University of South Carolina
Carolina Core

CHEMISTRY 141
PRINCIPLES OF CHEMISTRY I

BULLETIN INFORMATION
CHEM 141 - Principles of Chemistry I (4 credit hours)
Course Description:
Advanced general chemistry I. Atoms and chemical bonds.
Prerequisites: high-school chemistry; Prereq or coreq: MATH 141 or higher
Note: Three lecture hours, one recitation hour, and three laboratory hours per week. Credit cannot be received for both CHEM 111 and CHEM 141.

SAMPLE COURSE OVERVIEW
TBA

ITEMIZED LEARNING OUTCOMES
Upon successful completion of Chemistry 141, students will be able to:

1. Demonstrate knowledge of molecular-level chemical processes including thermodynamics, chemical equilibrium, acid-base reactions, electrochemistry, chemical kinetics, coordination chemistry, organic chemistry, polymers, and nuclear reactions
2. Master the skills of solving practical numerical problems in chemistry
3. Work collaboratively with other students for teaching and learning chemistry;
4. Demonstrate a mastery of historical knowledge of chemical events as compared to modern day practices
5. Demonstrate proficiency in assembling basic laboratory glassware, performing fundamental laboratory techniques, making and recording relevant experimental observations, and interpreting the results
6. Discuss the important scientific discoveries that lead to the development of modern chemistry (Carolina Core Scientific Literacy
7. Demonstrate understanding that the natural world has an atomic and molecular basis which successfully explains its physical phenomena
8. Discuss, through examples, the impact of chemical phenomena on the fields of medicine, pharmacy, dentistry, biology, and physics
9. Apply gas laws and kinetic molecular theory to processes involving gases
10. Explain the intermolecular attractive forces that determine the properties of the states of matter and phase behavior
11. Determine the rate of a reaction and its dependence on concentration, time, and temperature
12. Use Le Chatelier's Principle to predict the effects of concentration, pressure and temperature changes on equilibrium mixtures
13. Apply the principles of equilibrium to aqueous systems

14. Perform calculations with the thermodynamic functions, enthalpy, entropy, free energy
15. Follow experimental procedures
16. Write proper laboratory reports with abstract, introduction, experimental methods, results, discussion, conclusions, with appropriate graphs and statistical data analysis, including dimensional analysis

SAMPLE REQUIRED TEXTS/SUGGESTED READINGS/MATERIALS

1. *Chemical Principles*, 6th edition, by Zumdhal
2. *General Chemistry Laboratory Experience* by Freeman and Reger *(Lab Manual)*
3. lab goggles

SAMPLE ASSIGNMENTS AND/OR EXAM

The expected learning outcomes will be assessed through the use of homework assignments and/or quizzes, exams, laboratory reports and the final exam.

1. **EXAM I (Chapters 2-4):** Students will employ the terminology of the study of chemistry and will demonstrate an understanding of matter, measurements and uncertainty, Dalton's Atomic Theory, atomic composition, masses, and structure, the periodic table, chemical nomenclature, chemical equations and formulas, mole and molar mass, molarity, stoichiometry and limiting reactants and historical experiments as related to modern day.

2. **EXAM II (Chapters 5-7):** As an extension of the material from exam I, the students will demonstrate an understanding of properties and measurements of gases, the gas laws including the ideal gas law, Dalton's law of partial pressure, the kinetic molecular theory of gases, why gases deviate from the ideal gas law, relating the hydrogen ion concentration to hydroxide ion concentration in aqueous solutions, calculating the concentrations of species, the pH and the pOH of solutions of various acids and bases and any current societal impact discussed related to these topics.

3. **EXAM III (Chapters 8-10):** As an extension of the material from exam I and II, the students will demonstrate an understanding of the equilibrium systems for any chemical reaction, the response of an equilibrium system to changes in conditions by applying Le Chatelier's principle, enthalpy and thermochemical equations, the first law of thermodynamics, entropy and spontaneity, Gibbs free energy, and the effect of concentration on Gibbs free energy.

4. **FINAL EXAM (Cumulative):** Students will demonstrate an understanding of the material from exams I, II, and III.

5. **LECTURE QUIZZES:** There will be pop quizzes on the chapter material for each class. Reading the sections of the chapters before each lecture will adequately prepare the student for the quizzes.

6. **RECITATION QUIZZES:** A short quiz based on the reading material for the weeks lecture and pertinent laboratory pre-lab information.

7. **LABORATORY REPORTS:** The lab component will include 10 labs, which consist of lab reports, exercises, and discussions of research methodology as related to Safety & Laboratory Techniques, the physical properties of substances, determination of the percent of copper in Copper Sulfate Pentahydrate, the preparation of Aspirin, determination of the Concentration of a NaOH Solution through acid-base titration, heats of formation, determination of R, Ideal gas Constant, paper chromatography, waters of hydration, vapor density, and shapes of molecules.

