

## Course Outline

### Online Entry Test for Healthcare Assistant Certificate (HCA) – 2025

#### Syllabus (FSC level)

#### **PREAMBLE**

The National University of Medical Sciences (NUMS) is committed to setting the highest standards for the Entry Test for admission to its School of Allied Health Sciences. To ensure a level playing field for all aspiring candidates, the minimum syllabus is based on “must-know knowledge”, derived from common topics approved by various curriculum regulatory authorities in Pakistan.

However, as this is a highly competitive examination, candidates are strongly encouraged to adopt a broad-based study approach and not restrict themselves solely to the prescribed syllabus. A thorough and comprehensive preparation will significantly enhance their chances of success.

#### **BIOLOGY**

1.	Bio-diversity (acellular life / variety of life)
2.	Bio-energetics
3.	Biological molecules
4.	Cell structure and function

5.	Coordination and control / nervous & chemical coordination
6.	Enzymes
7.	Evolution
8.	Life processes in animals and plants (nutrition / gaseous exchange / transport)
9.	Prokaryotes
10.	Reproduction
11.	Support and movement
12.	Variation and genetics / inheritance

### TOPICS

1. Biodiversity (Acellular life / Variety of life)

- a. Classification of viruses
- b. Structure of viruses

2. Bioenergetics

- a. Anaerobic respiration (respiration without oxygen)
- b. Electron transport chain

- c. Glycolysis / aerobic respiration
- d. Photosynthesis
- e. Production of ATP
- f. Role of light, water, CO<sub>2</sub>, / factors effecting photosynthesis

### 3. Biological molecules

- a. Introduction to biological molecules
- b. Water
- c. Carbohydrates
- d. Proteins
- e. Lipids
- f. Conjugated molecules (glycolipids, glycoproteins)

### 4. Cell structure and function

- a. Cell wall
- b. Cytoplasm and cell organelles
  - 1) Nucleus
  - 2) RNA
  - 3) Endoplasmic reticulum
  - 4) Mitochondria
  - 5) Golgi apparatus / golgi complex / golgi bodies
  - 6) Lysosomes
  - 7) Plastids/chloroplasts
  - 8) Vacuoles
- c. Prokaryote and eukaryote
- d. Fluid mosaic model

### 5. Coordination and control / nervous & chemical coordination

- a. Nervous system
  - 1) Nerve impulse
  - 2) Steps involved in nervous coordination
  - 3) Neurons (Structure and Types)
- b. Transmission of action potential between cells—synapse
  - 1) Electrical synapses
  - 2) Chemical synapses
  - 3) Transmission of nerve impulse across synapse

- c. Hormones
- d. Endocrine glands
- e. Feedback mechanism
  - 1) Positive feedback mechanism
  - 2) Negative feedback mechanism
- f. Reflexes and reflex arc
- g. Levels of the spinal cord and its main functions
- h. Parts of the brain with their main functions

#### 6. Enzymes

- a. Introduction / characteristics of enzymes
- b. Mechanism of action of enzymes
- c. Factors effecting rate of enzyme action
- d. Enzyme inhibition

#### 7. Evolution

- a. Inheritance of acquired characteristics
- b. Darwinism
- c. Darwin's theory of evolution

#### 8. Life processes in animals and plants (nutrition / gaseous exchange / transport)

- a. Osmotic pressure / potential
- b. Cardiovascular system (including human heart structure, blood vessels)
- c. Respiratory system
- d. Digestive system
- e. Immune system
- f. Lymphatic system

#### 9. Prokaryotes (Kingdom Monera)

- a. Cellular Structure of bacteria
- b. Shape and size of bacteria
- c. Importance and control of bacteria

#### 10. Reproduction

- a. Male reproductive system
- b. Female reproductive system (including menstrual cycle)

#### 11. Support and movement

- a. Cartilage
- b. Types of muscles
  - 1) Skeletal muscles
  - 2) Cardiac muscles
  - 3) Smooth muscles

- c. Structure of skeletal muscles
- d. Mechanism of skeletal muscle contraction
- e. Types of joints

12. Variation and genetics / inheritance

- a. Mendel's law of inheritance
  - 1) Inheritance of single trait
  - 2) Mendel's principles of inheritance
  - 3) Inheritance of two traits
  - 4) Law of independent assortment
- b. Multiple alleles
- c. Sex linkage in human

## CHEMISTRY

1.	Introduction to fundamental concepts of chemistry
2.	Atomic structure
3.	Gases
4.	Liquids
5.	Solids
6.	Chemical equilibrium
7.	Reaction kinetics
8.	Thermo-chemistry and energetics of chemical reactions
9.	Electrochemistry
10.	Chemical bonding
11.	S and p block elements
12.	Fundamental principles of organic chemistry
13.	Chemistry of hydrocarbons
14.	Alcohols and phenols
15.	Aldehydes and ketones

TOPICS

1. Introduction to fundamental concepts of chemistry

- a. Atomic mass
- b. Empirical formula
- c. Molecular formula
- d. Concept of mole
- e. Avogadro's number
- f. Stoichiometry

2. Atomic Structure

- a. Concept of orbitals
- b. Electronic configuration
- c. Discovery and properties of proton (positive rays)
- d. Quantum numbers
- e. Shapes of orbitals

