



AUA-IIT Bombay Overseas Study Program 2023

Systems Biology: A quantitative way to tackle disease regulations for a futuristic public healthcare system

When: 3rd July, 2023 to 7th July, 2023

Where: Indian Institute of Technology Bombay (IIT Bombay), India

Who: UG, PG, or Ph.D. students with basic knowledge and interest in Biology, Mathematics, and a bit of computer programming skill (knowing it will be good but not essential) is encouraged to apply. We will teach all the basic skill sets that are required to enjoy the course.

Why: In a healthy human body, all biological regulations are extremely well-organized and precise. Thus, any alteration in these biological regulations leads to complex diseases. The severity of these diseases also varies from person to person which reflects the dire need for personalized treatment strategies to tackle these diseases for a better public healthcare system. However, personalized treatment strategies can only be developed by having a quantitative understanding of the biological regulations, the malfunctioning of which causes these complex diseases. Systems biology is an exciting interdisciplinary and quantitative approach that provides systematic ways to understand various biological regulations and paves the way to formulate such personalized treatment strategies for different disease regulations to create a futuristic public healthcare system in the future. In this course, we will cover various aspects of Systems biology by highlighting how it can help in understanding certain complex biological regulations (for example, novel therapeutics developments in combating Cancer and maintenance of stemness of stem cells and controlling their developmental dynamics) quantitatively by suggesting therapeutic measures.

Program Schedule:

Date	Time	Topic
3 rd July, 2023	9:00 am to 10:30 am	Introducing the course content, its philosophy, and aims, What is Systems Biology? How it got popularity among biologists? Who are involved in the Systems Biology community? Why is it useful for a Biologist? Broad classifications in Systems Biology (Top-down and Bottom-up), Mathematical and Computational modelling in Systems Biology, What is required to learn the art of modelling? Phenomenological modelling and Data-driven modelling
	11:30 am to 1:00 pm	Phenomenological models (some examples), Some basics of nonlinear dynamics and bifurcation theory, One-dimensional bifurcations, 2D-bifurcations, How to convert a biological observation to a dynamical model? How to analyse such dynamical models?
	3:00 pm to 4:00 pm	Hands-on training session

	4:00 pm to 5:00 pm	Self-study time for the students
4 th July, 2023	9:00 am to 10:30 am	How do Cells compute? (some Examples), Network Motifs and dynamical modules in Molecular Cell Biology, Understanding various network motifs (with examples), Positive-feedback motifs, and how to analyse them.
	11:30 am to 1:00 pm	Design Principles of Biochemical Oscillations, with discussions on various oscillatory biological systems and their implications (Circadian rhythm, glycolytic oscillation, p53 oscillation, Hes1 oscillation), 3- component motifs.
	3:00 pm to 4:00 pm	Hands-on training session
	4:00 pm to 5:00 pm	Self-study time for the students
5 th July, 2023	9:00 am to 10:30 am	Data-driven Mathematical Modelling approach (by taking a few interesting examples from Systems Biology literature will be discussed, Demonstrating a systems biology toolbox to perform data-driven modelling (COPASI), How to construct predictive models of disease regulations
	11:30 am to 1:00 pm	Noise in gene regulatory network, sources and how to deal with them by performing Stochastic modelling of biological systems (Numerical method such as Gillespie's stochastic simulation algorithm), Discussion of some simple stochastic mathematical models, Agent-based model and Rule-based models
	3:00 pm to 4:00 pm	Hands-on training session
	4:00 pm to 5:00 pm	Self-study time for the students
6 th July, 2023	9:00 am to 10:30 am	Discussion of some classic papers related to cell cycle regulation to showcase how the implementation of Systems biology has evolved from population-level study to single-cell level (starting from papers around 1990 to 2022). How it helps to figure out novel therapeutic strategies to tackle cancer.
	11:30 am to 1:00 pm	Discussion of some classic papers related to stem cell differentiation dynamics and signal-transduction to showcase how the implementation of Systems biology has helped us in understanding complex regulations in Biology. How it helps to understand regulations in stem cells for better therapeutic strategies.
	3:00 pm to 4:00 pm	Hands-on training session with Wet-lab demonstrations
	4:00 pm to 5:00 pm	Self-study time for the students
7 th July, 2023	9:00 am to 10:30 am	Project presentations by the participants
	11:30 am	Providing suggestions and feedback to the participants on project execution, overall

	to 1:00 pm	outcome, and presentations
	3:00 pm to 4:00 pm	Project presentations by the participants
	4:00 pm to 5:00 pm	Providing suggestions and feedback to the participants on project execution, overall outcome, and presentations
8 th July, 2023		Mumbai City Tour (Optional)

* Students are requested to carry their laptops as it will be required during the hands-on training sessions.

What we provide:

- (1) Invitation Letters
- (2) Airport Transfers
- (3) On campus accomodation (2nd July, 2023 to 9th July, 2023)
- (4) Meals (Breakfast, Lunch, Dinner)
- (5) Program fee / Registration fee waived
- (6) Local Conveyance for City Tour

Invite:

We would like to invite all members of AUA to nominate up to 2 students from their university to attend this program and have 2 more students on a waiting list. If a university does not nominate any students, or only nominates 1 student, then the unfilled places can be used by students on the waiting list.

Deadline for Registration: Kindly send the nominations in the attached excel sheet by 5th June, 2023 to tanvi.mehta@iitb.ac.in. Also, attach the scan copy of the passport of the nominated/waitlist students for us to issue invitation letters.

For any queries contact: tanvi.mehta@iitb.ac.in