Bachelor of Science (Computational Biology)

Programme Outcomes (POs)

At the end of the programme students will be able to:

PO1: Propose novel ideas towards solutions to contemporary problems justifying with relevant facts and data
PO2: Develop scientific outlook and see the relevance of science concepts in all aspects of life
PO3: Analyze complex scientific problems using principles of natural and applied sciences.
PO4: Comprehend concepts, frameworks and inventions through various learning methods and effectively communicate them to others orally and in writing.
PO5: Analyze critically the given scientific data ascribe meaning to them and draw objective conclusions.
PO6: Demonstrate empathetic social concern, skills to effectively participate in civic affairs and democratic decision making.
PO7: Imbibe ethical, moral and social values to become cultured and civilised global citizens.
PO8: Apply concepts of sustainable development to make a difference in social and environmental issues.
PO9: Develop multidimensional skills and habits as lifelong learners.

Programme Specific Outcome

PSO1: Intersection of biology and information sciences effectively analyses the structure-function relationships, information theory, gene expression, and database queries of living being.
PSO2: Acquire problem-solving skills, by developing new algorithms and analysis methods.
PSO3: Explain, design and utilise domain specific fields for the use of databases and software packages for analysis and interpretation of data.
PSO4: Facilitate a strong foundation in inter disciplinary sciences like computer and biological sciences to develop accelerated and precise technologies for industrial problems, and prepare them for productive careers in fields of biotechnology, pharmaceutical, bioinformatics, research, agriculture and healthcare industries.

Course Outcomes (COs)

Semester: 1

Subjects	Description
Basics of biology	**CO1** Knows the fundamentals of origin of life and the basic biomolecules. **CO2** Understands different levels of organization, form and functions of biological systems **CO3** Acquires knowledge on structure of biomolecules **CO4** Gets foundational knowledge in biomolecular science by understanding the classification and functions of biomolecules
basics of biology lab	**CO1** Gets skilled in analyzing samples for quantification of carbohydrates and lipids. **CO2** Quantifies unknown samples for the presence of amino acids, proteins, DNA and RNA **CO3** Gains skills for isolating DNA and RNA from the given samples
Fundamentals of Chemistry	**CO1** Demonstrate basic concepts of Stoichiometry and Chemical bonding. **CO2** Evaluate the feasibility of thermodynamics and reaction rates. . **CO3**Interprets the mechanistic pathways of organic reactions under various conditions
FUNDAMENTALS OF CHEMISTRY – LAB	**CO1** Examine the preparation and estimation of potassium permanganate, ferrous ammonium sulphate solutions etc. **CO2** Evaluate the preparation of organic compounds such as aspirin, density viscosity determination
PHYSIOLOGY AND DIVERSITY OF BIOLOGICAL SYSTEM	**CO 1** Use models to explain complex biological phenomena **CO 2** Describe the mechanisms by which organisms interact with their environment in ways that perpetuate life processes. **CO 3** Comprehend the basic form and function of the major groups of organisms and how this structure continuously evolves. **CO 4** Demonstrate the diversity and unity of organisms: identifying characteristics that unify major taxa; and recognize the relationships among major taxa.
Practicals	**CO 1** Test different phytochemicals present in plants qualitatively. **CO 2** Identify different types of microorganism by staining techniques. **CO 3** Estimate skill to extract carbohydrates from different plant sources

Semester : 2

Subjects	Description	
COMPUTER APPLICATIONS IN BIOLOGY	**CO1**	Gain basic ideas on the use of computer to collect biological data.
	CO2	Understands the intersection of life and information sciences
	CO3	Applies computational tools to identify and analyze biological information.
	CO4	Uses biological data to know about gene and protein sequence, protein structure and evolutionary relationships
COMPUTER APPLICATIONS IN BIOLOGY LAB	**CO1**	Analyze nucleotide and protein sequence from various databases.
	CO2	Evaluate sequence, structural, and functional analysis of biomolecules
	CO3	Demonstrate critical thinking and research methods in Bioinformatics to understand computational and experimental data
Cell Chemistry	**CO1**	Study the fundamentals of origin of life and the basic components of a cell, protein, denaturation and renaturation of proteins
	CO2	Elucidate the structure of a cell based on models, function of organelle such as mitochondria, proteins – primary, secondary, tertiary, quaternary structures
	CO3	Interpret different stages of cell cycle, cell division, protein folding, Signal transduction by G proteins. cell differentiation and stem cells, tumor suppressor genes and oncogenes
	CO4	Examine the protein databases: Secondary databases [PROSITE, PRINTS] and composite databases [OWL] with applications, tissue fixation methods,
CELL CHEMISTRY LAB	**CO1**	Examine the concentration of cell components like amino acids, proteins etc.
	CO2	Examine the microscopic features of a cell, cell division etc.
	CO3	Examine the cell viability, fixation of a cell, separation by density gradient centrifugation

