



National Institute of Technology Calicut
NITC Campus P.O, Kozhikode – 673601, Kerala, India
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Syllabus for Written Test for the post of Assistant Professor Grade II (Pay Level -10)

SCHOOL OF BIOTECHNOLOGY

Biochemistry: Structure and function of biomolecules; Basic concepts and regulation of metabolism of carbohydrates, lipids, amino acids and nucleic acids; Photosynthesis, respiration and electron transport chain. Enzymes - Classification, catalytic and regulatory strategies; Enzyme kinetics - Michaelis-Menten equation; Enzyme inhibition - competitive, non-competitive and uncompetitive inhibition.

Microbiology: Bacterial classification and diversity; Microbial interactions; Viruses - structure and classification; Methods in microbiology; Microbial growth and nutrition; Nitrogen fixation; Microbial diseases and host-pathogen interactions; Antibiotics and antimicrobial resistance.

Immunology: Innate and adaptive immunity, humoral and cell-mediated immunity, Antibody structure and function, Molecular basis of antibody diversity, Antigen-antibody reaction, Complement system, Major histocompatibility complex (MHC), Polyclonal and monoclonal antibody, Hypersensitivity, Autoimmunity.

Molecular Biology & Recombinant DNA technology: Molecular structure of genes and chromosomes; Mutations and mutagenesis; Regulation of gene expression; Nucleic acid - replication, transcription, splicing, translation and their regulatory mechanisms; Non-coding and micro RNA; RNA interference; DNA damage and repair. Restriction and modification enzymes; Vectors - plasmids, bacteriophage and other viral vectors, cosmids, Ti plasmid, bacterial and yeast artificial chromosomes; Expression vectors; cDNA and genomic DNA library; Gene isolation and cloning, strategies for production of recombinant proteins; Transposons and gene targeting.

Cell Biology: Prokaryotic and eukaryotic cell structure; Cell cycle and cell growth control; Cell-cell communication; Cell signaling and signal transduction; Protein trafficking; Cell death and autophagy; Extra-cellular matrix. Biological membranes - structure, membrane channels and pumps, molecular motors, action potential and transport processes.

Biochemical thermodynamics and Bioenergetics: Laws of thermodynamics; Solution thermodynamics; Phase equilibria, reaction equilibria; Energetics of metabolic pathways, oxidation and reduction reactions. Ionic equilibria, Dissociation equilibria of acids and bases, Henry's law, Properties of fluids, Gibbs free energy, Entropy and heat capacity relation, Chemical Potential, Gibbs-Helmholtz equation, Colligative properties.

Unit operations: Newtonian and non-Newtonian fluids, fluid flow - laminar and turbulent; Conductive and convective heat transfer, LMTD, overall heat transfer coefficient; Heat

exchangers. Units and dimensions, dimensional analysis. Equations of fluid flow - Continuity equation and Bernoulli's equation.

Bioreaction engineering: Rate law, zero and first order kinetics; Ideal reactors - batch, mixed flow and plug flow; Enzyme immobilization, diffusion effects - Thiele modulus, effectiveness factor, Damkohler number; Kinetics of cell growth, substrate utilization and product formation; Structured and unstructured models; Batch, fed-batch and continuous processes; Microbial and enzyme reactors; Optimization and scale up. Mixing in bioreactors, mixing time; Molecular diffusion and film theory; Oxygen transfer and uptake in bioreactor, $k_L a$ and its measurement.

Food Engineering: Mass and energy balance; Momentum transfer: Flow rate and pressure drop relationships for Newtonian fluids flowing through pipe, Reynolds number. Heat transfer: heat transfer by conduction, convection, radiation, heat exchangers. Mass transfer: molecular diffusion and Fick's law, conduction and convective mass transfer, permeability through single and multilayer films. Mechanical operations: size reduction of solids, high pressure homogenization, filtration, centrifugation, settling, sieving, mixing & agitation of liquid. Thermal operations: thermal sterilization, evaporation of liquid foods, hot air drying of solids, spray and freeze-drying, freezing and crystallization. Mass transfer operations: psychrometry, humidification and dehumidification operations. Types of microorganisms used for food processing and their resources, Nutritional values of food, Use of enzymes in food industry, Factors affecting growth and survival of microorganisms in food, Single cell protein, Genetically modified food, Fermented food products, Dairy products-Fermented milk, Cheese, Butter, Fermented Meat, Fermented fish.

Plant Biotechnology: Totipotency; Regeneration of plants; Plant growth regulators and elicitors; Tissue culture and cell suspension culture system - methodology, kinetics of growth and nutrient optimization; Production of secondary metabolites; Hairy root culture; Plant products of industrial importance; Artificial seeds; Somaclonal variation; Protoplast, protoplast fusion - somatic hybrid and cybrid; Transgenic plants - direct and indirect methods of gene transfer techniques; Selection marker and reporter gene; Plastid transformation.

Animal Biotechnology: Culture media composition and growth conditions; Animal cell and tissue preservation; Anchorage and non-anchorage dependent cell culture; Kinetics of cell growth; Micro & macro-carrier culture; Hybridoma technology; Stem cell technology; Animal cloning; Transgenic animals; Knockout and knock-in animals.

Molecular tools: Polymerase chain reaction; DNA/RNA labelling and sequencing; Southern and northern blotting; In-situ hybridization; DNA fingerprinting, RAPD, RFLP; Site-directed mutagenesis; Gene transfer technologies; CRISPR-Cas; Biosensing and biosensors.

Analytical tools: Principles of microscopy - light, electron, fluorescent and confocal; Principles of spectroscopy - UV, visible, CD, IR, fluorescence, FT-IR, MS, NMR; Electrophoresis; Microarrays; Enzymatic assays; Immunoassays - ELISA, RIA, immunohistochemistry; immunoblotting; Flow cytometry; Whole genome and ChIP sequencing.

Computational tools: Bioinformatics resources and search tools; Sequence and structuredatabases; Sequence analysis - sequence file formats, scoring matrices, alignment, phylogeny; Genomics, proteomics, metabolomics; Gene prediction; Functional annotation; Secondary structure and 3D structure prediction; Knowledge discovery in biochemical databases; Metagenomics; Metabolic engineering and systems biology.