Semester	V		
Course	Major 4		
Paper Title	Bioinformatics		
Paper Code	C3BT230542T/P		
No of Credits	4 (3+1)		
Theory /Practical /Composite	Composite		
Minimum No. of preparatory hours	4		
per week a student has to devote			
Number of Modules	2		
Syllabus	MODULE A [30 Marks]		
	<ul> <li>UNIT I: Introduction to Bioinformatics; Sequence Information resources: SWISSPROT, TrEMBL, PDB; GenBank, EMBL, DDBJ; Composite Databases: NRDB, UniProt, ExPASy server; Literature Databases: Open access and open sources, organism- specific databases; Annotation of databases; Information Retrieval; Sequence formats; Sequence similarity searches: Importance of Global &amp; Local alignments, BLAST; Mutation/Substitution Matrices: PAM250 &amp; BLOSUM62; Pairwise and Multiple Sequence Alignments: ClustalW, Multalin; Calculations of alignment score and gap penalty; Phylogenetic Analysis.</li> <li>UNIT II: Structural Classification of Proteins – CATH, SCOP; Protein Tertiery Structure Dradition - Hemelecy Madeling Threading</li> </ul>		
	Tertiary Structure Prediction - Homology Modeling, Threading and Fold Recognition, Alphafold; RNA structure prediction: Circular plot. Dot plot analysis of protein and RNA sequences. <b>UNIT III</b> : Characteristics of Protein-protein, Protein-DNA and Protein- RNA interaction surfaces, related databases; Solvent Accessible Surface area of Protein: SASA, interactive tool for exploring macromolecular interfaces: PISA; Overview of Docking & MD simulation.		
	MODULE B [15 Marks]		
	<ul> <li>UNIT IV:</li> <li>1. Prokaryotic and Eukaryotic Genome Analyses – File Formats and Retrieval. Concept of genome assembly.</li> <li>2. Microarray Technology – DNA; MMChips, Protein; Antibody and chemical compound based arrays. Analysis of Gene Expression Microarray data and overview of GEO database.</li> <li>3. Pathway Databases and Pathway Analyses – Concept of Enrichment.</li> <li>4. Overview of Database Management Systems. Data Mining using cloud platforms; ER diagrams, Decision Trees; ARIES</li> </ul>		

	algorithm.		
	5. Introductory idea on Systems Biology.		
	PRACTICAL [40 marks; End-Sem (8 marks) + CA (30		
	marks) + Attendance (2 marks)]		
	1. Retrieval of information of a protein of interest, Sequence		
	similarity searches, Sequence analysis. MSA. Preparation of		
	phylogenetic tree; Modeling of protein structure, Structure		
	analysis, Interactomics.		
	2. Microbial Genome Analyses: Use of suitable tools, servers		
	<ul><li>and databases for functional annotation.</li><li>Overview of operating systems</li></ul>		
	4. Python Programming Basics and applications in machine		
	learning techniques.		
	5 Bioinformatics Projects		
Learning Outcomes	1. Mine suitable data and information from different biological		
	databases and tools.		
	2. Apply algorithms for searching the biological databases.		
	3. Categorize sequence alignment methods.		
	4. Implement phylogenetic tree construction algorithms.		
	5. Predict gene and protein secondary and tertiary structure.		
	6. Analyze genomes and perform functional annotation		
	7. Navigate across different operating systems for performing		
	programming based operations.		
	8. Perform gene expression analyses and pathway enrichment		
	studies.		
	9. Practical modules shall focus on developing hands on skills		
	related to data analyses using the programming languages as		
	well as different tools and databases that would be discussed		
	in the theory classes.		
Reading / Reference List	1. Bioinformatics: Sequence and Genome Analysis, Second		
	Edition David W Mount; CSHL Press		
	2. Bioinformatics and Molecular Evolution Paul G. Higgs, Teresa		
	K. Attwood Wiley-Blackwell		
	3. Inferring Phylogenies Joseph Felsenstein; Oxford University		
	Press		
	4. Introduction to Protein Structure, Carl Ivar Branden and John		
	Tooze; Garland Science		
	5. Microarray Data Analysis: Methods and Applications; Pietro		
	Hiram Guzzi; https://doi.org/10.1007/978-1-4939-3173-6		
	6. Computational Genome Analysis; An Introduction; Richard		
	C. Deonier, Michael S. Waterman, Simon Tavaré;		
	https://doi.org/10.1007/0-387-28807-4		
	7. Biological Networks and Pathway Analysis; Tatiana V.		
	Tatarinova, Yuri Nikolsky; <u>https://doi.org/10.1007/978-1-</u>		
	<u>4939-7027-8</u>		
	8. Bioinformatics: Experiments, Tools, Databases, and		
	Algorithms by Orpita Basu and Simminder Kaur Thukral;		
	OXFORD HIGHER EDUCATION		
	9. Relevant Research and Review Papers		

Evaluation	Theory	Practical	
	CIA- 10	CA- 30	
	Assignment – 02	Attendance - 02	
	Attendance - 03	Semester Exam- 08	
	Semester Exam- 45		
Paper Structure for Theory	Module A (30 Marks)		
Semester Exam	• 1 Compulsory Objective Question ( <b>10 marks</b> )		
	• Any 2 out of 3 questions; each of 10 marks, with s (no subpart will be more than 5 marks, and less that mark): 2 × 10 marks = 20 marks		
	Module B (15 Marks)		
	<ul> <li>1 Compulsory Objective Question – (any 5 out of 7; each of 1 mark): 1 × 5 marks = 5 marks</li> </ul>		
	<ul> <li>Any 2 out of 3 Questions; each of 5 Marks with subparts; where no subpart will be less than 1 mark) 2 x 5 = 10</li> <li>Marks</li> </ul>		