Course Code	Course Title	L	T	P	C
BABIT306	Systems Biology	3	1	0	4
Pre-requisite	BABIT103 - Cell and Molecular Biology	Syllabus Version			
		1			

Course Objectives

1. Understand biological systems in terms of structure and dynamics of cellular and organism function.1. Understand biological systems in terms of structure and dynamics of cellular and organism function.
2. Develop knowledge on biological interaction networks and genome-level cellular metabolism.
3. Apply mathematics, statistics and computing in an integrated way to analyze biological systems.

Course Outcomes

1. Interpretation of the biological information with data analysis.
2. Build group and compare data, to gain information about single molecules compared to similar molecules.
3. Develop knowledge on genomic, transcriptomic and proteomic techniques work, and discuss their strengths and limitations.
4. Analyze the results of biological studies by making use of bioinformatics techniques.
5. 5. Develop basic scripts and pipelines for automating and repeating analysis.

Module:1	Transcription Networks Basic Concepts	8 hours

Introduction to cellular cognition; Elements of transcription networks; Separation of timescales in regulatory networks; Role of input functions; Framework for understanding network dynamics; multi-dimensional input functions; Dynamics and response time of simple regulation.

Module:2	Network Motifs	9 hours

Overview of patterns in biological networks; Functional implications: Introduction to randomized networks and their significance in studying biological systems; Definition and importance of network motifs in biological networks, Techniques for detecting network motifs through comparison with randomized networks; Autoregulation in gene circuits; Exploration of autoregulation as a key network motif.

Module:3	Global Structure of Transcription	9 hours

Single-input module (SIM) network motifs, multi-output feedforward loops (FFLS), Multi-output FFLS and their structural characteristics, First-in-first-out (FIFO) temporal programs and their biological implications, Signal integration mechanisms, Exploration of Bi-Fans in gene regulation

Module:4	Kinetic Proof reading and Conformational Proofreading	9 hours

Kinetic proof reading of the genetic code, Limitations of equilibrium binding, Error rate reduction in translation, Immune system recognition, Equilibrium binding in immune recognition, Efficiency of immune recognition processes.		
Module:5	**Robustness in Bacterial Chemotaxis**	**8 hours**
Introduction to bacterial chemotaxis; Overview of chemotaxis and its significance in bacterial behavior, Understanding the concept of how bacteria "think" and respond to their environment; Chemotaxis behavior; Response and exact adaptation; Chemotaxis protein circuit; Regulatory mechanisms; Barkai-Leibler model of exact adaptation.		
Module:6	**Contemporary Topics**	**2 hours**
Industry expert lectures		
	Total Lecture Hours:	**45 hours**
	Tutorial Hours:	**15 hours**
Text Book(s)		
Uri Alon, "**An Introduction to Systems Biology: Design Principles of Biological Circuits**", Chapman and Hall CRC Press United States, 2nd Edition, **2015** Mark Ptashne, "**A Genetic switch**", Cold Spring Harbor Laboratory, 3rd Edition, **2015**		
Reference Books		
James M. Bower, Hamid Bolouri , "**Computational Modeling of Genetic and Biochemical Networks** ", MIT Press, 1st Edition, **2015** Julio Collado, "**Gene Regulation and Metabolism: Postgenomic Computational Approaches,**", MIT Press, 1st Edition, **2015**		
Mode of Evaluation : Continuous Assessment Test, Digital Assignment, Quiz, Final Assessment Test, Presentaion		
Recommended by Board of Studies :	26-05-2025	
Approved by Academic Council : No. 78	12-06-2025	