INTRODUCTION TO DYNAMICAL MODELS IN BIOLOGY

PROF. BIPLAB BOSE  
Department of Biotechnology and Bioengineering  
IIT Guwahati

TYPE OF COURSE : Rerun | Elective | UG/PG  
COURSE DURATION : 4 weeks (23-Aug’ 21 - 17-Sep’ 21)  
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Must have studied Mathematics at 10+2 level. Have studied graduate-level Biochemistry and Molecular Biology. Knowledge of Computer Programming will be helpful but not a necessity

INTENDED AUDIENCE : Students of Biotechnology, Biology, Mathematical Biology, and allied subjects.

INDUSTRIES APPLICABLE TO : Bio-pharma industries use cellular level as well organism level mathematical models. This course would help to initiate biologists to such modeling.

COURSE OUTLINE :
Mathematical modeling has become integral part of different fields of biology, from ecology to cell biology. This course is intended to introduce students of biology to elementary mathematical concepts and tools for dynamical models. The course will focus on modeling using ordinary differential equations (ODEs). We will start with basic mathematical concepts of ODE-based models and then connect those with experimental biology. Mathematical models will be on cellular and molecular processes in biology, like cell signaling, and transcriptional networks. Students will learn basics of analytical techniques, graphical techniques, and numerical simulation.

ABOUT INSTRUCTOR :
Dr. Biplab Bose is an Associate Professor in the Department of Biosciences and Bioengineering at IIT Guwahati. Over the years, he has developed and taught courses on Systems Biology, Computational Biology, and Data Analysis. He uses Dynamical Systems and Statistical Physics to understand emergent and dynamical phenomena in Biology – particularly cell signaling, cell-cell interaction, and information processing in a cell.

COURSE PLAN :


Week 2: L1 & L2: Simulating ODE-based models L3 & L4: Steady state and stability analysis L5 & L6: Phase plane analysis

Week 3: L1 & L2: Concepts of bifurcation L3-L6: Mathematical formulations for elementary molecular processes

Week 4: L1 & L2: Modeling cell signaling L3: Properties of feedback and feed-forward network motifs L4 & L5: Modeling transcriptional circuits L6: Online resources for mathematical modeling in biology