

SYLLABUS FOR MICROBIOLOGY 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

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 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.

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.

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,

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

Cancery-Types of cancer. causes, treatment, Oncogenes, Tumor suppressor genes, Tumor viruses Cell division and cell cuyle-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

Enzymology and Bioprocess Engineering

Enzymes general characteristics, structure, nomenclature, classification, folding, unfolding, Mechanisms of enzyme based catalysis, Allosteric enzymes, role of enzymes in regulation of metabolism, kinetics of enzyme catalyzed reactions, enzyme-inhibition kinetics,

Enzyme technology: production purification and industrial applications of enzymes,Concept of Fermentation and bioprocess, types of bioprocesses, Steps in development of bioprocess, microbial growth and product formation, design of media for bioprocess. design of sterilization. process scale up and scale down

Bioreactor types, design and operation, economics of bioprocess, process monitoring and control,Bioprocess bases products: organics acids, antibiotics, SCP, amino acids, biofuel.

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Principles of downstream processing, Effluent treatment and discharge, pollution load parameters: Fermentation bases food products, food safety and preservation, Hurdle technology; HACCP concept.

Bacteriology and Virology

General Bacteriology: Morphology, ultrastructure and cellular organization of Bacteria and Archaea, including cell envelope, appendages, cytoplasmic components, bacterial extracellular vesicles, motility, chemotaxis, endospore formation and activation, cell division, chromosome replication and cytokinesis.

Bacterial Growth and Classification: Culture media, cultivation and preservation of microbial cultures, bacterial growth kinetics, growth measurement, factors influencing growth, physical, chemical and biological methods of growth control, and principles of bacterial classification based on Bergey's Manual.

Polyphasic Bacterial Classification: Culture-dependent methods for bacterial isolation and identification using morphological, microscopic, biochemical and molecular approaches, along with culture-independent methods including metagenomic DNA extraction, 16S rRNA and housekeeping gene analysis, metabarcoding, and next-generation sequencing-based microbial diversity studies.

General Virology and Types of Viruses: Discovery, classification, cultivation, morphology, genome organization and replication of viruses; viral metagenomics including viral enrichment, sequencing and diversity analysis; bacteriophages and their life cycles, major bacteriophage groups, important animal and plant viruses, viruses of cyanobacteria, algae and fungi, and virus-related agents such as viroids and prions.

Mycology and Phycology

Basics of mycology - Morphology, Thallus organisation; occurrence and distribution, Growth and Reproduction in fungi, fungal classification, Salient features of Major fungal groups;

Ecological and economic importance of fungi- Fungi in agriculture, forestry, food; bio-fertilizers and biopesticides, fungi as plant parasites, Mycorrhiza- types, structures and ecological significance; Yeast as model organism in genetics and molecular biology

Basics of Phycology- General characteristics, morphology, habitat diversity, nutrition, reproduction, and life cycles, Algal classification and taxonomy; Salient features of major Algal groups

Ecological and economic importance of algae- In food, feed, biofertilizers, Biofuels and industrial products, algal ecology, blooms, eutrophication, and bioindicators; lichens - occurrence, structure, types, and ecological importance.

Food and Environmental Microbiology:

Food Microbiology and Preservation: Food as a substrate for microorganisms; factors influencing microbial growth and survival in foods; principles and methods of food preservation; microbiology of meat, vegetable, cereal and fermented dairy products (cheese and yogurt); probiotics, prebiotics and synbiotics; food spoilage, factors affecting spoilage, and spoilage of canned, fermented and dairy products.

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Food Safety, Quality Control and Regulations: Food-borne infections and intoxications (bacterial and non-bacterial), food-borne outbreaks, laboratory diagnosis and preventive measures; HACCP, hurdle technology, food control agencies and regulatory frameworks; plant sanitation, worker health and hygiene, quality control, and waste management in the food industry.

Waste Management and Resource Recovery: Types and characterization of wastes; primary, secondary and tertiary waste treatment; physical, chemical and biological treatment methods; activated sludge process, oxidation ponds, solid waste treatment, biological oxygen demand (BOD) and chemical oxygen demand (COD); utilization of solid wastes for production of food, biofuels (ethanol and methane) and compost/fertilizers.

Microbial Ecology and Environmental Processes: Aerobiology, microbial ecology of water and soil ecosystems, biodegradation of recalcitrant compounds, bioaccumulation and detoxification of metals, biopesticides, biodeterioration of paper, leather, wood and textiles, bioremediation of contaminated soils and wastelands, microbial roles in greenhouse gas mitigation, and environmental impact of genetically modified organisms.

Clinical Microbiology

History and Classification of Microorganisms- Normal Human Microbiota, Pathogens and Infections: Opportunistic and true pathogens, exogenous infections, and modes of transmission

Mechanisms of Microbial Pathogenesis - Microbial Pathogenicity, Bacterial Virulence Factors, Bacterial Adhesion and Invasion, Virus-Host Interactions

Infectious Diseases and Diagnosis- Bacterial, Fungal and Viral Diseases, Laboratory Diagnostics

Management, Prevention and Control of Infections- Antimicrobial Therapy, Vaccines and Antiviral Strategies, Hospital-Acquired Infections

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