Course code	Course Name	L-T-P-Credits	Year of Introduction
BM365	BIOINFORMATICS	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To develop basic understanding about computational Biology and Bioinformatics.
- To inculcate skills in sequence analysis and structure modelling.
- To impart knowledge on molecular mechanism of diseases and drug action and to develop appreciation about computational drug design techniques.
- To expose students to basic concepts & algorithms in Bioinformatics based on molecular data and to impart skills in use of popular computing tools in this area.

Syllabus

Basic Concepts of Molecular Biology, Genomes and Genes, Gene expression, Web based genomic and proteomic data bases, Sequence alignments, Algorithms, Genomic Signal Processing, Introduction to NGS technology, RNA-seq, ChIP-seq analysis , Quantification of DNA, RNA and Protein using various Biochemical methods, Molecular modelling in drug discovery, Pharmacodynamics, Pharmacokinetics, Visualization of Molecular Structures, Introduction to systems biology, Enzyme Kinetics and Thermodynamics , Interaction networks overview, Tools for systems Biology.

Expected Outcome

The student will be able to

i. use tools and software for bioinformatics analysis

ii. apply basic genomic and transcriptomic sequence processing algorithms and popular software tools in this area.

Reference Books:

1. Setubal &Meidanis, *Introduction to Computational Molecular Biology*, Thomson: Brooks/Cole, InternationalStudent Edition, 2003.
2. Claverie&Notredame, *Bioinformatics - A Beginners Guide,* Wiley- Dreamtech India Pvt Ltd, 2003.
3. Lesk, *Introduction to Bioinformatics*, Oxford University Press, Indian Edition, 2003
4. Higgins and Taylor, *Bioinformatics: Sequence, structure and databanks*, Oxford University Press, Indian Edition, 2003
5. Zvelebil, M. J., & Baum, J. O. (2008). *Understanding bioinformatics*. Garland Science.
6. DovStekel, *Microarray Bioinformatics*, Cambridge University Press
7. Rastogi, S. C., Mendiratta, N., &Rastogi, P. (2013). *Bioinformatics: Methods and Applications: (Genomics, Proteomics and Drug Discovery)*. PHI Learning Pvt. Ltd.
8. K Anand Solomon (2008) Molecular Modelling and Drug Design, MJP Publishers
9. Alon, U. (2006). *An introduction to systems biology: design principles of biological circuits*. CRC Press.
10. Klipp, E., Liebermeister, W., Wierling, C., Kowald, A., Lehrach, H., &Herwig, R. (2013). *Systems biology*. John Wiley & Sons.

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
I	Basic Concepts of Molecular Biology: Cells - Chromosomes, DNA, RNA, Proteins, Central dogma of molecular biology,	1	15%
	Genomes and Genes - Genetic code, Transcription, Translation and Protein synthesis.	2	
	Gene expression, Microarrays, Microarray image analysis	2	
	Web based genomic and proteomic data bases: NCBI, Gen Bank	2	
II	Sequence alignments – Dot plot-Pair-wise sequence alignments, Local and global -Sequence similarity and distance measures.	1	15%
	Smith-Waterman algorithm, Needleman-Wunch algorithm, Multiple sequence alignment, PAM and BLOSUM, Phylogenetic analysis	3	
	Software tools for basic and specialized sequence processing such as: BLAST, FASTA, RasMol, Phylip, ClustalW	3	
FIRST INTERNAL EXAM			
III	Genomic Signal Processing, DNA Spectrograms, Identification of protein coding regions	2	15%
	Introduction to NGS technology, S Data analysis -Methods, Data formats, Data handling, Introduction to RNA-seq, ChIP-seq analysis	3	
	Quantification of DNA, RNA and Protein using various Biochemical methods, Amplification of DNA -Polymerase Chain Reaction	2	
IV	Molecular modelling in drug discovery, targets and receptors, target identification, small molecule drugs, Drug discovery pipeline	2	15%
	Pharmacodynamics, Pharmacokinetics, toxicology, formulations and delivery systems	2	
	Visualization of Molecular Structures, Molecular Descriptors, QSAR Methods	3	
SECOND SEMESTER EXAM			
V	Structure Based Virtual Screening in drug discovery, Molecular docking, Introduction to molecular dynamics.	2	20%
	Introduction to Systems Biology, Systems concept, feedback, control analysis in Biological systems.	2	
	Enzyme Kinetics and Thermodynamics, The Law of Mass Action; Reaction Kinetics, Rate Equation, Michaelis-Menten Equation, Hill Equation.	3	
VI	Interaction networks overview- Gene Regulatory Network, Protein – Protein Interaction Network, Signalling Pathways, Metabolic pathways; Network motifs.	4	20%
	Tools for systems Biology- Cell designer; Cytoscape.	3	
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3 Hours

There shall be three parts for the question paper.

Part A includes Modules 1 & 2 and shall have three questions of fifteen marks out of which two are to be answered. There can be subdivisions, limited to a maximum of 4, in each question.

Part B includes Modules 3 & 4 and shall have three questions of fifteen marks out of which two are to be answered. There can be subdivisions, limited to a maximum of 4, in each question.

Part C includes Modules 5 & 6 and shall have three questions of twenty marks out of which two are to be answered. There can be subdivisions, limited to a maximum of 4, in each question.

Note: Each part shall have questions uniformly covering both the modules in it.