Syllabus for Ph.D. Entrance Test of Biotechnology, UIET

Note: The paper will consist of 100 objective questions of two marks each. The questions should be uniformly distributed throughout the syllabus. Use of scientific calculator is permitted.

Part I: Research and Methodology: 15 objective type questions	**30 marks**
Part II: Subject specific: 85 objective type questions	**170 marks**
Time allowed: 2Hours	**Max marks: 200**

Part A: Research Methodology: 15 questions objective types

Statistical tools for analysis of data: chi square test for comparing variance, conditions for applications of chi square test, steps of Chi square test, Chi square as non-parametric test, conversion of chi square in Phi coefficient, important characteristics of Chi Square Test.

ANOVA: Basic principle of ANOVA, setting up analysis of variance table, ANNOVA technique, short cut method for one way ANOVA, two way ANOVA.

Multi Variate Analysis Technique: Growth, characteristics and applications of multivariate techniques, classification and variables in Multivariable Analysis, important methods of factor analysis, rotation in factor analysis, R type and Q type factor analysis.

Probability and Statistics: definition of probability, sampling theorems, conditional probability, mean, median, mode and standard deviation; random variables, Binomial, Poisson and Normal distribution.

Part II Subject specific (85 Questions)

Biochemistry: Biomolecules-structure and functions; Biological membranes, structure, action potential and transport processes; Enzymes- classification, kinetics and mechanism of action; Basic concepts and designs of metabolism (carbohydrates, lipids, amino acids and nucleic acids) photosynthesis, respiration and electron transport chain; Bioenergetics

Microbiology: Viruses- structure and classification; Microbial classification and diversity (bacterial, algal and fungal); Methods in microbiology; Microbial growth and nutrition; Aerobic and anaerobic respiration; Nitrogen fixation; Microbial diseases and host-pathogen interaction

Cell Biology: Prokaryotic and eukaryotic cell structure; Cell cycle and cell growth control; Cell-Cell communication, Cell signalling and signal transduction

Molecular Biology and Genetics: Molecular structure of genes and chromosomes; Mutations and mutagenesis; Nucleic acid replication, transcription, translation and their regulatory mechanisms in prokaryotes and eukaryotes; Mendelian inheritance; Gene interaction; Complementation; Linkage, recombination and chromosome mapping; Extra chromosomal inheritance; Microbial genetics (plasmids, transformation, transduction, conjugation); Horizontal gene transfer and Transposable elements; RNA interference; DNA damage and repair;

Analytical Techniques: Principles of microscopy-light, electron, fluorescent and confocal;
Centrifugation- high speed and ultra; Principles of spectroscopy-UV, visible, Raman, MS,NMR; Principles of chromatography- ion exchange, gel filtration, hydrophobic interaction, affinity, GC,HPLC, FPLC; Electrophoresis.

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Immunology: Innate, humoral and cell mediated immunity; Antigen; Antibody structure and function; Antigen-antibody reaction; Complement; Primary and secondary lymphoid organ; B and T cells and macrophages; Antigen processing and presentation; Polyclonal and monoclonal antibody.

Bioinformatics: Major bioinformatic resources and search tools; Sequence and structure databases; Sequence analysis (biomolecular sequence file formats, scoring matrices, sequence alignment, phylogeny); Data mining and analytical tools for genomic and proteomic studies; Molecular dynamics and simulations (basic concepts including force fields, protein-protein, protein-nucleic acid, protein-ligand interaction)

Recombinant DNA Technology

Restriction and modification enzymes; Vectors; plasmid, bacteriophage and other viral vectors, cosmids, Ti plasmid, yeast artificial chromosome; mammalian and plant expression vectors; cDNA and genomic DNA library; Gene isolation, cloning and expression ; DNA labelling; DNA sequencing; Polymerase chain reactions; DNA fingerprinting; Southern and northern blotting, RAPD, RFLP; Site-directed mutagenesis; Gene transfer technologies.

Plant and Animal Biotechnology

Totipotency; Regeneration of plants; Plant growth regulators and elicitors; Tissue culture and Cell suspension culture system: methodology, Production of secondary metabolites by plant suspension cultures; Hairy root culture; transgenic plants; Plant products of industrial importance.

Animal cell culture; media composition and growth conditions; Animal cell and tissue preservation; Anchorage and non-anchorage dependent cell culture; Hybridoma technology; Animal cloning; Transgenic animals

Bioprocess Engineering and Process Biotechnology

Principle of reactor design, ideal and non-ideal bioreactors, mass and heat transfer; Aeration and agitation; Media formulation and optimization; substrate utilization and product formation; Sterilization of air and media; Batch, fed-batch and continuous processes; Instrumentation control and optimization; Unit operations in solid-liquid separation and liquid-liquid extraction; Process scale-up.

Engineering principle of bioprocessing- Upstream production and downstream; Bioprocess design and development from lab to industrial scale; Microbial, animal and plant cell culture platforms; Production of biomass and primary/secondary metabolites; Biofuels, Bioplastics, industrial enzymes, antibiotics; Large scale production and purification of recombinant proteins; Immobilization of biocatalysts (enzymes and cells) for bioconversion processes.

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