



PATHFINDER ACADEMY

Syllabus: GATE (Life Sciences)

CHEMISTRY (Compulsory)

Atomic structure and periodicity: Planck's quantum theory, wave particle duality, uncertainty principle, quantum mechanical model of hydrogen atom; electronic configuration of atoms; periodic table and periodic properties; ionization energy, electron affinity, electronegativity, atomic size.

Structure and bonding: Ionic and covalent bonding, M.O. and V.B. approaches for diatomic molecules, VSEPR theory and shape of molecules, hybridization, resonance, dipole moment, structure parameters such as bond length, bond angle and bond energy, hydrogen bonding, van der Waals interactions. Ionic solids, ionic radii, lattice energy (Born-Haber Cycle).

s, p, and d Block Elements: Oxides, halides and hydrides of alkali and alkaline earth metals, B, Al, Si, N, P, and S, general characteristics of 3d elements, coordination complexes: valence bond and crystal field theory, color, geometry and magnetic properties.

Chemical Equilibria: Colligative properties of solutions, ionic equilibria in solution, solubility product, common ion effect, hydrolysis of salts, pH, buffer and their applications in chemical analysis, equilibrium constants (K_c , K_p and K_x) for homogeneous reactions.

Electrochemistry: Conductance, Kohlrausch law, Half Cell potentials, emf, Nernst equation, galvanic cells, thermodynamic aspects and their applications.

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, Kirchoff's equation, heat of reaction, Hess law, heat of formation, Second law, entropy, free energy, and work function. Gibbs-Helmholtz equation, Clausius-Clapeyron equation, free energy change and equilibrium constant, Trouton's rule, Third law of thermodynamics

Basis of Organic Reactions Mechanism: Elementary treatment of SN_1 , SN_2 , E_1 and E_2 reactions, Hoffmann and Saytzeff rules, Addition reactions, Markonikoff rule and Kharash effect, Diels-Alder reaction, aromatic electrophilic substitution, orientation effect as exemplified by various functional groups. Identification of functional groups by chemical tests.

Structure-Reactivity Correlations: Acids and bases, electronic and steric effects, optical and geometrical isomerism, tautomerism, conformers, concept of aromaticity.

BIOCHEMISTRY

Organization of life. Importance of water. Cell structure and organelles. Structure and function of biomolecules: Amino acids, Carbohydrates, Lipids, Proteins and Nucleic acids. Biochemical separation techniques and characterization: ion exchange, size exclusion and affinity chromatography, electrophoresis, UV-visible, fluorescence and Mass spectrometry. Protein structure, folding and function: Myoglobin, Hemoglobin, Lysozyme, Ribonuclease A, Carboxypeptidase and Chymotrypsin. Enzyme kinetics including its regulation and inhibition, Vitamins and Coenzymes. Metabolism and bioenergetics. Generation and utilization of ATP. Metabolic pathways and their regulation: glycolysis, TCA cycle, pentose phosphate pathway, oxidative phosphorylation, gluconeogenesis, glycogen and fatty acid metabolism. Metabolism of Nitrogen containing compounds: nitrogen fixation, amino acids and nucleotides. Photosynthesis: the Calvin cycle. Biological membranes. Transport across membranes. Signal transduction; hormones and neurotransmitters. DNA replication, transcription and translation. Biochemical regulation of gene expression. Recombinant DNA technology and

applications: PCR, site directed mutagenesis and DNA-microarray. Immune system. Active and passive immunity. Complement system. Antibody structure, function and diversity. Cells of the immune system: T, B and macrophages. T and B cell activation. Major histocompatibility complex. T cell receptor. Immunological techniques: Immunodiffusion, immunoelectrophoresis, RIA and ELISA.

MICROBIOLOGY

Historical Perspective: Discovery of microbial world; Landmark discoveries relevant to the field of microbiology; Controversy over spontaneous generation; Role of microorganisms in transformation of organic matter and in the causation of diseases.

Methods in Microbiology: Pure culture techniques; Theory and practice of sterilization; Principles of microbial nutrition; Enrichment culture techniques for isolation of microorganisms; Light-, phase contrast- and electron-microscopy.

Microbial Taxonomy and Diversity: Bacteria, Archea and their broad classification; Eukaryotic microbes: Yeasts, molds and protozoa; Viruses and their classification; Molecular approaches to microbial taxonomy.

Prokaryotic and Eukaryotic Cells: Structure and Function: Prokaryotic Cells: cell walls, cell membranes, mechanisms of solute transport across membranes, Flagella and Pili, Capsules, Cell inclusions like endospores and gas vesicles; Eukaryotic cell organelles: Endoplasmic reticulum, Golgi apparatus, mitochondria and chloroplasts.

Microbial Growth: Definition of growth; Growth curve; Mathematical expression of exponential growth phase; Measurement of growth and growth yields; Synchronous growth; Continuous culture; Effect of environmental factors on growth.

Control of Micro-organisms: Effect of physical and chemical agents; Evaluation of effectiveness of antimicrobial agents.

Microbial Metabolism: Energetics: redox reactions and electron carriers; An overview of metabolism; Glycolysis; Pentose-phosphate pathway; Entner-Doudoroff pathway; Glyoxalate pathway; The citric acid cycle; Fermentation; Aerobic and anaerobic respiration; Chemolithotrophy; Photosynthesis; Calvin cycle; Biosynthetic pathway for fatty acids synthesis; Common regulatory mechanisms in synthesis of amino acids; Regulation of major metabolic pathways.

Microbial Diseases and Host Pathogen Interaction: Normal microbiota; Classification of infectious diseases; Reservoirs of infection; Nosocomial infection; Emerging infectious diseases; Mechanism of microbial pathogenicity; Nonspecific defense of host; Antigens and antibodies; Humoral and cell mediated immunity; Vaccines; Immune deficiency; Human diseases caused by viruses, bacteria, and pathogenic fungi.

Chemotherapy/Antibiotics: General characteristics of antimicrobial drugs; Antibiotics: Classification, mode of action and resistance; Antifungal and antiviral drugs.

Microbial Genetics: Types of mutation; UV and chemical mutagens; Selection of mutants; Ames test for mutagenesis; Bacterial genetic system: transformation, conjugation, transduction, recombination, plasmids, transposons; DNA repair; Regulation of gene expression: repression and induction; Operon model; Bacterial genome with special reference to E.coli; Phage lambda and its life cycle; RNA phages; RNA viruses; Retroviruses; Basic concept of microbial genomics.

Microbial Ecology: Microbial interactions; C, S and N cycles; Soil microorganisms associated with vascular plants.

GENERAL APTITUDE

Verbal Ability: English grammar, sentence completion, verbal analogies, word groups, instructions, critical reasoning and verbal deduction.

Numerical Ability: Numerical computation, numerical estimation, numerical reasoning and data interpretation.