

CHEMISTRY FOR THE HEALTH SCIENCES

Course 1440 140

(3 Credits, Fall Semester, no prerequisite; W: Workshop; L: Practical Laboratory)

Learning Objective

The course objective is to educate and train students with an adequate background in basic chemical principles of health sciences and to provide an understanding of fundamental organic and inorganic components of the human body. With this knowledge, students will be able to advance into Biochemistry and Molecular Biology, Clinical Chemistry, and Pharmaceutical Chemistry as a health science profession.

Total Lecture hours: 38

Part One: Basic Chemical Principles

1. Introduction

2. Periodic table

- Subatomic structure, Electronic configuration, Pauli's and Hund's rules
- Classification of elements in the Periodic Table: elements and isotopes and their significance
- Elements and life

3. Chemical Bonding

- Ionic bonds
- Covalent bonds; polarity, geometry (VSEPR model)
- H-bonds and weak forces.

4. Chemical Reactions

- Classes of chemical reactions
- Chemical reactions: Energy and rates
- Chemical reactions and Equilibrium

5. Solution Chemistry

- Characteristics of solutions, colloids and mixtures
- The solution process and solid hydrates
- Effect of temperature and pressure on the solubility
- Concentration expressions of solutions
- Dilution of solutions

- Electrolytes in body fluids; equivalents and milliequivalents
- Colligative properties of solutions
- Osmosis and osmotic pressure
- Isotonic, hypotonic and hypertonic solutions
- Dialysis and hemodialysis

- Acids, Bases, Salts and Buffers. Henderson-Hasselbalch equation, pH and K eq. calculations
- Gases, Gas properties, O₂, O₃, H₂, NO, CO₂
- Applications of acids, bases, gases and buffer systems in body fluids, blood and urinary chemistry.

Part Two: Organic Chemistry

6. Organic molecules

- **Carbon as basic element of life: Electronic structure of carbon and valency**
 - Hybridization of carbon; properties of sp³, sp², sp
 - Covalent bonds of carbon; sigma bonds and pi bonds
 - Hybridization of carbon in simple organic compounds; CH₄, C₂H₄, C₂H₂
 - Bond strength, length and bond geometry
 - Delocalization and pi bonds; C₆H₆

7. Hydrocarbons

- Alkanes
- Alkenes & Alkyl halides

8. Aromatic Compounds and the Structure of Benzene.

- Naming Aromatic Compounds.
- Reactions of Aromatic Compounds

9. Compounds with Oxygen, Sulfur, or a Halogen

- Alcohols, Phenols and Ethers. Naming Alcohols. Properties of Alcohols. Reactions of Alcohols
- Phenols. Acidity of Alcohols and Phenols
- Ethers
- Thiols and Disulfides
- Halogen-Containing Compounds
- Aldehydes and ketones

10. Carboxylic acids & Esters

11. Amines & Amides

12. Organic reactions

Part Three: Analytical Methods

18. Chromatography; essential methods for separation and study of biomedical compounds

Part Four: Biomolecules

13. Structure and chemical properties of carbohydrates

- Monosaccharides, disaccharides, polysaccharides. Stereochemistry

14. Chemistry of Lipids

- Fatty acids, triacylglycerols, phospholipids

15. Structure and physico-chemical properties of amino acids and peptides

- Structure of amino acids
- Ionization of functional groups
- Classification of amino acids: polar, non polar, acidic, basic
- L and D Amino acid
- Structure of peptide bond

16. Chemistry of nucleotides and polynucleotides

- Chemical structure of nucleotides and nucleosides
- Nomenclature of RNA and DNA nucleotides
- Nucleotides as monomeric units of nucleic acids
- Polynucleotide chain (chemical orientation, phosphodiester bonds).

17. Coordination Chemistry

- **Transition elements**
 - Position of transition elements in the periodic table
 - Properties of transition elements including lanthanides and actinides
 - Role of certain transition elements in human health
- **Coordination Compounds**
 - Coordination compounds, coordination number and ligands
 - Properties of coordination compounds
 - Importance of coordination compounds in biology and health.

Part Five: Workshops & Practicals

Workshops

- W1: Electronic configuration and Chemical bonding
- W2: Chemical literacy for Health Sciences Profession: Inorganic compounds and basic chemical calculations.

- W3: Chemical literacy for Health Sciences Profession: Organic compounds, Part I
- W4: Chemical literacy for Health Sciences Profession: Organic compounds, Part II

Practical Laboratories

- Lab 1: Physicochemical properties of compounds of medical interest
- Lab 2: Identification of inorganic medical compounds
- Lab 3: Preparation of standard solutions and standardization. Titrimetric analysis (Acid-base titration).
- Lab 4: Identification of organic medical compounds (Functional group analysis)
- Lab 5: Complexometric titration and Instrumental analysis –chromatography. Thin-layer chromatography

Textbooks

- Fundamentals of general, Organic, and Biological Chemistry by McMurry, Castellion, Ballantine, Hoeger, Peterson (Pearson, latest edition)
- Lab Manual