19.49, 19.55
8.	Describe how nuclear fission works	Read: 19.8 Do: 19.71, 19.75
9.	Describe how nuclear fusion works	Read: 19.9

Alternate text: http://wwnorton.com/ebooklite/chemistry-atoms-2e-ch19/welcome.asp

ALT = alternate text text = textbook

10.	Identify classes of organic compounds	Read: ALT 19.1 Do: ALT 19.1, 19.3, 19.4 ALT 19.21, 19.22

11.	Be able to draw complete, condensed, and line structures of alkanes	Read: ALT 19.2 Do: worksheets
12.	Differentiate between constitutions/structural isomers	Read: ALT 19.2 Do: ALT 19.2, 19.24, 19.3
13.	Be able to name alkanes	Read: ALT 19.2, Appendix 7 Do: ALT 19.33
14.	Be able to draw complete, condensed, and line structures of alkenes and alkynes	Read: ALT 19.3 Do: worksheets
15.	Be able to name alkenes and alkynes	Read: ALT 19.3, Appendix 7 Do:
16.	Determine the products when alkanes, alkenes, and alkynes undergo reactions	Read: ALT 19.3 Do: worksheets
17.	Differentiate between cis- and trans- isomers	Read: ALT 19.3, text 20.2 Do: ALT 19.43, 19.51
18.	Draw, name, and perform reactions involving aromatic compounds	Read: ALT 19.4, Appendix 7 Do: ALT 19.5
19.	Identify functional groups	Read: ALT 19.5-19.7, Appendix 7 Do: 19.82, 19.102, 19.103, 19.107, text 20.1 24.48, 24.50
20.	Identify optical isomers	Read: ALT 19.8, text 20.11, 20.12

The syllabus is intended to give student guidance in what may be covered during the semester and will be followed as closely as possible. However, the faculty member reserves the right to modify, supplement, and make changes as the need arises.