

Course Code: CHE 141 (IAI P1 902L, CHM 911)

Course Title: General Chemistry I

Department: Natural Sciences

Effective Date: Summer 2026

PCS Code: 1.1 - Baccalaureate/Transfer

CIP Code: 40.0501

Repeatability: 0

Credit Hours

Catalog Notation: 4-3-5

Credit Hour Distribution:

Lecture: 4

Lab: 3

Clinical: 0

Total: 5

General Course Information

Catalog Description

Introduces new concepts and broadens those learned previously; chemical names, formulas, and equations; types of reactions; stoichiometry; thermochemistry; atomic structure and bonding; behavior of gases, liquids, and solids; properties of solutions.

General Course Objectives

- To provide a background in chemistry which enables students to successfully transfer to a senior institution.
- To apply course content to life experiences.

Minimum Placement Levels

English

None

Reading

Placement out of CCS 098

Math

Placement out of MAT 098

Prerequisites

Credit in high school or college level chemistry within the last three years with a grade of C or higher

Recommended before enrolling (not required):

Credit in MAT 124

Methods of Evaluation

6-15 homework assignments, 0-15 quizzes, 3-5 unit exams, 10-15 performance evaluated laboratory activities, 1 writing-intensive semester project, and 1 cumulative final exam. (Methods may vary slightly from section to section.)

Instructional Materials and Additional Supplies

Atom's First Chemistry 4th Edition, Julia Burdge and Jason Overby, published by McGraw-Hill, 2021.
Chemistry 141 Experiments, Parkland College Staff.

Course Content

General Learning Outcomes (GLOs)

- Critical Thinking and Information Literacy: Students will demonstrate the ability to evaluate perspectives, evidence, and implications, and to locate, assess, and use information effectively.
- Reasoning and Inquiry: Students will demonstrate the ability to solve problems using deductive reasoning and logic, quantitative reasoning, or the scientific method.

Course Segments and Student Learning Outcomes

Course Segment	Learning Outcomes	Lecture Hours	Lab Hours	Clinical Hours
Chemical Foundations	<ol style="list-style-type: none"> 1. Distinguish among observations, laws, theories, and hypotheses in the scientific approach to knowledge. 2. State and apply rules for taking measurements and significant figures. 3. Identify the common SI units for mass (kg), length (m), and time (s) and know the meaning of the following metric prefixes (i.e. memorize and be able to apply): giga, mega, kilo, deci, centi, milli, micro, nano, pico. Memorize and be able to apply $1 \text{ cm}^3 = 1 \text{ mL}$. 4. Perform conversions among different units using dimensional analysis (note: students should be able to apply English to metric and English to English conversion factors, but they do not need to memorize them). 5. Interconvert temperatures among Celsius, Fahrenheit, and Kelvin scales. 6. Solve problems involving density. 7. Differentiate between pure substances and mixtures, and correctly use specific terms such as elements, compounds, homogeneous, heterogeneous, states (phases), and solutions. 8. Differentiate between chemical and physical properties and changes. 	2	0	0
Atomic Theory	<ol style="list-style-type: none"> 1. Explain atomic theories. 2. Describe the discovery of subatomic particles. 3. Navigate the periodic table. 4. Perform atomic mass calculations involving moles, molar mass, and percent composition. 	3	0	0
Quantum Theory	<ol style="list-style-type: none"> 1. List the eight regions of the electromagnetic spectrum in the designated order and perform calculations involving frequency, wavelength, and energy (note: students should memorize $E = hv$ and $c = vl$ and be able to apply Planck's constant and the speed of light, if given). 2. Define photon and relate the photon to the dual nature of electromagnetic radiation. 3. Describe the relationship between electronic transitions and line spectra. 4. Solve quantitative problems related to electronic transitions in the hydrogen atom. 5. Explain, in a qualitative way, the Bohr model of the hydrogen atom. 6. List the four quantum numbers and relate them to electronic structure by creating and comparing them to electron configurations. 7. Differentiate between a Bohr orbit and a quantum mechanical orbital. 8. Sketch any s, p, or d orbital. 9. Write electron configurations for all elements which strictly follow the Aufbau principle, Pauli exclusion principle, and Hund's rule. 10. Write electron configurations for the anomalies Cr, Mo, Cu, Ag, Au. Draw orbital diagrams based on electron configurations and use them to predict paramagnetism and diamagnetism. Define paramagnetic and diamagnetic. 	6	0	0