Semester : 3

Subjects	Description
DATA COMPUTATION AND BIOSTATISTICS	**CO1** : Understand the fundamental concepts of data computation and biostatistics and apply them to solve real-world problems in the field of biology. **CO2**: Evaluate scientific literature critically, and understand how data computation and biostatistics play a critical role in data analysis, and interpretation. **CO3** : Infer the concept of correlation and regression for relating two or more related variables. **CO4**: Apply statistical tests and techniques such as hypothesis testing and ANOVA to explore and understand relationships between different variables. **CO 5**: Develop a foundation for further study in biostatistics and related fields, including research design, statistical modeling, and computational biology.
DATA COMPUTATION AND BIOSTATISTICS LAB	**CO1.** Develop proficiency in statistical computing tools and Excel, SPSS. **CO2.** Communicate scientific findings and statistical analyses effectively using appropriate visual aids such as graphs, charts, and tables. **CO3.** Understand ethical considerations and best practices in data computation and biostatistics, including data privacy and security.

Semester : 4

Subjects	Description
Computational Chemistry and Cheminformatics	CO 1 Explain the most important principles for chemical and molecular mechanic methods of computing the geometry and energy of molecules CO 2 Apply computer-based calculations to determine the geometry, energies and electronic properties of molecules. CO 3 Describe theoretical methods and conduct computer-based calculations of chemical properties (for example, size, hydrophobicity, dipole moment) in molecules and relate these to biological/environmental chemical effects via calculation models CO 4 Critically examine and discuss the results from computer-based computational chemistry
PYTHON PROGRAMMING	**CO1** Discuss the basics of python programming language such as variable, operators, data types and control statements. **CO2** Use different data structures for handling data

	CO3	Develop reusable programs using the concepts of inheritance, polymorphism
	CO4	Demonstrate the rules to construct regular expressions, and apply them to text to search for patterns and make changes.
PYTHON PROGRAMMING	**CO1**	Explain the usage of variable, operators, data types and control statements and write simple programs
	CO2	Demonstrate the usage of different data structures for handling data
	CO3	Develop reusable programs using inheritance
	CO4	Demonstrate search for patterns in strings, split strings using regular expressions, and replace parts of strings with new text
Genomics and Proteomics	**CO 1**	Discuss the genes, organization, Gene expression – Levels of expression, Operon concept- Lac Operon, Mutation- Nonsense, missense and point mutations, frameshift mutations, physical, chemical and biological mutagens. Replication concept, Transcription, translation, posttranslational modifications
	CO 2	Illustrate the protein structure, function nature by 2_D gel electrophoresis, chromatography, MS/MS, MALDi TOF, rDNA technology – restriction enzymes, similarity search, Overview of PCR – primer selection and design, BLASTN, BioEDIT, cDNA library, Expressed sequence tag (EST), Computational tools for gene identification, detection of functional sites
	CO 3	Elucidate the Protein Micro array in protein expression, profiling and diagnostics, drug target discovery, Phylogenetic analysis: - Evolution, elements of phylogeny, methods of phylogenetic analysis, Phylogenetic tree of life
DATA BASE MANAGEMENT	**CO1**	Describe the fundamental elements of database management systems
	CO2	Design database for a given mini-world using ER model and relational model
	CO3	Explain relational algebra operations for retrieving data
	CO4	Evaluate a data model for its correctness using functional dependencies.
Structural Bioinformatics	**CO 1**	Outline the structure, molecular interactions, motifs, loops, active site of an enzyme, Ramachandran plot – theory, Types of interactions of DNA with proteins and small molecules/ligands. Types of molecular complexes, Factors affecting the protein ligand interaction, protein ligand complexes – chemical composition, solubility, structure – topology, protein sequence. Protein ligand database (PLD). HMM Model

	CO 2 Interpret the secondary structure of proteins, modelling of proteins, tools involved in structure prediction, X-ray crystallography, NMR, cryoelectron microscopy etc. **CO 3** Examine the Global and Local alignment, Multiple Sequence alignment (MSA): Progressive and Iterative Methods Eg:- Clustal W , Clustal X , Molecular modelling visualization tools- Swiss PDB Viewer (SPDBV), Structure visualization tools such as Rasmol, Cn3D, VMD, MOLMOL, Chime.
DATA BASE MANAGEMENT lab	**CO1** Explain the data types, operators, and constraints in SQL and the general form of SQL commands **CO2** Write SQL queries for data definition/manipulation/alteration **CO3** Discuss the different constraints on a database and enforce constraints on a database to maintain data integrity. **CO4** Discuss the different join operations and extract required data by combining two or more tables **CO5** Write SQL queries to create sub groups of tuples and apply aggregate functions to produce summary reports