Shri Vile Parle Kelavani Mandal's

Dwarkadas J. Sanghvi College of Engineering

(Autonomous College Affiliated to the University of Mumbai)

Scheme and detailed Syllabus (DJS23)
of
Honors Degree Program
in

Computational Biology

With effect from the Academic Year: 2024-2025

Shri Vile Parle Kelavani Mandal's
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

Proposed Scheme for Second Year Undergraduate Program in Artificial Intelligence (AI) and Data Science with Honors in Computational Biology:

Semester IV (Autonomous)

Academic Year: 2024-2025

Sr. No.	Course Code	Course	Teaching Scheme (hrs.)				Continuous Assessment (A) (marks)			Semester End Assessment (B) (marks)					Aggregate (A+B)	Total Credits
			Th.	P	T	Credits	Th.	T/W	Total CA (A)	Th.	O	P	O &P	Total SEA (B)		
SEM III																
1	DJS23SCH1301	Computational Cellular Biology	3	–	–	3	40	–	40	60	–	–	–	60	100	3
SEM IV																
2	DJS23SCH1401	Computational Molecular Biology	3	–	–	3	40	–	40	60	–	–	–	60	100	3
SEM V																
3	DJS23SCH1501	Algorithms for Computational Biology	3	–	–	3	40	–	40	60	–	–	–	60	100	3
	DJS23SLH1501	Algorithms for Computational Biology Laboratory	–	2	–	1	–	25	25	–	–	–	–	–	25	1
SEM VI																
4	DJS23SCH1601	Computational Models for Biology	3	–	–	3	40	–	40	60	–	–	–	60	100	3
	DJS23SLH1601	Computational Models for Biology Laboratory	–	2	–	1	–	25	25	–	–	–	–	–	25	1
SEM VII/VIII																
5	DJS23SCH1701	Bigdata in Bioinformatics	4	–	–	4	40	–	40	60	–	–	–	60	100	4
Total			16	4	0	18	200	50	250	300	0	0	0	300	550	18

Prepared by

Checked by

Head of the Department

Vice-Principal

Principal

Program: Second Year B. Tech. in Artificial Intelligence (AI) and Data Science				Semester: IV							
Course: Computational Molecular Biology				Course Code: DJS23SCH1401							
Teaching Scheme (Hours / week)				Evaluation Scheme							
				Semester End Examination Marks (A)			Continuous Assessment Marks (B)			Total Marks (A+ B)	
Lectures	Practical	Tutorial	Total Credits	Theory			Term Test 1	Term Test 2	Avg.		
				60			20	20	40	100	
				Laboratory Examination			Term work				
3	--	--	3	Oral	Practical	Oral & Practical	Laboratory Work	Tutorial / Mini project / presentation/ Journal	Total Term work	—	

Prerequisite: - Knowledge of Cellular Biology and cell structure along with the concepts of cellular transportation systems.

Course Objectives:

The course aims:

1. To understand and combine principles of computer science, statistics, and molecular biology to analyse and interpret biological data.
2. To apply network biology, machine learning and data mining in practical scenarios for biological data analysis and interpretation.

Course Outcomes:

On completion of the course, learner will be able to

3. Understand the foundations of molecular biology relevant to computational analysis.
4. Learn algorithmic strategies for sequence analysis and pattern recognition.
5. Apply computational tools to solve problems related to genomics and proteomics.
6. Understand skills in programming and data analysis specific to bioinformatics.

Unit	Description	Duration
1.	**Introduction to Molecular Biology and Bioinformatics** Review of Basic Concepts of Molecular Biology: DNA, RNA, Protein, Central Dogma of Biology, Introduction to Bioinformatics and its Applications, Overview of Biological Databases (GenBank, PDB, UniProt), Tools for Biological Data Retrieval and Analysis	08
2.	**Genomic Data & Phylogenetic Analysis**	10

	Genome Assembly and Annotation, Genome Mapping Techniques, Comparative Genomics, Analysing Next-Generation Sequencing (NGS) Data, Introduction to Phylogenetics and Evolutionary Trees, Basics of Tree Construction Methods (UPGMA, Neighbour-Joining), Tools for Phylogenetic Analysis (MEGA, PHYLIP), Applications of Phylogenetic Analysis in Evolutionary Biology	
3.	**Protein Structure and Function Prediction** Understanding Protein Structure Hierarchy: Primary to Quaternary Structures, Understanding Techniques for Protein Structure Prediction: Homology Modelling, Threading, Ab Initio Methods Protein-Protein Interactions and Functional Annotation.	**08**
4.	**Systems Biology and Network Analysis** Concepts of Systems Biology, Network Biology viz., Analysing Protein-Protein Interaction Networks and Metabolic Pathway Analysis. Applications in Drug Discovery and Personalized Medicine	**08**
5.	**Machine Learning and Data Mining in Bioinformatics** Introduction to Machine Learning for Biological Data, Classification and Clustering Techniques. Applications: Predicting Protein Functions, Disease Models	**05**
	Total	**39**

Books Recommended:

Textbooks:

1. Bioinformatics For Dummies", Jean-Michel Claverie and Cedric Notredame, For Dummies. (2019)
2. Bioinformatics Algorithms: An Active Learning Approach" by Phillip Compeau and Pavel Pevzner, Active Learning Publishers (2019)
3. An Introduction to Bioinformatics Algorithms, Neil C. Jones, and Pavel A. Pevzne, MIT Press,2004.

Reference Books:

1. Introduction to Bioinformatics, Arthur Lesk, Biologist & Bioinformatics Expert, 2019
2. Introduction to Biomedical Data Science, Robert Hoyt, Informatics Education, 2019
3. Python for Biologists: A Complete Programming Course for Beginners, Martin Jones, Oxford University Press, 2013
4. Exploring Bioinformatics: A Project-Based Approach, Caroline St. Clair, and Jonathan E. Visick, Jones & Bartlett Learning, 2014.

Online References

1. "Molecular Biology" by Dr. Nayan K. Jain, https://onlinecourses.swayam2.ac.in/cec20_ma13
2. "Fundamental of Bioinformatics" by Dr. Vivek P.J. https://www.coursera.org/learn/big-data-introduction

Evaluation Scheme:

Semester End Examination (A):
Theory:

1. Question paper based on the entire syllabus total comprising of 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.

Continuous Assessment (B):

Theory:

1. Term Test 1 (based on 40 % syllabus) of 15 marks for the duration of 45 min.
2. Term Test 2 (on next 40 % syllabus) of 15 marks for the duration of 45 min.
3. Assignment / course project / group discussion /presentation / quiz/ any other for 10 marks.

Web Links:

1. The National Center for Biotechnology Information advances science and health by providing access to biomedical and genomic information, https://www.ncbi.nlm.nih.gov/
2. Bioinformatics-Oxford Academy: https://www.bioinformatics.org/
3. Rosetta Code, https://rosettacode.org/wiki/Rosetta_Code

Prepared by Checked by Head of the Department Vice Principal Principal