INDIAN INSTITUTE OF INFORMATION TECHNOLOGY
DESIGN AND MANUFACTURING (IIITDM) KANCHEEPURAM

INTRODUCTION OF NEW COURSE

Course Title	**Computational Systems Biology**	Course Code				
Dept./ Specialization	Science and Humanities	Structure (LTPC)	3	1	0	4
To be offered for	UG and PG	Status	Core ☐		Elective ▬	
Faculty Proposing the course	Dr. M.Monisha	Type	New ▬		Modification ☐	
Recommendation from the DAC		Date of DAC				
External Expert(s)	3) Dr. Biplab Bose, Associate Professor, Department of Biosciences and Bioengineering, IIT Guwahati 4) Dr. Sriram K, Associate Professor, Department of Computational Biology, IIIT Delhi					
Pre-requisite	Basics of calculus Fundamentals of programming	Submitted for approval				
Learning Objectives	The objective of the course is to provide students with a comprehensive and concise overview of interactions between the components of biological systems to understand the physiological function of the system. This course will help engineering students to understand the computational tools designed to investigate and analyze various molecular systems, including metabolic systems, signaling pathways, and gene regulatory networks.					
Learning Outcomes	On successful completion of the course, the student will be able to: • Construct and analyze computational models of biological systems • Understand common mathematical approaches to study biological problems • Apply computational analyses to explore the behavior of biological systems					
Contents of the course *(With approximate break-up of hours for L/T/P)*	**Introductions to Systems Biology:** Concepts of systems biology, general properties of plotting graphs, dynamic systems, types of data used in modeling, self-organization, emergent properties, robustness and stability of systems. (11L+2T) **Analysis of dynamical systems:** Concepts of modeling biological systems using ordinary differential equations; numerical methods of solving ordinary differential equations, stability analysis of linear and nonlinear systems of ordinary differential equations, concept of bifurcation. (8L+2T) **Modeling molecular network:** Concepts of molecular network and network motifs, Enzyme catalysis, analysis of biochemical switches, positive feedback, negative feedback, transcriptional circuits, hysteresis in network motifs and integral feedback (7L+2T). **Stochastic modeling:** Concepts of probability theory, Mathematics of stochastic processes - Poisson process and Monte Carlo, Gillespie's algorithm (6L+1T). **Graph-theoretic modeling of molecular networks:** Basic concepts of graph theory, random networks - Erdos Reny Model, Protein-protein interaction networks: lethality-centrality rule, gene networks, host-pathogen protein-protein interaction, comparative analysis of Biological networks, capstone project on integrated analysis in systems Biology (10L+7T).					

Text Book	1. Lee A. Segel and Leah Edelstein-Keshet. A Primer on Mathematical Models in Biology, Society for Industrial and Applied Mathematics Publisher, 2013. 2. Ingalls, Brian P. Mathematical Modeling in Systems Biology: An Introduction (1st edition). MIT Press, 2013.
Reference Books	3. Uri Alon. An Introduction to Systems Biology: Design Principles of Biological Circuits, Chapman and Hall/CRC, 2nd edition, 2019. 4. Szallasi, Zoltan; Stelling, Jörg; Periwal, Vipul (ed). System Modeling in Cell Biology, From Concepts to Nuts and Bolts. The MIT Press, 2006. 5. Palsson, Bernhard O. Systems Biology: Properties of Reconstructed Networks. New York: Cambridge University Press, 2006. 6. Bernhard Ø. Palsson , Systems Biology: Simulation of Dynamic Network States, Cambridge University Press, 2011.