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CHM 112
College Chemistry II

Faculty Name:

Program Head: Lanette Upshaw

Dean's Review:

Dean's Signature: _____Date Reviewed: ___/___/_____

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Revised: Fall 2016

CHM 112
College Chemistry II

COURSE OUTLINE

Course Description:

Prerequisite: CHM 111. Explores the fundamental laws, theories, and mathematical concepts of chemistry. Designed primarily for science and engineering majors. Requires a strong background in mathematics. Lecture 3 hours. Laboratory 3 hours. Total 6 hours per week.

Semester Credits: 4 **Lecture Hours: 3 Lab/Recitation Hours: 3**

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Course Outcomes

At the completion of this course, the student should be able to:

Distinguish between oxidation and reduction reactions, balance redox equations, and apply redox reactions to the operations of electrochemical cells.

Exhibit an understanding of acids, bases, pH, and buffers and relate to their importance in industrial and life processes.

Demonstrate an understanding of reaction rates and homogeneous and heterogeneous equilibria and solve problems involving their concepts.

Explain why certain reactions occur spontaneously in terms of enthalpy, entropy, and free energy changes.

Classify the name hydrocarbons and the common hydrocarbon derivatives and develop and respect the role that organic compounds play in our lives.

Identify the types of nuclear reactions and radiation and discuss the advantages and disadvantages of nuclear energy.

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Required Materials:

Textbook, Lab manual, and online homework access code

Textbook:

Principles of Chemistry: A Molecular Approach, 2nd ed., Tro, Pearson Education, ISBN 1323402640

Lab Manual:

Chemical Principles in the Laboratory, 11th ed., Slowinski, Wolsey and Masterton, Cengage Learning ISBN 9781337051057

Online Homework Access Code:

MasteringChemistry, Pearson Education, www.masteringchemistry.com

The following supplementary materials are available:

1. 5th edition of old Masterton/Hurley textbook with Student Solutions Manual in the library

2. Student Solutions Manual/Workbook and Study Guide (available in bookstore) 9780133928259

3. Online resources

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Topical Description:

11 Liquids, Solids, and Intermolecular Forces
- 11.1 Water, No Gravity
- 11.2 Solids, Liquids, and Gases: A Molecular Comparison
- 11.3 Intermolecular Forces: The Forces That Hold Condensed States Together
- 11.4 Intermolecular forces in Action: Surface Tension, Viscosity, and Capillary Action
- 11.5 Vaporization and Vapor Pressure
- 11.6 Sublimation and Fusion
- 11.7 Heating Curve for Water
- 11.8 Phase Diagrams
- 11.9 Water: An Extraordinary Substance
- 11.10 Crystalline Solids: Until Cells and Basic Structures
- 11.11 Crystalline Solids: The Fundamental Types
- 11.12 Crystalline Solids: Band Theory

12 Solutions
- 12.1 Thirsty Solutions: Why You Should Not Drink Seawater
- 12.2 Types of Solutions and Solubility
- 12.3 Energetics of Solution Formation
- 12.4 Solution Equilibrium and Factors Affecting Solubility
- 12.5 Expressing Solution Concentration
- 12.6 Colligative Properties: Vapor Pressure Lowering, Freezing Point Depression, Boiling Point Elevation, and Osmotic Pressure
- 12.7 Colligative Properties of Strong Electrolyte Solutions

13 Chemical Kinetics
- 13.1 Catching Lizards
- 13.2 The Rate of a Chemical Reaction
- 13.3 The Rate Law: The Effect of Concentration on Reaction Rate
- 13.4 The Integrated Rate Law: The Dependence of Concentration on Time
- 13.5 The Effect of Temperature on Reaction Rate
- 13.6 Reaction Mechanisms
- 13.7 Catalysis

14 Chemical Equilibrium

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- 14.1 Fetal Hemoglobin and Equilibrium
- 14.2 The Concept of Dynamic Equilibrium
- 14.3 The Equilibrium Constant (K)
- 14.4 Expressing the Equilibrium Constant in Terms of Pressure
- 14.5 Heterogeneous Equilibria: Reaction Involving Solids and Liquids
- 14.6 Calculating the Equilibrium Constant from Measured Equilibrium Concentrations
- 14.7 The Reaction Quotient: Predicting the Direction of Change
- 14.8 Finding Equilibrium Concentrations
- 14.9 Le Châtelier's Principle: How a System at Equilibrium Responds to Disturbances

15 Acids and Bases

- 15.1 Heartburn
- 15.2 The Nature of Acids and Bases
- 15.3 Definitions of Acids and Bases
- 15.4 Acid Strength and the Acid Ionization Constant (K_a)
- 15.5 Autoionization of Water and pH
- 15.6 Finding the $[H_3O^+]$ and pH of Strong and Weak Acid Solutions
- 15.7 Base Solutions
- 15.8 The Acid-Base Properties of Ions and Salts
- 15.9 Acid Strength and Molecular Structure
- 15.10 Lewis Acids and Bases

