20BT017 COMPUTATIONAL SYSTEM BIOLOGY

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P
45	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
-	-	-	-	-	-

Course Description and Objectives:

This course provides an overall understanding about comprehensive skills in interdisciplinary areas of Life Sciences and their applications to understand biological systems such as, mathematical modeling or networks and also uses programming and data analytics skills, to analyze large sized biological data

Course Outcomes:

Upon successful completion of this course, the student will be able to

- Understand the basic concepts of systems biology.
- Discuss systems approach to solve biological problems
- Set up and solve ODEs concerning simple to advance problems such as enzymatic reactions, population dynamics etc.
- Understand the concepts of networks and graphs
- Read, understand and interpret published articles in mathematical modelling and network biology

SKILLS:

- ✓ Construct and analyze biological networks
- ✓ Setting up of ODEs for simple mathematical models
- ✓ Integration of gene expression data with protein-protein interaction data and building of context specific networks
- ✓ Analyze the Public domain databases on protein-protein interactions

UNIT - I

Introduction to Computational Biology: Life of a Cell and its Analysis: Structure and Function of the Nucleus and Cell Organelles.-Transcription and the Control of Gene Expression.-RNA Processing and Translation.-DNA Replication, Recombination, and Repair.-Cell signaling.

UNIT - II

Concepts of Systems Biology: Biology in time and space. Models and Modeling: purpose, adequateness, advantage of computational modeling, basic notion for computational models, model scope, statements, system state, variables parameters constants, behavior, classification, steady states.

UNIT - III

Computational Tools for Sequence Analysis: Fundamentals of Nucleic acid and protein sequence analysis. Analysis of complex biological systems Sequencing (DNA & amino acid) and Micro array. Protein structure analysis. Genome assembly Tools and Databases Computational gene hunting (gene predication -HMM)Alignment of bio-molecular sequences (Local, Global, DP, Blast, multiple) their principles and methods. Motif finding.

UNIT - IV

Computational Genomics: Structural modeling and structure prediction Network modeling. Genomic regulation, Protein folding Genetic variation RNA world Systems Biology (gene, protein and membrane machine)—Human and Pathogens—Cancer genomics (Tumor complexity).

UNIT - V

Metabolic Networks: Gene regulatory network Codon optimization Algorithmic Drug designs. Current and emerging areas in the field of computational and systems biology.

TEXT BOOK:

1. An Introduction to Systems Biology: Design Principles of Biological Circuits by Uri Alon Published by Chapman & Hall/CRC Mathematical and Computational Biology

REFERENCE TEXT BOOKS:

1. Analysis of Biological Networks Edited by Bjorn H. Junker and Falk Schreiber Published by Wiley.

2. Mathematical Modelling in Systems Biology – An Introduction by Brian Ingalls, MIT Press, Cambridge, London 2013 Edition

ACTIVITIES:

- Insilico determination of exons and introns in a gene.
- Annotate a given assembled genome using gene prediction tools including GenScan and Augustus.
- Create synteny between the genomes of two related species using CoGe and other tools.