

SYLLABUS FOR BIOCHEMISTRY Ph.D. ENTRANCE TEST (W.E.F 2026)

Biochemistry and Metabolism

Carbohydrates, their structure and metabolic pathways, glycogenesis, Krebs cycle, gluconeogenesis, pentose phosphate pathway, Photosynthesis, its pathways and regulations, ATP cycle and its regulations, Electron transport chain, chemiosmotic theory

Proteins, their structure and metabolism, biosynthesis of essential proteins, allosteric regulation, their degradation to TCA cycle, glucogenic and ketogenic amino acid metabolism, Urea cycle and inborn errors of amino acid metabolism

Major classes of lipids and their role, Biosynthesis of even and odd chain fatty acids, saturated and unsaturated fatty acids, prostaglandins and cholesterol, ketogenesis and its regulation

Structure of DNA and RNA, metabolism of purines and pyrimidines, purine salvage pathway, purine and pyrimidine biosynthesis, feedback control and genetic disorders

Plant Biochemistry, Physiology and Biotechnology

Plant cell structure and organelles; plant biomolecules (cellulose, lignin, pectin); cell wall biosynthesis; xylem and phloem transport; secretory structures.

Photosynthesis: photosynthetic pigments, Photosystems I & II, electron transport, photophosphorylation, Calvin cycle, C3, C4 and CAM pathways, photorespiration, starch and sucrose metabolism, and sugar signaling.

Nitrogen and sulfur metabolism: biological nitrogen fixation, nitrate and ammonium assimilation, sulfur uptake and reduction; biosynthesis and functions of secondary metabolites (alkaloids, phenolics, flavonoids, terpenoids, lignin and tannins); lipid signaling molecules.

Plant growth regulators: auxins, gibberellins, cytokinins, abscisic acid and ethylene; seed dormancy, germination, embryogenesis, fruit ripening, photoperiodism, vernalization and flowering regulation.

Plant stress physiology and biotechnology: plant defense mechanisms, ROS and antioxidant systems, stress signaling molecules, plant tissue culture, micropropagation, protoplast technology, genetic transformation, CRISPR, transgenic crops and biofortification.

Enzymology and Analytical Techniques

General characteristics, nomenclature and classification of enzymes; enzyme structure, folding and unfolding; mechanisms of enzyme catalysis; allosteric enzymes and regulation of metabolism.

Michaelis-Menten kinetics, enzyme inhibition, factors affecting enzyme activity, enzyme regulation and metabolic control. Production, purification, immobilization and characterization of enzymes; industrial, clinical and biotechnological applications of enzymes.

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Principles and applications of spectroscopy (UV-Visible, Fluorescence, IR), chromatography (paper, TLC, HPLC, GC), electrophoresis (agarose and PAGE/SDS-PAGE), centrifugation, microscopy, radiotracer techniques, blotting techniques (Southern, Northern and Western), ELISA, flow cytometry, mass spectrometry, proteomics and bioinformatics tools for biological data analysis.

Genetics

Mendelian genetics, linkage and recombination, genetic system of Neurospora, bacterial genetic system, gene tagging, gene mapping, restriction mapping, reverse genetics

Genetic fine structures, mutations and their molecular basis, DNA repair, transposons, mechanism of transposition, retrotransposons, transposable elements in eukaryotes and prokaryotes, transposon tagging

Human genetics, role of genetics in medicine, single gene inheritance, multiple alleles, X-linked inheritance, Sex influenced pattern, Hemoglobinopathies

Cell division and errors, structural and numerical abnormalities, sex determination, genetic recombination, FISH, GISH and comparative genomic hybridization

Molecular Biology and Genetic Engineering

DNA as a genetic material, DNA structure and function: Physical and chemical structure of DNA, alternate forms of DNA A,B,Z; Alternate DNA structure, Elements and factors required for replication of core genome in eukaryotes, prokaryotes and viruses taking E. coli, yeast and phiX174 as models. Mechanism of transcription in prokaryotes: Elements and factors involved in prokaryotes; Promoter sequences and regulatory factors, Mechanism of transcription in Eukaryotes: Post transcriptional regulation: mRNA processing capping and polyadenylation splicing and editing, nucleo-cytoplasmic transport, mRNA stability and degradation, RNA as a regulatory molecule; RNAi and Antisense RNA

Genetic Code: Universality and degeneracy of code and exceptions to code, Wobble hypothesis. Codon bias. Mechanism of translation in prokaryotes and Eukaryotes: Regulation of translation, co- and post translational modification of peptides, role of molecular chaperons.

