GUJARAT TECHNOLOGICAL UNIVERSITY

BIOTECHNOLOGY (04)
BIOINFORMATICS
SUBJECT CODE: 2160410
B.E. 6th Semester

Type of course: B.E. (Biotechnology)

Prerequisite: Basic Concepts of Biological processes and Computational tools

Rationale: It is one of the advanced subjects of Biotechnology. It involves the use and applications of various computational tools & software in the field of biotechnology.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Course Contents:

Sr. No.	Topics	Teaching Hours	Module Weight-age
1	**UNIT I:** **Introduction to bioinformatics** Introduction, historical overview, definition, applications, major databases, data management & analysis, molecular biology & bioinformatics. **Information search & data retrieval:** Introduction, tools for web search, data retrieval tools and data mining of biological databases.	**08**	**17.39%**
2	**Unit II:** **Pair-wise Sequence Alignment:** Introduction, alignment problems, methods of sequence alignments, using scoring matrices & measuring sequence detection efficiency. **Multiple Sequence Alignment:** Introduction, methods of multiple sequence alignment, evaluating multiple alignments, applications of multiple sequence alignment & phylogenetic analysis.	**06**	**13.04%**
3.	**UNIT III:** **Tools for similarity searches & sequence alignment:** Introduction, working with BLAST, working with FASTA, Filtering and gapped BLAST, FASTA and BLAST algorithms comparison **Protein Structure Prediction & Visualization:** Protein Secondary Structure Prediction, Protein Tertiary Structure Prediction, Prediction of Protein Function, Evaluation of Predicted Structure, Visualization Tools: Rasmol, RasTop & spdbv	**12**	**26.08%**

4.	**Unit IV:** **Gene identification & prediction:** Basis of gene prediction, pattern recognition, gene prediction methods, gene prediction tools. **Gene expression & microarrays:** Introduction, DNA microarrays, clustering gene expression profiles, data source and tools for microarray analysis, applications of microarray technology	**10**	**21.74%**
5.	**Unit V:** **Proteomics:** Definition, History, Branches, 2D- PAGE and MS, Proteomics analysis and protein microarray, protein-protein interaction, methods of gene family identification **Introduction to drug discovery:** Areas influencing drug discovery, pharmacogenetics & pharmacogenomics applications, analysis of SNPs and important parameters in drug discovery.	**10**	**21.74%**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
12	**12**	**22**	**16**	**08**	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1) Rastogi. S. C, Mendiratta. N and Rastogi. P. Bioinformatics Methods and Applications: Genomics, Proteomics and Drug Discovery. Prentice-Hall of India Pvt. Ltd.3rd edition.
2) Zhumur Ghosh & Bibekanand Mallick, Bioinformatics: Principles and Applications, Oxford University Press, Second Edition
3) Teresa K. Attwood and David J. Parry – Smith. 2005. Introduction to Bioinformatics. Pearson education, Singapore.
4) A.R. Leach, Molecular Modeling- Principles and Applications, Second Edition, Pearson.
5) David W. Mount. 2003. Bioinformatics: Sequence & Genome Analysis.CBS Publishers and Distributors. New Delhi.
6) Westhead. D. R, Parish. J. H and Twyman. R. M, 2003. Bioinformatics. Viva Books Private Limited, New Delhi.

Course Outcome:

After learning the course, the students should be able to:

- Develop a fundamental understanding of basic concepts of bioinformatics and its use in the field of biotechnology.
- Evaluate applications of techniques & software of bioinformatics to facilitate biotechnological advancement and innovations.

List of Practicals:

Practicals based on the following topics and introducing the concerned tools is as under:

1. Introduction to Home Page: NCBI, DDBJ & PDB.
2. Sequence Retrieval System-Entrez
3. Pair-wise Sequence Alignment-BLAST & FASTA
4. Multiple Sequence Alignment-CLUSTALW
5. Sequence Analysis Software
6. Post Translational Modification
7. Secondary Structure Prediction
8. Visualization Software
9. Generating Drug Molecule
10. Primer Design
11. Introduction to simulation software

Open Ended Projects:
Students are free to select any tool / technique / software of Bioinformatics based on Biotechnological applications to define projects. Some suggested projects are listed below:

- Study on whether man is close to mice or monkey?
- Study on conservation of DNA sequences across the organisms.
- Study on resistant genes in plants.
- Study on evolutionary connections amongst living organisms.

List of Open Source Software/learning website:
Students can refer to video lectures available on the websites including NPTEL. Students can refer to the CDs which are available with some reference books. Students can develop their own flowsheets for demonstration of various molecular biology techniques.

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.