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Electron Configuration and Periodic Trends	<ol style="list-style-type: none"> 1. Use the Periodic Table to write noble gas abbreviated electron configurations (i.e. Mg = [Ne]3s²). Write the electron configurations of ions. 2. Explain the concept of effective nuclear charge and the trend which exists across a period. 3. Define ionization energy and electron affinity and be able to write equations related to each. 4. Use the Periodic Table to predict trends in ionization energies, electron affinities, and atomic radii and to provide adequate explanations for these trends. 5. Determine the number of valence electrons for main group elements. 	2	0	0
Chemical Bonding and Naming	<ol style="list-style-type: none"> 1. Draw Lewis dot symbols for atoms and ions of main group elements. 2. Distinguish and describe the difference between covalent molecular elements and covalent compounds. Identify and name ionic compounds containing monoatomic ions. 3. Distinguish between empirical and molecular formulas. 4. Define the terms diatomic vs polyatomic, homonuclear vs heteronuclear, and allotrope. 5. Predict which combinations of elements tend to bond ionically, polar covalently, and nonpolar covalently. 6. Identify and name covalent compounds and acids without oxygen. 7. Name and write formulas and charges for selected polyatomic ions. 8. Recognize trends in naming polyatomic ions. Name ionic compounds containing these polyatomic ions. 9. Name oxoacids containing these polyatomic ions. 10. Recognize and describe ionic hydrates. 11. Define and calculate molecular formula and molecular mass. 12. Determine percent composition by mass. 13. Interconvert mass, moles, and number of particles using molar mass and the mole definition. 14. Use percent by mass composition to determine empirical and molecular formulas. 	5	0	0
Bonding Theories	<ol style="list-style-type: none"> 1. Recognize that bonding is an example of a model. 2. State and explain the effect of a loss or gain of electrons on atomic size. 3. Describe the meaning of lattice energy and solve qualitative problems related to the concept. 4. Define electronegativity and apply it towards determining bond polarity. 5. Determine the formal charge on any atom within a molecule or ion. 6. Draw Lewis structures for molecules and polyatomic ions and recognize when to apply the octet rule model and when to apply the model which satisfies formal charge rules. 7. Draw resonance structures for molecules and ions and solve problems related to the resonance concept. 8. Use the Valence Shell Electron Pair Repulsion Theory (VSEPR) to predict electron pair geometries for the following electron pair arrangements: linear, trigonal planar, tetrahedral, trigonal bipyramidal, and octahedral. 9. Use VSEPR to predict bond angles and molecular geometries, and to sketch shapes of molecules using perspective drawings. 10. Predict whether molecules are polar (have a dipole moment) or nonpolar (do not have a dipole moment). 11. Use the valence bond theory (localized electron model) to predict hybridization and solve related problems. 12. Describe the difference between sigma and pi bonds and be able to sketch pi bonds. 13. State the relative bond lengths of similar single, double, and triple bonds and solve related problems. 14. Describe basic molecular orbital theory, in particular how it contrasts with valence bond theory. 15. Define and explain the difference between bonding and antibonding orbitals. 16. Draw MO diagrams for period 1 and 2 homonuclear diatomic molecules and use them to evaluate bond order. 	8	0	0