Concept of cloning; gene centric cloning and genome centric cloning, restriction endonucleases, DNA, RNA ligases, kinases, terminal transferases, DN ases, DNA phosphates, polynucleotide kinases, Southern, Northern and Western blotting.

Polymerase chain reaction and nucleic acid amplification, Primer design, fidelity of thermostable enzymes; DNA polymerases Types of PCR-multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products; T-vectors proof reading enzymes, PCR in gene recombination, DNA sequencing; Chemical degradation and chain termination methods, automated sequencing methods, pyrosequencing: their applications. Site directed mutagenesis and protein engineering; methods strategies and application.

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Cell Biology and Animal Biotechnology

Cellular organization, Membrane structure and function-Plasma membrane, cell walls, extra cellular matrix, cell-cell interactions,

Structural Organization and function of intracellular organelles-Nucleus, ER, Golgi complex, Lysosomes Mitochondria, Chloroplast, Peroxisomes, Actin filaments, microtubules, intermediate filaments,

Cell Signalling: Signal molecules and receptors. Intercellular signal transduction, cell junctions, signal related hormones, protein kinases

Cancer-Types of cancer, causes, treatment, Oncogenes, Tumor suppressor genes, Tumor viruses
Cell division and cell cycle-meiosis, mitosis, apoptosis, check points, cyclins and cyclin dependent kinases

Tissue culture techniques, Animal cell culture-cell separation, biology and characterization of cells, cell viability and toxicity, measuring parameter of growth, trypsinization, cryopreservation, manipulation of cultured cells and tissues

Clinical and Nutritional Biochemistry

Clinical Organ Function and Laboratory Diagnostics: Liver, kidney, pancreatic and cardiac function tests; clinical specimen collection, processing, interpretation of laboratory data, quality control and quality assurance.

Clinical Enzymology, Biomarkers and Metabolic Disorders: Diagnostic enzymes and isoenzymes, tumor markers, inflammatory markers and acute-phase proteins; diabetes mellitus, glucose homeostasis, thyroid, adrenal and reproductive hormone disorders, metabolic syndrome and dyslipidaemia.

Nutrients, Energy Metabolism and Micronutrients: Digestion, absorption and utilization of nutrients; energy balance and nutritional requirements; vitamins, minerals, trace elements and their biochemical functions, deficiencies and toxicities.

Nutritional Regulation and Disease Management: Nutrigenomics, functional foods, nutraceuticals, dietary antioxidants and oxidative stress; malnutrition, obesity, diabetes, cardiovascular diseases and nutritional intervention strategies.

Immunology

Innate and acquired immunity-Clonal nature of immune response, Cells of the Immune system: Hematopoiesis and differentiation, Nature and Biology of antigens and super antigens. Antibody structure, types and function, Antigen-antibody interactions, BCR & TCR, generation of diversity

Regulation of immune response-Antigen processing and presentation, generation of humoral and cell mediated immune responses, Complement system: Complement fixing antibodies and

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complement cascade, cytokines and their role in immune regulation, T-cell regulation, MHC molecules and restriction, immunological tolerance

Hypersensitivity, Autoimmunity and auto immune disorders, Immunodeficiency disorders and their molecular mechanism, Transplantation immunology, Tumor immunology,

ELISA, RIA fluorescent IA, Agglutination and hemagglutination, Hybridoma Technology and Monoclonal antibodies application, Vaccines: Conventional vaccines, viral vaccines, peptide vaccines genetically engineered vaccines, interleukine therapy, overview of stem cell functions and its medical application.

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