Syllabus for Biotechnology Master's

Section 1: Subject Knowledge

Please Note: A Total of 40 Questions will be asked, combining the following topics, with the difficulty level commensurate to a Master's Candidate.

Unit I: Cellular and Molecular Biology

Prokaryotic vs eukaryotic cells, membrane structure, organelles, and cytoskeleton, Cell cycle, mitosis, meiosis, and apoptosis, DNA replication, transcription, RNA processing, and translation, Gene expression regulation, stem cells, differentiation, and embryogenesis.

Unit II: Plant and Animal Biotechnology

Recombinant DNA technology, gene transfer methods, and transgenic plant/animal development, Genetic markers (RFLP, RAPD, SSRs) and marker-assisted selection, Genomic tools, QTL analysis, and CRISPR/Cas genome editing in animals.

Unit III: Biochemistry and Bioenergetics

Amino acid properties and protein structure (primary to quaternary), Protein folding, function, and post-translational modifications, Lipid structure and metabolism, Enzyme classification, kinetics, and inhibition.

Unit IV: Microbiology

Cell structure, metabolism, and growth in bacteria, archaea, and eukaryotes, Gene regulation, horizontal gene transfer, CRISPR-Cas genome editing, and mutagenesis, Plasmids, transposons, and phages.

Unit V: Analytical Technique

Molecular cloning (vectors, enzymes, PCR), electrophoresis, blotting (Western, Southern, Northern), CRISPR/Cas9 gene editing, and Next-Generation Sequencing (NGS) techniques and applications.

Unit VI: Genetic Engineering

Restriction enzymes, cloning vectors (plasmids, cosmids, phages), PCR and variants, gel electrophoresis, DNA sequencing (Sanger, NGS), CRISPR-Cas9, and molecular markers (RFLP, AFLP, SSR, SNP).

Unit VII: Immunology

Physical, chemical, and biological barriers, PRRs, complement system, inflammation, phagocytosis, and antigen presentation, T and B cell development, antigen recognition, clonal selection, and T-cell activation and differentiation.

Unit VIII: Bioinformatics

Sequence alignment (pairwise, multiple), algorithms (Needleman-Wunsch, Smith-Waterman), scoring matrices (PAM, BLOSUM), Phylogenetic tree construction and bioinformatics databases (NCBI, EMBL, DDBJ), Applications in research, medicine, and industry.

Unit IX: Biostatistics

Central tendency (mean, median, mode), dispersion (range, variance, standard deviation), and data visualization, Hypothesis testing, errors, p-values, and confidence intervals, One-sample and two-sample tests: z-test, t-test (independent, paired).

Unit X: Environmental Biotechnology

Scope, significance, and challenges in sustainability, Biotechnological solutions for environmental issues, Biological treatment processes (aerobic, anaerobic, anoxic) and advanced wastewater technologies (e.g. membrane bioreactors, anaerobic digestion).

Unit XI: Proteomics and Genomics

Genome sequencing (Sanger, NGS), annotation, and gene prediction, Transcriptomics (RNA-seq, microarrays) and functional genomics (GWAS), Proteomics techniques: mass spectrometry (MALDI-TOF, ESI), protein quantification (Label-free, SILAC, iTRAQ), and targeted proteomics (SRM, PRM), Data acquisition methods (DDA, DIA).

Unit XII: Drug Discovery and Development

Drug target identification (proteins, genes, pathways), genomics, proteomics, and bioinformatics in target discovery and validation, Lead generation, structure-activity relationship (SAR), in silico drug design, and physicochemical properties (Lipinski's rule of five).

Section 2: Fundamental Skills

-

Please Note: A Total of 24 Questions will be asked, combining the following topics, with the difficulty level commensurate to a Master's Candidate.

Unit I: Data Analysis
Unit II: Math and Statistics
Unit III: Lab skills
Unit IV: Reading and Writing

Section 3: Specific Skill Proficiency

This section has more than 30 skills. You can select the ones you are proficient in from the enrollment form. You can choose a maximum of 4 skills. Each skill contains 10 questions.