Indian Institute of Science

Department of Bioengineering

BE, Third Floor, Biological Sciences Building, Indian Institute of Science, Bengaluru, 560012, India
+91 80 2293 2624 chair.be@iisc.ac.in http://www.be.iisc.ac.in

Course Title:	Fundamentals of Bioengineering 1
Course Code:	BE 213
Couse Schedule:	Aug Semester
Credits:	2:0
Course Coordinator:	Prof. Mohit Kumar Jolly and Prof. Bhushan Toley
Pre-Requisites:	None

Description

This course covers essentials of systems biology and biosensors. It caters to those who want to get first exposure to the topics that lay the foundation for advanced courses in these two topics. Systems biology: Dynamical systems biology, Feedback loops in biological systems, Cellular decisionmaking and cell differentiation, Mathematical modeling and nonlinear dynamics of biochemical reactions and networks, cell-to-cell variability and stochasticity in biological networks. Biosensors: The recognition-transduction system in a biosensor, chemistries for detection of small molecules, proteins/polypeptides, and nucleic acids; electronic and optical signal detection; microfluidics and its applications in biosensing; fluid dynamics and chemical kinetics of microfluidic biosensors; introduction to point-of-care biosensing; systems engineering approach in designing sample-in-answer-out biosensors

Course eligibility

This course is open to doctoral and master's students from all disciplines; and undergraduate students who have completed their second year. This course is divided into two parts, each being taught for half the semester. The first half is on computational systems biology, and the second one is on biosensors. The first half is an introduction to viewing biological systems from an evolutionary and engineering lens, and asking why a biological system is designed in a particular way, and how can simple mathematical models be used to characterize and predict their dynamical behavior. The second part is an introduction to the highly multidisciplinary area of biosensors and provides the fundamental concepts needed for students to pursue research in this area.

Course outcomes

- Appreciate and identify how systems-level properties emerge from the nonlinear dynamics of underlying biochemical networks
- Formulate and analyze simple mathematical models for various biological systems
- Understand the basic components of a biosensing system
- Given an analyte, be able to conceptualize the design of a biosensor that can detect it

Resources

1. Uri Alon, An Introduction to Systems Biology: Design Principles of Biological Circuits, Chapman & Hall/CRC Press (2006)
2. Biosensors, 2nd edition, J. Cooper and T. Cass, Oxford University Press