

**RANGE OF KNOWLEDGE REQUIRED –
TOPICS TO PREPARE FOR THE ENTRANCE EXAM**

Admission for studies in English: Medicine (6MD) & Dentistry (5DMD)

BIOLOGY

1. Macromolecules: carbohydrates and lipids (structure, synthesis, metabolism, functions, examples of the use in living organisms), proteins and nucleic acids (structure, synthesis, metabolism, functions, examples of the living organisms).
2. Energy of life: metabolism, energy flow through organisms, forms of energy, laws governing energy flow, free energy, equilibrium, ATP (powering cells, synthesis, hydrolysis, function, regeneration).
3. Enzymes: activation energy, speeding up reactions, substrates, active site.
4. Prokaryotic cell – characterization.
5. Eukaryotic cell – characterization.
6. Cell membranes - structure and functions (built, transport).
7. Cellular organelles - structure and function of mitochondria and chloroplast.
8. Cellular organelles - structure and function of nucleus, nucleolus and rough endoplasmic reticulum.
9. Cellular organelles - structure and function of ribosomes, Golgi apparatus and the cytoskeleton.
10. Cell communication: cell junctions, receptors and chemical messengers, pathways of intracellular signal transduction.
11. Cell cycle, mitosis and meiosis process.
12. Catabolic and anabolic processes in human organism – from macromolecules to simplest inorganic compounds (general pathways).
13. Glycolysis (and its connection to other metabolic pathways).
14. Krebs cycle (and its connection to other metabolic pathways).
15. Cellular respiration (electron transport, proton motive force, oxidative phosphorylation).
16. Protein and fats metabolism (and its connection to other metabolic pathways).
17. Mendelian genetics (concepts, experiments, laws, connection to modern genetics).
18. Linkage and chromosomes (organization of genetic material in cell, sex linked genes, linked genes, genetic disorders, inheritance patterns).
19. Nucleic acids as genetic material (DNA - structure, function, organization, role in cell and organism).
20. Nucleic acids as genetic material (RNA - structure, function, organization, role in cell and organism).
21. Expression of genes - transcription and translation (role, function, all the details).
22. Regulation of gene expression in prokaryotes and eukaryotes.
23. Mutations in organism (gene level, chromosome level, role in pathogenesis and role in evolution).
24. DNA technology and genome evolution (sequencing, cloning, GMO, DNA-based biotechnology).
25. Skeletal System: the structure and functions of bones, types of bones, structural classes of joints (fibrous, cartilaginous and synovial joints).
26. Muscle structure and physiology: structure of a muscle cell, structures of muscle filaments, basic types of vertebrate muscle (skeletal muscle, cardiac muscle, smooth muscle) processes of muscle contraction.