8. **OWL ONLINE HOMEWORK:** Students will demonstrate critical thinking and problem solving through the OWL homework assignments. The assignments are based on the text book and follow the chapter progression according to the lecture schedule.

SAMPLE COURSE OUTLINE WITH TIMELINE OF TOPICS, READINGS/ASSIGNMENTS, EXAMS/PROJECTS

Week 1:	**Class-1**	Syllabus and OWL information, Chapter 1
Week 2:	**Class-2**	Chapter 2: Atoms Molecules and Ions, early history, fundamental chemical laws
	Class-3	Chapter 2: Dalton's atomic theory, modern view of atomic structure
	Class-4	Chapter 3: periodic table, naming simple compounds
Week 3:	**Class-5**	Chapter 3: Stoichiometry atomic masses, the mole, molar mass
	Class-6	Chapter 3: percent composition, determining the formula of a compound
Week 4:	**Class-7**	Chapter 3: chemical equations, stoichiometry
	Class-8	Chapter 3: stoichiometric calculations, limiting reactants
	Class-9	Chapter 4: Types of Chemical reactions and solution stoichiometry: Water as a universal solvent
Week 5:	**Class-10**	Chapter 4: The composition of solutions; Types of reactions in aqueous solutions
	Class-11	Chapter 4: Precipitation reactions, stoichiometry of precipitation reactions.
	Class-12	Chapter 4: Reactions in solution, oxidation-reduction reactions, acid bas reactions
Week 6:	**Class-13**	Chapter 5: Gases, pressure, Gas Laws, Ideal Gas Law, Gas stoichiometry

	Class-14	Chapter 5: Dalton's Law of partial pressure, Kinetic molecular theory of gases,
	Class-15	**EXAM I Chapters 1-4**
Week 7:	**Class-16**	Chapter5: Effusion and Diffusion, Real Gases, Chemistry of the atmosphere
	Class-17	Chapter 6: Chemical equilibrium
	Class-18	Chapter 6: Solubility Equilibria
Week 8:	**Class-19**	Chapter 6: Le Chatliers Principle
	Class-20	Chapter 6: Heterogeneous Equilibria
	Class-21	Chapter 7: Acids and Bases, conjugate acid base pairs
Week 9:	**Class-22**	Chapter 7: Acid base reactions, autoionization of water
	Class-23	Chapter 7: Acid and base in solution,
Week 10:	**Class-24**	Chapter 7: calculation pH of acids and bases in solution
	Class-25	Chapter 6-7 recaps
	Class-26	**EXAM II Chapters 5-7**
Week 11:	**Class-27**	Chapter 8: Applications of Aqueous Equilibria
	Class-28	Chapter 8: Common ion effect
	Class-29	Chapter 8: Buffered solutions
Week 12:	**Class-30**	Chapter 8: Titrations of buffer solutions
	Class-31	Chapter 8: Acid base titrations
	Class 32	Chapter 8: Calculation a titration curve, indicators
Week 13:	**Class-33**	Chapter 9: Energy, Enthalpy, and Thermochemistry,
	Class-34	Chapter 9: state functions, heat transfer
	Class-35	Chapter 9: Laws of Thermodynamics
Week 14:	**Class-36**	Chapter 9: Enthalpy, Calorimetry, Hess's Law
	Class-37	Chapter 9: Sources of energy, global concerns
	Class-38	Chapter 8-9 recaps
Week 15:	**Class-39**	**EXAM III Chapters 8-9**
	Class-40	Chapter 10: Spontaneity, Entropy and Free energy, factors that influence entropy
	Class-41	Chapter 10: Isothermal expansion of a gas, Entropy and expansions
Week 16:	**Class-42**	Chapter 10: Entropy and Physical changes

FINAL EXAM According to University exam schedule

LABORATORY SHEDULE

Week 2: **Experiment #0**
Introduction (Lab Notebook and Lab Reports)
Safety/Lab check-in/Glassware Cleaning
Experiment #1
Introduction to Data Analysis
Chem 141 Class Data
Frequently Asked Questions about Expt 1

Week 3: **Experiment #2**
Qualitative Analysis
Grading for Experiment 2

Week 4: **Experiment #2**
Qualitative Analysis

Week 5: **Experiment #2**
Qualitative Analysis

Week 6: **Experiment #2**
Qualitative Analysis

Week 7: **Experiment #2**
Qualitative Analysis

Week 8: **Experiment #3**
Introduction to the Analytical Balance and Volumetric Glassware

Week 10: **Experiment #4**
Determining the atomic weight of an element

Week 11: **Experiment #5**
Determination of Acetic Acid in Vinegar

Week 13: **Experiment #6**
Identification of an Unknown Acid by Titration

Week 15: **Experiment #7**
Heat of Vaporization of Liquid Nitrogen

Week 16: Lab clean-up and checkout