

### Course Description

#### **CHM1020 | General Education Chemistry | 3.00 credits**

This course provides students with an introduction to chemical principles and applications for the non-science major. Students will engage in problem solving and critical thinking while applying chemical concepts. Topics will include the scientific method of problem solving, classification of matter, atomic theory, the periodic table, gases, chemical reactions, energy, and chemical bonds. Student learning outcomes: students will be able to distinguish between physical and chemical properties and changes; students will recognize components of gaseous chemistry; students will recognize components of aqueous chemistry including properties of water, solutions, and acids and bases; students will correlate the design of the periodic table to periodic trends and physical and chemical properties elements; and students will write and interpret chemical formula and write balanced chemical equations.

### Course Competencies:

**Competency 1:** The student will be able to demonstrate knowledge of the fundamental methodologies of science by:

1. Describing the steps involved in the scientific method.

**Competency 2:** The student will be able to demonstrate knowledge of the basic units, calculations, conversions, and measurements that are the very foundation of chemistry by:

1. Demonstrating how large or small numbers are expressed in scientific or exponential notation.
2. Converting ordinary numbers into scientific or exponential notation and vice-versa.
3. Converting measurements from one metric unit to another using conversion factors.
4. Defining density and performing basic density calculations.

**Competency 3:** The student will demonstrate knowledge of matter's classification, properties, and changes by:

1. Comparing and contrasting several properties of the different states of matter.
2. Explaining how the interconversion between states of matter can occur and describing and naming these processes.
3. Identifying the symbols used to represent the most common elements.
4. Distinguishing matter as either a pure substance or mixture.
5. Distinguishing pure substances as elements or compounds.
6. Distinguishing mixtures as either homogeneous or heterogeneous.
7. Distinguishing between physical and chemical properties and physical and chemical changes of matter.

**Competency 4:** The student will be able to demonstrate knowledge of the basic building blocks of matter by:

1. Identifying several properties and general arrangement of the atom's three major subatomic particles (i.e., electrons, protons, and neutrons).
2. Defining isotopes and describing how various isotopes of a single element differ.
3. Identifying the number of protons, neutrons, electrons, mass number, and atomic number that an atom has, given its isotopic symbol.

**Competency 5:** The student will be able to demonstrate an ability to understand several of the intricacies of the periodic table by:

1. Distinguishing between periods and groups on the periodic table.
2. Showing the relationship between position on the periodic table and atomic number.
3. Distinguishing elements by using the structure of the periodic table and the periodic law (e.g., metal, non-metal, metalloid, noble gas, representative element, transition element, alkali metal, alkaline earth metal, and halogen).

4. Describing the relationship that exists between the number of valence electrons an element has and its group number.
5. Describing the relationship between an element's group number and the ion that it commonly forms.

**Competency 6:** The student will be able to demonstrate knowledge of electronic structures by:

1. Demonstrating the relationship between wavelength, frequency, and energy of electromagnetic radiation.
2. Stating the number of electrons that can be accommodated in the main energy levels of an atom.
3. Using the Bohr Model to determine the electronic configuration for the first twenty elements in the periodic table.
4. Stating the number of valence electrons in an atom.

**Competency 7:** The student will be able to demonstrate knowledge of chemical bonding and intermolecular forces by:

1. Predicting the bond that two atoms will form depending on where they are located on the periodic table.
2. Describing the formation of ions from their parent atoms.
3. Describing how and why ionic and covalent bonds form.
4. Writing the Lewis electron dot structure of elements, ions, ionic compounds, and covalent compounds.
5. Comparing and contrasting ionic and covalent bonding.
6. Defining electronegativity.
7. Describing the difference between polar and non-polar covalent bonds.
8. Predicting bond polarity by calculating the difference in electronegativity between two elements involved in a chemical bond.
9. Describing how forces of attraction, such as hydrogen bonding, operate between molecules.

**Competency 8:** The student will be able to demonstrate knowledge of the composition, nomenclature, and reactivity of several chemical substances by:

1. Identifying what atoms are present in a compound and in what ratio.
2. Naming and writing the formula of binary ionic and covalent compounds.
3. Naming and writing the formula of common polyatomic ions.
4. Naming and writing the formula of ternary ionic compounds.
5. Defining a mole.
6. Computing the molar mass of a substance from the sum of the atomic masses of the elements from which it is made.
7. Manipulating conversions between mass and moles.
8. Producing balanced chemical equations.
9. Identifying the significance of the coefficients in a balanced chemical equation.
10. Solving basic stoichiometry problems.
11. Applying the Law of Conservation of Mass.
12. Comparing and contrasting endothermic and exothermic reactions.

**Competency 9:** The student will be able to demonstrate knowledge of the properties and characteristics of water and aqueous solutions by:

1. Showing the distribution of water resources on the surface of the earth and how water is recycled in the hydrologic cycle.
2. Distinguishing between the components in a solution.
3. Distinguishing between the different types of solution (i.e., saturated, unsaturated, and supersaturated).
4. Showing how polarity, temperature, and pressure affect solubility.
5. Performing mass percent and molarity calculations.
6. Identifying several unique properties of water.
7. Comparing and contrasting several properties of solution (e.g., freezing point depression, boiling point

elevation, osmosis).

8. Explaining water hardness and its effects.
9. Explaining steps to treat, purify, and disinfect water.

**Competency 10:** The student will be able to demonstrate knowledge of acid-base chemistry by:

1. Predicting the products and producing balanced equations for ionization reactions of acids, bases, and salts.
2. Differentiating between different types of electrolytes (e.g., strong, weak, and nonelectrolytes).
3. Comparing and contrasting properties of acids and bases.
4. Predicting the products and producing balanced equations for neutralization reactions.
5. Describing the interrelationship between pH, pOH, [H<sup>+</sup>], and [OH<sup>-</sup>] and the conversion from one to another.
6. Comparing and contrasting properties of buffered and unbuffered solutions.

**Competency 11:** The student will be able to demonstrate knowledge of the nature and nomenclature of organic compounds by:

1. Providing dash structural formulas and condensed structural formulas for various classes of organic compounds.
2. Identifying and producing formulas for structural isomers.
3. Distinguishing between functional groups (alkanes, alkenes, alkynes, arenes, halides, alcohols, phenols, ethers, amines, aldehydes, ketones, carboxylic acids, esters, and amides).
4. Applying the International System of Pure and Applied Chemistry (IUPAC) nomenclature to simple organic compounds.

**Competency 12:** The student will be able to demonstrate knowledge of the nature of biomolecules by:

1. Comparing and contrasting the properties, sources, caloric value, and dietary and nutritional importance of carbohydrates, lipids, and proteins.
2. Comparing and contrasting the composition and properties of nucleic acids.

**Competency 13:** The student will be able to demonstrate knowledge of nuclear chemistry by:

1. Comparing and contrasting the relative harmfulness, shielding requirements, and penetrating ability of several types of nuclear radiation emitted from atomic nuclei.
2. Producing balanced nuclear reactions.
3. Identifying radioisotopes' risks, benefits, disposal, and uses.
4. Solving half-life problems.
5. Comparing and contrasting nuclear fission and fusion.

**Learning Outcomes:**

- Communicate effectively using listening, speaking, reading, and writing skills
- Use quantitative analytical skills to evaluate and process numerical data
- Solve problems using critical and creative thinking and scientific reasoning