27. Structure and function of the skin, accessory structures of the skin: nails, hairs (which extend from hair follicles), glands located within the layers of the skin (sebaceous glands, sudoriferous glands, ceruminous glands).
28. Structure and function of the nervous system, main parts (sub-divisions) of the nervous system, parts of the central nervous system, neurons and glial cells, blood-brain barrier, structure and function of electrical and chemical synapses.
29. Sense organs: the visual system, hearing and equilibrium, taste and olfaction, types of sensory receptors.
30. Respiratory system: structure of upper and lower respiratory tract, external and internal respiration, function of hemoglobin.
31. Circulation system: pulmonary and systemic circulation, the structure and function of the heart, structure and functions of blood vessels, comparison between arteries and veins.
32. The structure and functions of blood: the functions of blood (generally - as opposed to the functions of particular components of blood), the composition of blood (incl. the different types of blood cells and their properties and functions), process of oxygenation of tissues due to circulation of blood, types of leucocytes (white blood cells), the blood clotting mechanism.
33. Immune system: the organs of the immune system, the cells of the immune system, the immune response, antigen- antibody, allergies, vaccination.
34. Endocrine system: definition of the hormone, water-soluble hormones and fat-soluble hormones, hormone regulation feedback mechanisms, major glands of the endocrine system and other (non-endocrine glands) organs and tissues that secrete hormones.
35. Structure of the digestive tract, digestive enzymes and their functions, absorption in the digestive tract, function of the liver and gallbladder, pancreas and its functions.
36. Urinary system: parts and functions of the urinary system, anatomy of the kidney, kidney nephron and bladder, processes of blood filtration by the kidneys, female bladder and urethra, male bladder and urethra, characteristics and composition of urine.
37. Reproductive system: parts and functions of the female and male reproductive system, gametogenesis, the menstrual cycle.
38. Viruses: definition, structure and replication, bacteriophage, viroids and prions, human virus infections, transmission of viruses, virus tissue tropism, emerging viruses.
39. Bacteria: characteristics of bacteria, five basic shapes of bacteria, cell surface structures, the gram stain, motility, bacterial growth, plasmids, diverse nutritional and metabolic adaptation, harmless, beneficial, and harmful bacteria.
40. Fungi: types and characteristics, body structure, fungal reproduction, fungi as pathogens, role in ecosystems.
41. Protists: definition, characteristics and examples, role in environment.
42. Ecology: biosphere, ecosystem, community, population, habitat, niches, biotic potential, limiting factors, tolerance, carrying capacity, adaptation, succession, consumers, producers, food chain, symbiosis, mutualism, commensalism, parasitism.
43. Evolution: evolution in population, evolution of human being, Hardy-Weinberg equilibrium, natural selection, genetic drift, and gene flow, phylogeny and the tree of life.

CHEMISTRY

- I. Chemistry and measurements
 1. Chemistry
 2. Units of measurements
 3. Density
- II. Matter and energy
 1. Classification of matter
 2. States and properties of matter
 3. Temperature
 4. Energy
 5. Specific heat
 6. Changes of state
- III. Atoms and elements
 1. Elements and symbol
 2. The periodic table
 3. The atom
 4. Atomic number and mass number
 5. Isotopes and atomic mass
 6. Electron energy levels
- IV. Nuclear chemistry
 1. Nuclear radioactivity
 2. Nuclear reactions
 3. Radiation measurement
 4. Half-life of a radioisotope
 5. Nuclear fission and fusion
- V. Ionic and molecular compounds
 1. Ions
 2. Naming ionic compounds
 3. Writing formulas for ionic compounds
 4. Polyatomic ions
 5. Molecular compounds
 6. Electronegativity and bond polarity
 7. Shapes and polarity of molecules
 8. Attractive forces of compounds
- VI. Chemical quantities and reactions
 1. The mole
 2. Molar mass and calculations
 3. Equations for chemical reactions
 4. Types of reactions
 5. Oxidation-reduction reactions
 6. Mole relationships in chemical equations
 7. Mass calculation for reactions
 8. Energy in chemical reactions

- VII. Gases
 - 1. Properties of gases
 - 2. Boyle's law
 - 3. Charles's law
 - 4. Gay-Lussac's law
 - 5. Avogadro's law
 - 6. Dalton's law
- VIII. Solutions
 - 1. Solutions
 - 2. Electrolytes and nonelectrolytes
 - 3. Solubility
 - 4. Concentrations of solutions
 - 5. Dilution of solutions
 - 6. Properties of solutions
- IX. Acids and bases and equilibrium
 - 1. Acids and bases
 - 2. Strengths of acids and bases
 - 3. Ionization of water
 - 4. The pH scale
 - 5. Reactions of acids and bases
 - 6. Buffers
- X. Organic chemistry, hydrocarbons
 - 1. Organic compounds
 - 2. Alkanes
 - 3. Alkanes and substituents
 - 4. Properties of alkanes
 - 5. Alkenes and alkynes
 - 6. Cis-trans isomers
 - 7. Aromatic compounds
- XI. Alcohols, thiols, ethers, aldehydes and ketones
 - 1. Alcohols, phenols, thiols and ethers
 - 2. Properties of alcohols
 - 3. Aldehydes and ketones
 - 4. Reactions of alcohols, thiols, aldehydes and ketons
- XII. Carbohydrates
 - 1. Carbohydrates
 - 2. Chiral molecules
 - 3. Fischer projections of monosaccharides
 - 4. Haworth structures of monosaccharides
 - 5. Chemical properties of monosaccharides
 - 6. Disaccharides
 - 7. Polysaccharides
- XIII. Carboxylic acids, esters, amines and amides
 - 1. Carboxylic acids
 - 2. Properties of carboxylic acids
 - 3. Esters
 - 4. Hydrolysis of esters
 - 5. Amines
 - 6. Amides

