MSSVRAT-2023 (Written)
Syllabus for Paper-II (Bioinformatics)

Internal organization of the cell

The chemical components of a cell, intracellular compartments and protein sorting, mitochondria and chloroplasts, cytoskeleton and cell motility; major functions of cytoskeleton.

Nucleic acid metabolism

Structure of DNA and its physico-chemical properties; DNA replication in prokaryote and eukaryote; structure and properties of RNA polymerases in prokaryote and eukaryote; mechanism of transcription; eukaryotic promoters and enhancers; general transcription factors, TATA binding proteins (TBP) and TBP associated factors (TAF); activators and repressors; Post transcriptional modifications of RNA.

Regulation of gene expression

Prokaryotic gene expression with reference to inducible and repressible operons, concept of eukaryotic gene regulation, genetic basis of pattern formation in Drosophila, antisense RNA and RNA interference, post transcriptional controls.

Cell cycle

An overview of gene control, checkpoint pathways induced in response to DNA damage, the role of tumor suppressor genes and oncogenes, signal transduction pathways of apoptosis, defective apopt- otic/cell proliferation pathways leading to cancer etc, role of ROS in signalling.

Biochemistry of Macromolecules

Sugars: Classification, occurrence, isolation, purification, properties and biological reaction, Glycoproteins and Proteoglycans. Proteins: Amino acids and Peptides – classification, Physio- chemical properties, peptide bond, Primary, Secondary and tertiary structure of protein, Conformation of protein and polypeptide Lipids: Structure and function, Triglycerides, Phospholipids, steroids and terpenes, Role of lipids in biomembranes.

Enzymology and Nucleotide metabolism

Nomenclature, Enzyme kinetics, Regulation of enzymatic activity, Enzyme catalysis. Active sites:Enzymes and coenzymes: coenzymes interactions: activators and inhibitors, kinetics of enzyme inhibitors, isoenzymes, allosteric enzymes, ribozymes. Abzyme. Biosynthesis and degradation of nucleotide.

Bioenergetics

Glycolytic pathway; Gluconeiogenesis; Pentose Phosphate pathway; Kreb's cycle; Fatty acid catabolism; Amino acid oxidation; Biosynthesis of carbohydrates, lipids; amino

acid biosynthesis and oxidation; Oxidative phosphorylation; Photosynthesis; Elucidation of metabolic pathways; Logic and integration of central metabolism; entry/ exit of various biomolecules from central pathways; Principles of metabolic regulation; Regulatory steps; Signals and second messengers.

Virology

Virus and bacteriophages, General properties of Viruses, Viral structure, Taxonomy of virus, Purification and Isolation, cultivation and identification of viruses, viral replication. Control of virus, Subviral particles – viroids and prions.

C**ontrol of microorganisms**

Microbial diseases, detection and Control of microorganisms: Physical and chemical control of microorganisms, antibiotics, antifungal drugs, mode of action, antimicrobial drug resistant.

Cytogenetics

Cell division and errors in cell division; non disjunction; structural and numerical chromosomal abnormalities – deletion, duplication, translocation; Disorders of sex chromosomes and autosomes. Molecular cytogenetics – Fluorescence *In Situ* Hybridization (FISH), Comparative GenomicHybridization (CGH).

Mutagenesis

Mutagenic agents, mechanisms of mutagenesis-chemical and radiation; Expression of mutations – gene mutation; point mutations and frameshift mutations, isolation of auxotroph, conditional, lethal Assay of mutagenic agents (Ames test).

Immunology-Basic concepts and anatomy of the immune system

Components of innate and acquired immunity; Phagocytosis, inflammation, Molecules, cells and organs of the immune system: Lymphoid cells, Mononuclear phagocytes, Granulocytic cells; Primary Lymphoid Organ, Secondary Lymphoid Organ, Mucosa-associated lymphoid tissues

Immune response mechanism

B-cell generation, activation and differentiation; T-cell maturation; activation and differentiation; antigen processing and presentation- antigen presentation; antigen processing pathways-cytosolic and endocytic pathway. Acute inflammatory response, cytokines families and functions, therapeutic use; cell mediated immune response- subsets of CD4+ effector T cells and their functions; antibody dependent cellular cytotoxicity (ADCC); opsonisation.

Immunoglobulin and antigen antibody interaction

Basic structure of immunoglobulins; classes and subclasses; generation of antibody diversity,antigen-antibody reactions-precipitation, agglutination, complement fixation.

Introduction to Bioinformatics; Biological databases (protein and nucleic acid); Sequence data formats; Conversion of sequence formats; Sequence submission to databases; Sequence flatfile format; Exploring resources at NCBI; Data searching engine and retrieval tools; Basics of programming.

Introduction to computer, hardware and software; Basics of operating system and their use in Bioinformatics; Computational infrastructure for bioinformatics; Types of operating systems- Introduction to LINUX and basic commands, Windows operating system; Introduction to PERL

Molecular phylogeny-Molecular evolution, phylogenetic tress, types of trees, phylogeneticanalysis, tree building methods, software for phylogenetic analysis.
Protein modeling and Drug design- protein Secondary structure prediction, visualisation of molecular structures- RasMol and Pymol; Fold Recognition; Ramachandran plot, Transmembrane topology prediction; Protein modelling methods-Homology modelling, *Ab initio/Denovo* methods; Drug discovery process; Techniques in drug design; Molecular docking.