

Syllabus for the Written Test for Admission to Integrated M.Sc.-Ph.D. Program in “Chemical and Molecular Biology” for the year 2019

General Biology:

Taxonomy and physiology, pro-and eukaryotic organisms; cell organelles and their function; multicellular organization; energy transformations; internal transport systems of plants; respiration; regulation of body fluids and excretory mechanisms; cellular reproduction; Mendelian genetics and heredity; biology and populations and communities; evolution; genesis and diversity of organisms; nervous system; animal behaviour, plant and animal diseases.

Basics of Biochemistry, Biophysics, Molecular Biology:

Buffers; trace elements in biological systems; enzymes and proteins; vitamins; biological oxidations, carbohydrates and lipids and their metabolisms; digestion and absorption; detoxifying mechanisms; plant and animal hormones and their action, nervous system, nucleic acids, nature of gene and its function, genetic code, synthesis of nucleic acids and proteins. Enzyme mechanisms and kinetics, nucleic acid metabolism, photo synthesis. Structure of biomolecules; protein conformation and folding; intra and intermolecular forces; thermodynamics and kinetics of biological systems, principles of X-ray diffraction, NMR spectroscopy, IR and UV spectroscopy and hydrodynamic techniques.

Microbiology, Cell Biology and Immunology:

Classes of microorganisms and their characterization, nutrient requirement for growth; laboratory techniques in microbiology, pathogenic microorganisms and disease; applied microbiology; viruses, microbial genetics. Innate and adaptive immunity, antigen and antibodies. Cell theory, cell architecture; methods of cell fractionation; cell division; types of chromosome structure; biochemical genetics- inborn errors of metabolisms, viruses and fungi; principles of processes of development.

Chemistry:

Atomic Structure and Periodicity: Planck's quantum theory, wave particle duality, uncertainty principle, quantum mechanical model of hydrogen atom, electronic configuration of atoms and ions. Periodic table and periodic properties.

Structure and Bonding: Ionic and covalent bonding, MO and VB approaches for diatomic molecules, VSEPR theory and shape of molecules, hybridization, resonance.

d Block Elements: General characteristics of 3d elements. Coordination complexes: valence bond and crystal field theory, color, geometry, magnetic properties and isomerism.

Chemical Equilibria: Colligative properties of solutions, ionic equilibria in solution, solubility product, common ion effect, hydrolysis of salts, pH, buffer.

Electrochemistry: Conductance, Kohlrausch law, cell potentials, emf, Nernst equation.

Reaction Kinetics: Rate constant, order of reaction, molecularity, activation energy, zero, first and second order kinetics, catalysis and elementary enzyme reactions.

Thermodynamics: First law, reversible and irreversible processes, internal energy, enthalpy, entropy and free energy.

Structure-reactivity of organic molecules: organic acids and bases, electronic and steric effects, optical and geometrical isomerism, tautomerism, conformers and concept of aromaticity. Elementary treatment of SN1, SN2, E1 and E2 reactions, Hoffmann and Saytzeff rules, addition reactions, Markownikoff rule and Kharash effect. Aromatic electrophilic substitutions, orientation effect as exemplified by various functional groups. Diels-Alder, Wittig and hydroboration reactions.

Chemistry and biology of medicines:

Molecular basis of therapeutics; mechanism of action of drugs like common antibiotics, anti-cancer and anti-inflammatory agents.

Mathematics:

Mathematical functions (algebraic, exponential, trigonometric), their derivatives (derivatives and integrals of simple functions), permutations and combinations.