Course Code	BIO522
Course Name	Algorithms for Computational Biology
Credits	4
Course Offered to	UG/PG
Course Description	This is an introductory course on algorithms for computational biology. The goal is to make students familiar with the basics of algorithm designing techniques and their application in solving problems of molecular biology. Students will be trained for developing their own algorithms for solving real life biological problems. Hands on training will be given for commonly used softwares for genomic data analysis.

Pre-requisites

Pre-requisite (Mandatory)	Pre-requisite (Desirable)	Pre-requisite(other)
None	None	Familiarity with structural programming and molecular biology.

Post Conditions

CO1	CO2	CO3	CO4
Design algorithms for computational biology problems using algorithmic techniques like greedy, divide and conquer, dynamic programming etc.	Analyse algorithms from computational complexity point of view.	Utilize common bioinformatic tools for solving practical problems.	Implement algorithms using common data structures like arrays, graphs and trees.

Weekly Lecture Plan

Week Number	Lecture Topic	COs Met	Assignment/Labs/Tutorial
1	Background, algorithms, complexity, brute force, recursive techniques	CO1, CO2	5 Assignments
2	Molecular biology primer, different data types. Anecdotes of breakthroughs.	CO3	5 Labs
3,4,5	Sequence alignment: pairwise, global, local, multiple sequence alignments, sequence database search, suffix trees; dynamic programming based algorithms, space efficient alignment using divide & conquer.	CO1, CO2, CO3, CO4	1 project
6	addressing challenges with pseudoknots, application of dynamic programming.	CO1, CO2, CO3, CO4	
7.8	Genome assembly - Overlap Layout Consensus and de Bruijn graph assembly, greedy algorithm for shortest common superstring.	CO1, CO2, CO3, CO4	
9	Regulatory motif discovery: brute force, greedy algorithms, the Pattern Branching algorithm	CO1, CO2, CO3, CO4	
10.11	Analysis of bulk and single cell expression; data: normalisation, dimension reduction, clustering, biclustering, BiMax, a divide and conquer algorith, differential expression analysis, pseudo time analysis using minimum spanning tree.	CO2, CO3, CO4	
12	Network analysis: clique finding, regulatory networks, co-expression networks, causality analysis (mutual entropy and partial correlation)	CO2, CO4	
13	Presentation of projects	CO1, CO2, CO3, CO4	

Assessment Plan

Type of Evaluation	% Contribution in Grade
Assignment	10
Project	10
Quiz	15
Laboratory	20
Mid-sem	15
End-sem	30

Resource Material

Type	Title
Textbook	Kleinberg, Jon, and Eva Tardos. Algorithm design. Pearson Education India, 2006.
Textbook	Jones, Neil C., and Pavel Pevzner. An introduction to bioinformatics algorithms. MIT press, 2004.