3. Gases

- a. Properties of gases
- b. Gas laws
- c. Boyle's law
- d. Charles's law
- e. General gas equation
- f. Kinetic molecular theory of gases
- g. Ideal gas equation

4. Liquids

- a. Properties of liquids
- b. Intermolecular forces
- c. Hydrogen bonding
- d. Vapor pressure
- e. Boiling point and external pressure

5. Solids

- a. Types of solids
- b. Ionic solids
- c. Molecular solids

6. Chemical Equilibrium

- a. Reversible and irreversible reactions
- b. State of chemical equilibrium

- c. Solubility product
- d. The Le Chatelier's principle
- e. Synthesis of ammonia by Haber's Process
- f. Buffer solutions

7. Reaction Kinetics

- a. Rate of reaction
- b. Determination of the rate of chemical reaction
- c. Factors affecting rate of reaction
- d. Order of reaction and its determination

8. Thermochemistry and energetic of chemical reactions

- a. Definitions of terms used in thermodynamics
- b. Energy in chemical reactions
- c. First Law of thermodynamics
- d. Enthalpy of a reaction
- e. Hess's law of constant heat summation

9. Electrochemistry

- a. Oxidation number or state
- b. Explanation of electrolysis
- c. Electrode potential

10. Chemical Bonding

- a. Energetic of bond formation
- b. Atomic sizes
- c. Atomic radii
- d. Ionic radii
- e. Covalent radii
- f. Ionization energy
- g. Electron affinity
- h. Electro negativity
- i. Bond energy
- j. Bond length
- k. Types of bonds
- l. Electrovalent or Ionic Bond
- m. Covalent bond
- n. Sigma and Pi bond
- o. Hybridization
- p.  $sp^3$ -Hybridization
- q.  $sp^2$ -Hybridization
- r.  $sp$ -hybridization

11. s and p Block Elements

- a. Electronic configuration

- b. Chemical properties of s-block elements
- c. Group1 Elements (Alkali Metals)
- d. Atomic and Physical properties
- e. Group2 Elements (Alkaline earth metals)
- f. Physical and chemical properties

12. Fundamental principles of organic chemistry

- a. Classification of organic compound
- b. Isomerism

13. Chemistry of hydrocarbons

- a. Open chain and closed chain hydrocarbons
- b. Benzene: Properties, reactions

14. Alcohols and phenols

- a. Alcohols:
  - 1) Classification
  - 2) Reactivity
- b. Phenols: 1) Physical properties 2) Reactivity

15. Aldehydes and ketones

- a. Reactions

16. Carboxylic acids

- a. Physical properties
- b. Reactivity

**PHYSICS**

1.	Force and motion
2.	Work and energy
3.	Rotational and circular motion
4.	Waves
5.	Thermodynamics
6.	Electrostatics
7.	Current electricity

8.	Electromagnetism
9.	Electromagnetic induction
10.	Electronics
11.	Nuclear physics

## TOPICS

1. Force and motion
  - a. Displacement
  - b. Velocity
  - c. Acceleration
  - d. Newton's laws of motion
  - e. Linear Momentum
  - f. Law of conservation of momentum
  - g. Collision
  - h. Projectile motion
  
2. Work and energy
  - a. Work
  - b. Energy
  - c. Kinetic energy
  - d. Potential energy
  - e. Gravitational potential energy
  - f. Power
  
3. Rotational and circular motion
  - a. Angular displacement
  - b. Revolution
  - c. Degree
  - d. Radian
  - e. Angular velocity
  - f. Relation between linear and angular displacements
  - g. Centripetal force
  
4. Waves
  - a. Crest
  - b. Trough
  - c. Amplitude
  - d. Wavelength
  - e. Time period and frequency
  - f. Transverse waves
  - g. Longitudinal waves
  - h. Speed of sound in air

- i. Doppler effect
  - j. Simple harmonic motion (SHM)
  - k. Characteristics of simple harmonic motion
  - l. Amplitude
  - m. Vibration
  - n. Time period
  - o. Frequency
5. Thermodynamics
- a. First law of thermodynamics
  - b. Specific heat and Molar specific heat / specific heat capacity
6. Electrostatics
- a. Coulomb's law
  - b. Electric field and its intensity
  - c. Electric potential
  - d. Capacitor
  - e. Capacitance
  - f. Capacitance of a capacitor and its unit
  - g. Energy stored in a capacitor
  - h. Charging and discharging a capacitor
7. Current Electricity
- a. Ohm's Law
  - b. Electrical resistance
  - c. Effect of temperature on resistance
  - d. Electric power
  - e. Units of electric power
  - f. Kilowatt-hours
8. Electromagnetism
- a. Magnetic field
  - b. Magnetic Flux
  - c. Magnetic flux density
9. Electromagnetic induction
- a. Electromagnetic induction
  - b. Faraday's Law
  - c. Lenz's Law
  - d. Generating electricity - Alternating Current Generator
  - e. Transformers
10. Electronics
- a. Rectification

11. Nuclear Physics

- a. Nuclear decay / the law of radioactive decay
- b. Half Life and rate of decay
- c. Biological effects of radiation
- d. Biological and medical uses of radiation

**ENGLISH**

1.	Vocabulary
2.	Tense / Sentence structure
3.	Spelling
4.	Punctuation
5.	Verb / Adverb / Adjective