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Stoichiometry	<ol style="list-style-type: none"> 1. Interpret, write, and balance chemical reactions. 2. Calculate molar mass, empirical formulas, and percent composition. 3. Interconvert mass, moles, and number of particles. 4. Determine limiting reactants and products, calculate the mass of reactants and products, and calculate reaction yields. 5. Perform combustion analysis calculations. 	5	0	0
Types of Chemical Reactions	<ol style="list-style-type: none"> 1. Define the terms solute, solvent, and solution. 2. Define the terms strong, weak, and non-electrolyte and solve related problems. 3. Define Arrhenius acid and base. 4. Define and list common examples of: a) strong acids, b) weak acids, c) strong bases, and d) weak bases. 5. List and/or recognize all ionic compounds and strong acids as examples of strong electrolytes. 6. List and/or recognize weak acids and weak bases as examples of weak electrolytes. 7. List and/or recognize common examples of nonelectrolytes. 8. Recognize and describe the nature of a precipitation reaction, acid-base reaction, and redox reaction. 9. State and be able to apply the solubility rules for ionic compounds. 10. Predict products and write a balanced molecular equation, ionic equation, and net ionic equation for precipitation reactions and acid-base reactions that are double displacement reactions. 11. Identify spectator ions in a chemical reaction. 12. State the meaning of molarity. 13. Calculate the molarity of a solution (or of the ions in solution for strong electrolytes) and solve related problems. 14. Solve molarity problems involving calculating quantities of solute or solution. 15. Describe the proper techniques for solution preparation. 16. Solve problems involving dilutions of solutions. 17. Define titration and perform calculations related to titrations. 18. Use gravimetric analysis to evaluate precipitation reactions. 	6	0	0
Thermochemistry	<ol style="list-style-type: none"> 1. Solve problems related to work (in terms of pressure and volume) and the first law of thermodynamics. 2. Define exothermic and endothermic reaction and solve related problems. 3. Solve problems related to enthalpy. 4. Define the terms specific heat capacity (specific heat), heat capacity, and molar heat capacity and solve related problems. 5. Solve problems related to calorimetry and describe what a bomb calorimeter is. 6. Use Hess' Law to calculate enthalpy changes for a variety of reactions. 7. Apply knowledge of standard states and standard enthalpies of formation to calculate the enthalpy change for a variety of reactions and solve related problems. 	4	0	0
Gases	<ol style="list-style-type: none"> 1. Describe what is meant by gas pressure. 2. Identify, memorize conversion factors, and know how to interconvert between the following common units of pressure: atm, mm Hg, and torr. 3. Identify and, if given the conversion factors, know how to interconvert between the following common units of pressure: Pa, inHg, and psi (pounds per square inch). 4. State and describe the meaning of Boyle's, Charles', and Avogadro's Laws. 5. Solve qualitative and quantitative problems involving the application of Boyle's, Charles', and Avogadro's Laws. 6. Explain the difference between an ideal gas and a real gas. 7. State the values for standard temperature and pressure and the molar volume of a gas at STP. 8. Solve problems involving the ideal gas law ($PV = nRT$). 9. Perform stoichiometric calculations that involve gaseous reactants and/or products. 10. State Dalton's Law of Partial Pressures, state the meaning of mole fraction, and solve related problems. 11. Use the kinetic-molecular theory to explain the gas laws. 	4	0	0

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Liquids and Solids	<ol style="list-style-type: none"> List the various intermolecular attractions in liquids and solids (dipole-dipole, London dispersion, hydrogen bond, and ion-dipole), describe the nature and relative strength of each, and identify which compounds exhibit which intermolecular attraction. Predict and explain how intermolecular attractions affect the physical properties of liquids and solids. List the characteristics of molecular, network covalent, ionic, and metallic solids. Describe the relationships among temperature, vapor pressure, and boiling point. Define heat of vaporization and heat of fusion and solve related problems. Differentiate between the terms melting, freezing, boiling, evaporation, condensation, sublimation, and deposition. Draw and interpret a heating/cooling curve for a substance. Describe the nature of a supercooled liquid and a superheated liquid. Solve quantitative problems related to heat of fusion and heat of vaporization. Define normal melting point and normal boiling point. Interpret phase diagrams. Define the terms critical point and triple point as they apply to phase diagrams. 	4	0	0
Physical Properties of Solutions	<ol style="list-style-type: none"> Explain the colligative properties of solutions. Perform calculations involving colligative properties of solutions. 	2	0	0
Chemical Equilibrium	<ol style="list-style-type: none"> Write equilibrium-constant expressions for a balanced chemical equation. Numerically evaluate K_c from knowledge of the equilibrium concentrations of reactants or products or from the initial concentrations and the equilibrium concentration of at least one substance. Calculate the reaction quotient, and by comparison with the value of K_c, determine whether a reaction is at equilibrium. Use the equilibrium constant and ICE tables to calculate the equilibrium constant to calculate the equilibrium concentrations. Explain how the relative equilibrium quantities of reactants and products are shifted by changes in temperature, pressure, or the concentrations. Explain how the change in equilibrium constant or reaction quotient is related to the reaction. 	9	0	0
Introduction to the Chemical Laboratory and Measurement	<ol style="list-style-type: none"> Identify safety features and procedures in the lab. Identify lab glassware and instrumentation. Employ proper techniques to measure data points correctly including use of a buret, top-loading and analytical balances, a ruler, a thermometer, and graduated cylinders. Maintain a scientific notebook. 	0	3	0
Lab Techniques, Glassware, and Density	<ol style="list-style-type: none"> Employ proper techniques to measure volume using a graduated pipet, graduated cylinder, buret, and volumetric flask. Determine the density of an object by water displacement. Measure the masses of several volumes of a sodium chloride solution, plot the data, and determine the density of the solution from the graph. Design simple procedures to evaluate the densities of common substances. Maintain a scientific notebook. 	0	3	0
Visible Light Spectroscopy Lab	<ol style="list-style-type: none"> Describe the relationship between electronic transitions and line spectra. Solve quantitative problems related to energy, wavelength, and electronic transitions in the hydrogen atom. Use literature data for the emission spectrum of helium to calibrate a spectroscope. Measure the wavelengths of the lines in the hydrogen emission spectrum using a spectroscope. Maintain a scientific notebook. 	0	3	0
Determination of Phosphorus in Plant Food Lab	<ol style="list-style-type: none"> Selectively precipitate phosphorus in a sparingly soluble salt. Collect the precipitate via gravity filtration or vacuum filtration. Employ gravimetric analysis to determine the mass percent of phosphorus and P_2O_5 in a plant food sample. Evaluate the experimentally determined P_2O_5 content compared to the N-P-K ratio on the plant food label. Maintain a scientific notebook. 	0	3	0