16 Aqueous Ionic Equilibrium

- 16.1 The Danger of Antifreeze
- 16.2 Buffers: Solutions That Resist pH Change
- 16.3 Buffer Effectiveness: Buffer Range and Buffer Capacity
- 16.4 Titrations and pH Curves
- 16.5 Solubility Equilibria and the Solubility Product Constant
- 16.6 Precipitation
- 16.7 Complex Ion Equilibria

17 Free Energy and Thermodynamics

- 17.1 Nature's Heat Tax: You Can't Win and You Can't Break Even
- 17.2 Spontaneous and Nonspontaneous Processes
- 17.3 Entropy and the Second Law of Thermodynamics
- 17.4 Heat Transfer and Changes in the Entropy of the Surroundings
- 17.5 Gibbs Free Energy
- 17.6 Entropy Changes in Chemical Reactions: Calculating ΔS^o_{rxn}
- 17.7 Free Energy Changes in Chemical Reactions: Calculating ΔG^o_{rxn}

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- 17.8 Free Energy Changes for Nonstandard States: The Relationship between ΔG^{o}_{rxn} and ΔG_{rxn}
- 17.9 Free Energy and Equilibrium: Relating ΔG^{o}_{rxn} to the Equilibrium Constant (K)

18 Electrochemistry
- 18.1 Pulling the Plug on the Power Grid
- 18.2 Balancing Oxidation-Reduction Equations
- 18.3 Voltaic (or Galvanic) Cells: Generating Electricity from Spontaneous Chemical Reactions
- 18.4 Standard Electrode Potentials
- 18.5 Cell Potential, Free Energy, and the Equilibrium Constant
- 18.6 Cell Potential and Concentration
- 18.7 Batteries: Using Chemistry to Generate Electricity
- 18.8 Electrolysis: Driving Nonspontaneous Chemical Reactions with Electricity
- 18.9 Corrosion: Undesirable Redox Reactions

19 Radioactivity and Nuclear Chemistry
- 19.1 Diagnosing Appendicitis
- 19.2 Types of Radioactivity
- 19.3 The Valley of Stability: Predicting the Type of Radioactivity
- 19.4 The Kinetics of Radioactive Decay and Radiometric Dating
- 19.5 The Discovery of Fission: The Atomic Bomb and Nuclear Power
- 19.6 Converting Mass to Energy: Mass Defect and Nuclear Binding Energy
- 19.7 Nuclear Fusion: The Power of the Sun
- 19.8 The Effects of Radiation on Life
- 19.9 Radioactivity in Medicine

20 Organic Chemistry
- 20.1 Fragrances and Odors
- 20.2 Carbon: A Unique Element
- 20.3 Hydrocarbons: Compounds Containing Only Carbon and Hydrogen
- 20.4 Alkanes: Saturated Hydrocarbons
- 20.5 Alkenes and Alkynes
- 20.6 Hydrocarbon Reactions
- 20.7 Aromatic Hydrocarbons
- 20.8 Functional Groups
- 20.9 Polymers

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Lab Outline

Lab Manual: Chemical Principles in the Laboratory with Qualitative Analysis, Slowinski, Wolsey, and Masterton, Custom ed, Thomson Custom Publishing/Cengage Learning.

Experiment Number	Experiment Title	Page
15	Spot Tests for Some Common Anions	97
17	Determination of Iron by Reaction with Permanganate-- A Redox Titration	113
22	Qualitative Analysis of Group III Cations	155
25	Preparation of Aspirin	173
18	Chemical Kinetics	119
23	Determination of Solubility Product Constant (Two week lab)	163
23	Determination of Solubility Product Constant (cont'd)	163
20	The Standardization of Basic Solution and the Determination of the Molar Mass of an Acid	137
19	Properties of Systems in Equilibrium – LeChatelier's Principle	125
21	pH, Buffers and Their Properties	133
Handout	Hydrocarbons	
16	The Alkaline Earth and the Halogens-Two Families In the Periodic Chart	105
24	Electrolysis	169
Handout	Reaction of Certain Organic Compounds (optional)	
Handout	Polymers	

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Notes to Instructors

1. Please note that a three-hour time slot is allotted to the laboratory and the student should be aware that this time will be fully utilized. The laboratory time is used not only for experimentation, but may also be used for testing, demonstrations, movies, and problem solving. Whenever time permits, homework problems will be worked out in the beginning of the laboratory and the student is expected to participate.

2. Attendance in the laboratory is mandatory at the scheduled time. In case of an unavoidable situation, the student should contact the instructor beforehand to be excused and to see if any arrangements can be made to make up the laboratory. It may or may not be possible. Approved safety glasses must be worn in the laboratory ***over the eyes*** as required by state law.

3. Laboratory reports are due at the beginning of the next lab period. The report includes the data report sheet and advance study assignment. To aid not only the instructor but especially the students, reports will not be accepted two weeks after the lab was assigned. Completion of the lab experiment followed by turning in the data and calculations on the due date with appropriate write-up insures a good grade. Grading scales for laboratory reports are at the professor's discretion, but will count towards the overall grade for the course.

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