- XIV. Lipids
 - 1. Lipids
 - 2. Fatty acids
 - 3. Waxes and triacylglycerols
 - 4. Phospholipids
 - 5. Steroids: cholesterol, bile salts, steroid
 - 6. Cell membranes
- XV. Amino acids, proteins and enzymes
 - 1. Proteins and amino acids
 - 2. Amino acids as acids and bases
 - 3. Protein: primary structure
 - 4. Protein: secondary, tertiary and quaternary structures
 - 5. Enzymes
 - 6. Factor affecting enzyme activity
- XVI. Nucleic acids and protein synthesis
 - 1. Components of nucleic acids
 - 2. Primary structure of nucleic acids
 - 3. DNA double helix
 - 4. RNA and the genetic code
 - 5. Protein synthesis
 - 6. Genetic mutations
 - 7. Viruses
- XVII. Metabolic pathways and energy production
 - 1. Metabolism and ATP energy
 - 2. Digestion of food
 - 3. Coenzymes in metabolic pathways
 - 4. Glycolysis: oxidation of glucose
 - 5. The citric acid cycle
 - 6. Electron transport and oxidative phosphorylation
 - 7. Oxidation of fatty acids
 - 8. Degradation of amino acids

PHYSICS

1. Units, Conversions, and Estimation
2. Describing Motion: Kinematics in One Dimension
3. Kinematics in Two Dimensions; Vectors
4. Dynamics: Newton's Laws of Motion
5. Circular Motion; Gravitation
6. Work and Energy
7. Linear Momentum
8. Rotational Motion
9. Static Equilibrium; Elasticity and Fracture
10. Fluids
11. Oscillation and Waves
12. Sound
13. Temperature and Kinetic Theory
14. Heat
15. The Laws of Thermodynamics
16. Electric Charge and Electric Field
17. Electric Potential
18. Electric Currents
19. DC Circuits
20. Magnetism
21. Electromagnetic Induction and Farady's Law
22. Electromagnetic Waves
23. Light: Geometric Optics
24. The Wave Nature of Light
25. Optical Instruments, lenses

MATHEMATICS

1. **Algebra Reference:** Polynomials, Factoring, Rational, Expressions, Equations, Inequalities, Exponents, Radicals
2. **Functions:** Composition, Lines and Linear Functions, The Least Squares Line, Properties of Functions, Quadratic Functions; Translation and Reflection, Polynomial and Rational Functions
3. **Exponential, Logarithmic, and Trigonometric Functions**
4. **The Derivative:** Limits, Continuity, Rates of Change, Definition of the Derivative, Graphical Differentiation
5. **Calculating the Derivative:** Derivatives of Products and Quotients, The Chain Rule; Graphs and the Derivative, Increasing and Decreasing Functions, Relative Extrema, Absolute Extrema
6. **Integration:** Antiderivatives, Substitution, Integration by Parts
7. **Multivariable Calculus:** Functions of Several Variables, Partial Derivatives, Maxima and Minima, Total Differentials and Approximations
8. **Probability:** Sets, Conditional Probability; Independent Events; Discrete Random Variables, Expected Value and Variance of Continuous Random Variables