Integrative Systems Biology(SSB-912) CHR 3(3-0)

Educational Objectives

The Integrative Systems Biology course is design such that to cover the broader interdisciplinary areas of Synthetic, Computational, Systems and Network Biology, it will cover the concepts and methodologies used in systems-level analysis of biological systems. The core objectives include dealing with large data sets; quantitative reasoning, models (mathematical and formal) and simulations, biomarker discovery. The understanding of dynamics of the biological systems and to demonstrate “how” cell- level functions arise and “why” mechanistic knowledge allows us to predict cellular behaviors leading to disease states and drug responses.

Course Outcomes

Students should at the end of the course have,

- Understanding of how to use experimental, computational (Formal), and mathematical methods in systems biology.
- Knowledge and skills in designing practical systems-level frameworks to address questions in a variety of biomedical fields.
- Skills to model biological systems, Pathways and Networks.
- Understanding of the modeling tools and suitable approaches.

Course contents

- Experimental Methods in Systems Biology
- Network Analysis in Systems Biology | Molecules to Pathways and pathways to Networks | Types of Biological Networks
- Dynamical Modeling Methods for Systems Biology | Mathematical Representations of Cell Biological Systems | Simulations of Cell Biological Systems
- Experimental Technologies | Network Building and Analysis | Topology to Function
- Boolean Logic | Kinetic Logic | Formal Modeling Approaches and its Application in Biological Systems

- Machine Learning Models for Systems Biology Applications
- Strengths and Limitations of Different Types of Models
- Systems Medicine | Systems Pharmacology and Therapeutics
- Tools for Modeling Biological Systems and Regulatory Network GINsim | Cell Designer Cytoscape etc.

Recommended books

- Fundamentals of Network Biology by WenJun Zhang Published by World Scientific.
- Networks in Systems Biology- Applications for Disease Modeling by da Silva Published by Springer 2020
- An Introduction to Systems Biology: Design Principles of Biological Circuits by Uri Alon
- Mathematical Modeling in Systems Biology: An Introduction by Brain P. Ingalls. The MIT Press 2019.
- Internet Resources