**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  

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**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*  
  
  - *Safety Goggles:* New Jersey state law requires that all students wear appropriate splash and impact proof safety goggles while performing laboratory experiments. They are available at the College Store  
  
- **Laboratory Coat:** Available at the College Store  

- **Online Students Only:**  
  - *Laboratory Kit*  
    - http://www.esciencelabs.com/student
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:**

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<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>A</td>
<td>92 - 100%</td>
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<tr>
<td>A-</td>
<td>89 - 91%</td>
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<tr>
<td>B+</td>
<td>86 - 88%</td>
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<tr>
<td>B</td>
<td>82 - 85%</td>
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<tr>
<td>B-</td>
<td>79 - 81%</td>
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<tr>
<td>C+</td>
<td>76 - 78%</td>
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<tr>
<td>C</td>
<td>70 - 75%</td>
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<td>D</td>
<td>65 - 69%</td>
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<tr>
<td>F</td>
<td>&lt;65%</td>
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**COURSE CONTENT:**

Unit 1: Chemical Kinetics and Chemical Equilibrium  
Unit 2: Acids and Bases and Acid-Base Equilibrium & 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:**

Click on the links for information regarding:

- Brookdale’s Academic Integrity Code  
- Student Conduct Code  
- Student Grade and the Grade Appeal Process

**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:**

Instructional assistants are available for help both for lab and lecture. The times of availability are posted on the door to the IA’s office (MAS-031). No appointment necessary.
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

1. Define chemical kinetics and describe the factors that influence the rate of chemical reactions

   **Recommended Learning Experiences**
   
   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

   **Recommended Learning Experiences**
   
   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

   **Recommended Learning Experiences**
   
   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

   **Recommended Learning Experiences**
   
   READ: 13.3 p 650-9
   DO: 13.67-76

5. Describe the relationship between the temperature and speed using the Arrhenius equation

   **Recommended Learning Experiences**
   
   READ: 13.4
   DO: 13.77-90

6. Explain the parts of a reaction mechanism and how to determine if a mechanism is plausible

   **Recommended Learning Experiences**
   
   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

13. 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

14. 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

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1.</td>
<td>Identify conjugate acid-base pairs and their relative strengths for Bronsted Acids and Bases</td>
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<tr>
<td></td>
<td>Read: 15.2</td>
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<td>2.</td>
<td>Explore the acid-base properties of water using the ion product constant Kw</td>
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<td></td>
<td>Read: 15.3</td>
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<tr>
<td>3.</td>
<td>Calculate pH and pOH</td>
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<td></td>
<td>Read: 15.3</td>
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<td>4.</td>
<td>Write ionization constant expressions for weak acids and weak bases. Calculate pH of weak bases, weak acids and % ionization</td>
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<td>Read: 15.4 and 15.5</td>
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<td>5.</td>
<td>Write reactions, calculate pH for polyprotic acids</td>
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<td>Read: 15.6</td>
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<tr>
<td>6.</td>
<td>Determine the relationship between Molecular structure and the strengths of Acids.</td>
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<td>Read: 15.7</td>
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<tr>
<td>7.</td>
<td>Determine the acid-base properties of salt solutions through the use of hydrolysis reactions.</td>
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<td>Read: 15.8</td>
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</tbody>
</table>
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


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, 17.43, 17.47, 17.49,
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
Problems: 4.99, 4.101, 4.103
Read: 4.9, 18.1 & Handouts
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
### LEARNING OBJECTIVES

<table>
<thead>
<tr>
<th>Learning Objective</th>
<th>Read</th>
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<tbody>
<tr>
<td>1. Calculate mass defect and nuclear binding energy</td>
<td>19.1</td>
<td>19.15</td>
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<tr>
<td>2. Identify stable and unstable nuclei</td>
<td>2.9, 19.2</td>
<td>19.17</td>
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<tr>
<td>3. Identify and balance different types of nuclear reactions</td>
<td>19.2</td>
<td>19.25, 19.26, 19.91, 19.95</td>
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<td>4. Describe how instruments measure radiation</td>
<td>19.3</td>
<td>19.35</td>
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<td>5. Calculate the rate of radioactive decay</td>
<td>19.4</td>
<td>19.33, 19.37</td>
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<td>7. Discuss the biological effects of radiation</td>
<td>19.6</td>
<td>19.49, 19.55</td>
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<tr>
<td>8. Describe how nuclear fission works</td>
<td>19.8</td>
<td>19.71, 19.75</td>
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<td>9. Describe how nuclear fusion works</td>
<td>19.9</td>
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| 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 |