Programme	BS Biotechnology	Course Code	BCBT-303	Credit Hours	3
Course Title	**Bioinformatics**				

Course Introduction

This course provides an introduction to the field of Bioinformatics, designed for undergraduate students majoring in Biochemistry and Biotechnology. The curriculum covers computational techniques used to analyze and interpret biological data, including DNA, RNA, and protein sequences. Students will learn about database searching, sequence alignment, and basic genomic and proteomic analysis. The course will also introduce bioinformatics tools and software, as well as applications of bioinformatics in research and biotechnology.

Learning Outcomes

On the completion of the course, the students will:

- Understand types, access and retrieval of data.
- Apply the principles of database searching, sequence alignment, phylogenetic analysis and protein structure prediction.
- Apply computational methods to solve problems in Biological molecules

Course Content

- Introduction to Bioinformatics**,** Overview, Importance and Applications
- Biological Databases, Nucleotide Databases, Protein Databases
- Sequence Alignment: Pairwise Alignment, Dot Matrix
- Local and Global Pairwise Sequence Alignment
- Needleman Algorithm
- Water Smith Algorithm for Local Sequence Alignment, Basic of algorithm Scoring of Local Sequence Alignment
- Word Algorithm for Database Searching, Fundamentals of Word Algorithm
- Use of Word Algorithm in BLAST: Basic of BLAST, Getting Results from BLAST
- Multiple Sequence Alignment (MSA), Fundamentals of MSA, Algorithms of MSA
- Progressive sequence alignment
- Iterative Sequence Alignment
- Match Box Algorithm
- Application of MSA
- Position Specific Scoring Matrix
- Genomic Bioinformatics: Fundamentals of Molecular Biology, Basic of Prokaryotic and Eukaryotic genes
- Algorithms for Gene Prediction, GC bias, Ab-inito based Algorithms, Homology based Algorithms, Neural Networks
- Structural Bioinformatics: Basics of Structural Bioinformatics
- Understanding Structure of Proteins: Ramachandran plot

- Visualization of Protein 3D structure, Use of Pymol, Use of VMD
- File structure of Protein Databank: Protein Secondary Structure Prediction, Chou-Fasman Algorithm, GOR Algorithm
- Transmembrane protein, Use of TMHMM Algorithm
- Protein 3D Structure Prediction: Importance and Fundamentals of 3D structure Prediction
- Algorithms of Protein 3D structure Prediction, Homology Based Algorithms
- Iterative 3D Structure Prediction
- Alpha-Fold; AI Based 3D structure Prediction
- Phylogenetic Bioinformatics, Basics of Phylogenetic tree
- Algorithms for Phylogenetic Trees: Neighborhood joining Algorithm, Maximum Like hood Algorithm
- Assessment of Phylogenetic Tree, Bootstrapping Techniques

Textbooks and Reading Material

1. Textbooks.

- Krane, D. E. (2002). *Fundamental concepts of bioinformatics*. Pearson Education India.

- Huang, X., Moore, J. H., & Zhang, Y. (Eds.). (2023). *Integrative Bioinformatics for Biomedical Big Data: A No-boundary Thinking Approach*. Cambridge University Press.

- "Baxevanis, A. D., Bader, G. D., & Wishart, D. S. (Eds.). (2020). *Bioinformatics*. John Wiley & Sons.

Teaching Learning Strategies

- Class lecture
- Class Discussions
- Class Tutorials

Assignments: Types and Number with Calendar

- 1st Quiz in 4th Week of 5 marks
- 2nd Quiz in 10th Week of 5 marks
- 3rd Quiz in 14th Week of 5 marks
- 1st Assignment in 8th Week of 10 marks