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| **Bioinformatics** |
| **Sr. No.** | **Core Areas** | **Percentage** |
| 1. | Core Areas of Bioinformatics | 30% |
| 2. | Biological and Allied Sciences | 30% |
| 3. | Computer Sciences | 20% |
| 4. | Mathematics and Statistics | 20% |
|  | **Total** | **100%** |

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| **Bioinformatics (Detailed)** |
| **Sr. No.** | **Core Areas** | **Percentage** |
| **1.** | **1. Core Areas of Bioinformatics*** 1. **Fundamentals of Bioinformatics: -\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_4%**

Genesis of Bioinformatics; Scope, limitations and applications of Bioinformatics; Application of computer sciences in solving biological problems; Introduction to biological Databases and their uses (Primary and Secondary Databases)* 1. **Applications of Bioinformatics:- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_7%**

Application of computational genomics in medicine; Personalized medicines and genomic data; Polymorphism and its application in personalized medicine; Protein engineering; Protein structure and function prediction, prediction of protein- protein interactions, drug design and development.* 1. **Sequence analysis, Alignment and Phylogenetics:- \_\_\_\_9%**

Sequence Similarity and Alignments; Pair wise Alignments, Multiple sequence alignments; Genetic Algorithms; Multiple Sequence Alignment using GA’s; Gene prediction and regulation. Gene Expression Algorithms; Genome Analysis and Comparative genomics; Phylogenetics algorithms; Hidden Markov Models* 1. **Structural Bioinformatics, Modeling and Simulations:- \_6%**

Introduction to complex adaptive systems; modeling, emergence, computation as a theory; Agent-based modeling; Complex adaptive systems; Evolving automata; Macromolecular structure prediction; Molecular modeling and docking; Molecular dynamics and its types; Monte Carlo simulations; Force fields* 1. **Software Development in Bioinformatics:- \_\_\_\_\_\_\_\_\_\_4%**

Software development methodology including waterfall model, iterative models, rapid application development, prototyping; software life cycle; Development of software projects for bioinformatics problems; HTML; XML; overview of software architecture; Web based applications and their architecture; Developing frontend applications and tools | **30%** |
| **2.** | **2. Biological and Allied Sciences****2.1 Fundamentals of Biochemistry:- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_5%**Water; pH and Buffer; Proteins and Enzymes; Carbohydrates; Lipids; Nucleic Acids* 1. **Biochemical Pathways, Metabolism and Bioenergetics:- 5%**

Glycolysis; Krebs Cycle; Glucogenesis; Pentose Pathway; Oxidative Phosphorylation and Electron Transport Chain; Gluconeogenesis; Lipid Metabolism; Protein Metabolism; Urea Cycle; Nucleic Acid Metabolism* 1. **Cell Biology and Signaling Pathway:- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_4%**

Cell theory; Viruses, Prokaryotic and eukaryotic cell, Organelles and cytoskeleton; Cell cycle; Inter and Intracellular signaling; Differentiation and mortality; Apoptosis; Necrosis, Chemetaxis* 1. **Molecular Biology:-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 6%**

Genetic material and its organization in viruses, prokaryotes and eukaryotes; Central dogma of Molecular biology, Replication Process, Transcription, Translation, Recombination; Mutations and Repair; Control of gene expression in prokaryotes and eukaryotes; RNA processing, splicing and editing; Plasmids and vectors; DNA modifying enzymes, primers and probes, PCR and its variants, cloning, Hybridization techniques; Microarrays* 1. **Genetics and Genomics:- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_5%**

Genetics; definition, classification and concept, heredity and variations; Chromosomal theory of heredity; Mendelian laws of genetics; Fine structure of chromosome; Multiple alleles; Linkage analysis; Chromosomal aberrations and genetic disorders, Polymorphism; Introduction to genomics and its anatomy; Genome evolution; Genome mapping; QTLs; Non-coding RNAs and RNA interference, Metagenomics* 1. **Proteomics:- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_5%**

Introduction and applications; Post-translational modifications of proteins, Techniques in Proteomics; Isolation and Purification; One and two dimensional electrophoresis; Zymographical analysis; Mass spectrometry and analysis, Protein structure determination; Protein engineering, Metaproteomics | **30%** |
| **3.** | **3. Computer Sciences:****3.1 Introduction to Computing:- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_3%**Brief history of computers and their applications; Major components of a computer; Application software and system software; Word-processing, graphics packages, databases and spreadsheets. Introduction to Microsoft Windows and Linux Operating System; Using Internet: Introduction to WWW (Web Server, Web Client, HTML, and HTTP)**3.2 Object Oriented Programming:- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_6%**Classes/Objects; Constructors/Destructors; Access Specifiers for Data Members and Methods; Overloading; Friend Functions; Composition/Aggregation; Inheritance; Polymorphism; Dynamic Data Binding; Virtual Functions; Inline Classes; Encapsulation/Data Hiding**3.3 Database Systems:-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 5%**What are databases/database systems (DBMS); Applications of databases/DBMS; Data Models; Entity Relationship Model; Relational Model; Relational Databases; Query Languages; Relational Algebra; SQL; Normalization; Transaction Management and Concurrency Control**3.4 Data Structures and Algorithms:- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_6%**Basic Array Data structure and operations; Stack; Queue; Priority Queues; Linked Lists; Singly and Doubly Linked List; Trees; Binary Trees and AVL Trees; Graphs; Sorting Techniques; Insertion Sort; Selection Sort; Bubble Sort; Binary Sort; Merge Sort; Quick Sort; Divide and Conquer Strategy; Dynamic Programming Technique; Time Complexity calculation; Asymptotic Notations; Lower Bound; Upper Bound; Tight Bound; Big O Notation; Greedy Approach; Recursion | **20%** |
| **4.** | **4. Mathematics and Statistics****4.1 Calculus :- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_5%**Functions, Graphs and limits; Analysis of Graphs; Limits of Functions (incl. one-sided limits); Asymptotic and Unbounded Behavior; Continuity as a Property of Functions; Concept of the Derivative; Derivative at a Point; Derivative as a Function; Second Derivatives; Interpretations and Properties of Definite Integrals; Fundamental Theorem of Calculus; Techniques of Antidifferentiation; Applications of Antidifferentiation; Numerical Approximations to Definite Integrals**4.2. Linear Algebra and Differential equations:- \_\_\_\_\_\_\_\_\_5%**Elementary Row operation; Vector spaces; Symmetric Matrices; Hermitian Matrices; Echelon form; Reduced Echelon Form; Rank of a matrix; Inverse of a matrix; Gaussian Elimination Method; Gauss Jardon Method; Determinants; Cramer’s Rule; First order and degree differential equations; Separable equations; Homogeneous equations; Exact Differential equations; Second order DEs; Non homogeneous Des**4.3** **Biostatistics:-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 5%** Frequency distribution and probabilities; Measure of central tendencies and dispersion standard distributions and tests of significance; Test of independence or association; Method related to one and two means; Variance and covariance heritability and its uses; Bayesian statistics; Analysis of variance (ANOVA); Regression analysis**4.4 Discrete Mathematics:- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_5%**Logic and proofs, direct proofs, proof by contradiction. Sets, combinatorics, sequences, formal logic, prepositional and predicate calculus, methods of proof, mathematical induction and recursion, loop invariants, relations and functions, Pigeonhole principle, trees and graphs, elementary number theory, optimization and matching. Fundamental structures, functions, relations (more specifically recursions), cardinality and countability, probabilistic methods. | **20%** |
|  | **Total** | **100%** |