	Brief Syllabus
Qs paper for students from Biotechnology / Computational biology / biochemistry / or similar life sciences branches	
Chemistry of biomolecules	The versatility of carbon bonding, covalent, ionic, coordinate, and hydrogen bonds, van der Waals, hydrophobic, interactions; Carbohydrates; Simple sugars to complex polysaccharides and glycoconjugates, roles in energy storage and cellular recognition. Amino acids, R groups, proteins, biosynthetic and chemical synthesis; Lipids, including fatty acids and phospholipids, signaling molecules and structural components with implications in health and disease. Nucleic acids, primary, secondary, tertiary structures and composition; Secondary metabolites, terpenoids, alkaloids, and antibiotics, biosynthetic pathway. Biochemical methods: chromatography and electrophoresis, paper chromatography, gel electrophoresis, and high-pressure liquid chromatography.
Genetics	Basic Concepts of Genetics: Transmission Genetics (Mendelian Theory and its extension, sex linked inheritance, Quantitative traits), Molecular Genetics (Eukaryotic chromatin structure and chromosome organization, cell division, Eukaryotic genomes, Gene mutation), Human Molecular Genetics and Genetic disorder, Population and Evolutionary Genetics
Enzymes and metabolisms	Introduction; Enzymology – Introduction, classification & characteristics of enzymes, enzyme kinetics and inhibition, extraction, purification & application of enzymes; Metabolism & associated diseases – Photosynthesis & carbohydrates metabolism, amino acid biosynthesis & salvage, fatty acids biosynthesis & diseases involved, nucleotide biosynthesis & salvage, bio-geochemical cycles
Microbiology and Immune system	Introduction to microbiology, microscopy, diversity of microbial world, microbial cell organization, microbial nutrition and growth, microbial genetics, infectious diseases and antimicrobial resistance, Epidemiology, evolution and surveillance of infectious pathogens, scope and advances of microbiology, introduction to immunobiology, structure and function of innate and adaptive immune systems, development and maturation of immune cells, the immune system in health and diseases, principles and applications of immunotechnology
Cellular and molecular biology	 Cell as basic unit of life, prokaryotic and eukaryotic cells, organelles, compartmentalization, and their function; Cell division. DNA replication, Outline of replication machinery, initiation, maintainance and termination of replication. Transcription, Structure and function of a gene, Outline of transcription machinery Transcriptional initiation, elongation, and termination. Translation, Overview of translation machinery, translation initiation, elongation, and termination. Regulation of Gene Expression, operon, activators, repressors, hormones and signaling factors, epigenetic modification. Post-transcriptional Processing, Transcription attenuation, RNA editing and RNAi. Post-translational Processing, Protein degradation DNA Damage, DNA Repair, and Origin of Mutation; Cell Signalling and signal transduction, Signalling receptors;
Bioinformatics	Bioinformatics: Overview, history, and significance. Biological Databases: Accessing and querying biological data. Sequence Analysis: Pairwise and multiple sequence alignment, sequence similarity searching. Molecular Evolution: Phylogenetic analysis, evolutionary models. Structural Bioinformatics: Protein structure prediction, molecular modeling. Genomics: Genome assembly, gene prediction, genome annotation. Proteomics: Protein

	identification, characterization, and quantification. Applications of Bioinformatics in Drug
D:	discovery, personalized medicine, systems biology.
Bioprocess	Laws of thermodynamics; Rate law and orders, fluid viscosity and flow types, Molecular
technology	diffusion, Mixing and Oxygen transfer in bioreactor, heat transfer and heat exchangers; Ideal
	bioreactors; Stoichiometry of growth and product formation; Kinetics of cell growth,
	substrate utilization and product formation; Batch, fed-batch and continuous processes;
	Media formulation, optimization and scale up; Sterilization; Filtration regimes,
D1t C	Centrifugation; Cell disruption; chromatography, Extraction, adsorption and drying
Flain Science	transport CO ₂ fixation - C3 & C4 pathways): Phytohormones – Biosynthesis & functions
	(Auxin, Gibberellins, Cytokinins, Ethylene, Abscisic acid & Brassinosteroids). Photobiology
	(Plant photoreceptors mechanisms of action of phytochromes cryptochromes and
	phototropins, photoperiodism and biological clocks): Secondary metabolites (Biosynthesis of
	terpenes, phenols and nitrogenous compounds and their roles): Stress physiology (Responses
	of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.
	Plant Growth & Development: Plant cell wall – structure & function; Male and female
	gametophytes; Male sterility; Pollination; Fertilization; Seeds; Fruits; Apomixis; Control of
	flowering.
	Plant, Cell, Tissue & Organ Culture: Micropropagation; Somatic embryogenesis; Anther
	culture; Somatic hybridization; Protoplast fusion & culture; Callus culture; Cell suspension
	culture; Hairy root culture; Hydroponics & Aeroponics
	GMOs: Plant vectors; Methods of introducing foreign DNA into plant cells (Biolistic
	transformation, electroporation & Agrobacterium-mediated gene transformation);
	Commercial GMOs - Bt cotton (pest resistant); Golden rice (β -carotene rich); Purple tomato
	(anthocyanin rich); GABA-enriched tomato (first CRISPR-edited food); DHA canola (high
	omega-3 levels); Blue rose (blue color).
Qs paper for those interested in PhD in bioinformatics specialization: For students from non-life science	
quantitative (e.g., eng	gineering, statistics, maths, physics) background but interested in pursuing PhD in
computational biolog	gy / biostatistics
Basic	Data, statistics, data collection, presentation of data (grouped and ungrouped frequency
Mathematics,	table), graphical representation of data (bar graph, histogram, frequency polygon), Population
statistics and	and samples, Frequency distribution, Measures of central tendency (mean, median, mode and
programming	deviation)
	deviation
	Distribution of data (normal distribution binomial distribution Poisson distribution)
	Hypothesis testing concept of p-value
	Vectors: Vector algebra, Dot and Cross products and Correlation & Regression: Methods of
	studying simple correlation: Scatter Diagram, KarlPearson's Co-efficient of Correlation,
	Spearman's Rank Correlation.
	Basic C++: I/O functions/operators, Conditional statements: if-else, and switch, Looping and
	unconditional branching statements, Arrays and matrix operations.

Question Pattern

- MCQs 35-40% weightage
- Critical thinking and/or short/descriptive answer Qs 60-65% weightage