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3D Printing and Bonding Lab	<ol style="list-style-type: none"> 1. Examine the arrangement of electrons in bonds. 2. Use light to specifically break targeted photosensitive bonds and create a controlled free radical initiated polymerization reaction. 3. Compare this reaction to others used in modern manufacturing/materials. 4. Evaluate the differences in the strengths of various covalent bonds and compare relative reactivities of different bonds. 5. Perform calculations related to energy, light, and bond enthalpies. 6. Maintain a scientific notebook. 	0	3	0
Molecular Modeling Lab	<ol style="list-style-type: none"> 1. Use 2D representations and physical models to explore molecular structure, VSEPR geometries, bond angles, molecular polarity, and hybridization. 	0	3	0
Stoichiometric Analysis of a Mixture Lab	<ol style="list-style-type: none"> 1. Engage in authentic scientific inquiry by deducing how to empirically determine the percent composition by mass of a carbonate/bicarbonate mixture 2. Utilize stoichiometry. 3. Recognize the importance of scientific communication. 4. Apply principles of green chemistry. 5. Maintain a scientific notebook. 	0	3	0
Analysis of Vinegar Lab	<ol style="list-style-type: none"> 1. Standardize a sodium hydroxide solution using potassium hydrogen phthalate. 2. Analyze the concentration of acetic acid in a commercial vinegar solution via titration. 3. Maintain a scientific notebook. 	0	5	0
Reaction Enthalpies and Hess' Law Lab	<ol style="list-style-type: none"> 1. Determine the heat capacity of a calorimeter. 2. Measure the enthalpy change for the reaction between magnesium metal and hydrochloric acid. 3. Measure the enthalpy change for the reaction between magnesium oxide and hydrochloric acid. 4. Use Hess' Law to determine the heat of formation for magnesium oxide. 5. Calculate the relative percent error between the experimentally determined value of the heat of formation and the accepted value. 6. Maintain a scientific notebook. 	0	5	0
Molar Volume of Gases Lab	<ol style="list-style-type: none"> 1. Generate, then collect oxygen gas and hydrogen gas via chemical reactions. 2. With data gathered during the lab, calculate the molar volume of each gas at STP. 3. Calculate the relative percent error between the experimentally determined values of molar volume and the accepted value. 4. Maintain a scientific notebook. 	0	5	0
Analysis of a Sports Drink Lab	<ol style="list-style-type: none"> 1. Prepare standard solutions from a stock solution of FD&C dye by serial dilution. 2. Measure the absorbance of the standard solutions using a UV/VIS spectrometer. 3. Create a calibration line from the absorbances and concentrations of the standard dye solutions. 4. Measure the absorbance of a sports drink sample containing the dye and determine its concentration in the beverage. 5. Prepare standard solutions from a stock solution of potassium ion by serial dilution. 6. Measure the emission intensity of the standard solutions via flame photometry. 7. Create a calibration line from the emission intensities and concentrations of the standard potassium ion solutions. 8. Measure the emission intensity of a sports drink sample containing potassium ion and determine its concentration in the beverage. 9. Maintain a scientific notebook. 	0	6	0

Course Segment	Learning Outcomes	Lecture Hours	Lab Hours	Clinical Hours
Le Châtelier's Principle	<ol style="list-style-type: none"> 1. Perform calculations associated with creating a solution of a specific volume and concentration. Prepare the solution using a volumetric flask. 2. Evaluate the effect of various perturbations on a system at equilibrium. 3. Use an ice bath and hot plate to evaluate if the reaction is endothermic or exothermic. 4. Maintain a scientific notebook. 	0	3	0

Total Contact Hours

Lecture Hours	Lab Hours	Clinical Hours
60	45	0