



## AUA-IIT Bombay Youth Forum 2024

### A Fresh Outlook to Drug Discovery and Personalised Medicine: Hands-on Workshop and Brainstorming Sessions

**When:** 11<sup>th</sup> November 2024 to 15<sup>th</sup> November 2024

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

**Who:** Undergraduate and Master's students with basic knowledge and interest in quantitative Biology are encouraged to apply. We will teach all the basic skill sets that are required to enjoy the forum.

**Why:** In today's healthcare, patients with the same condition often receive identical or similar treatments, despite their inherent physiological differences. However, disease progression is influenced not only by external factors but also by an individual's intrinsic factors, such as the tissue microenvironment. As a result, a drug that is effective for one patient may not work for another or may cause severe adverse reactions. This highlights the need for a paradigm shift toward personalized medicine, which requires a deep understanding of how the tissue microenvironment, or niche, influences cellular behavior in a pathophysiological context. Toward this goal, 3D cell culture and microfluidic organ-on-chip technologies, among others, are being developed. The proposed course will critically explore the applicability of these new approaches for personalized medicine and drug discovery. In the three modules of this course, we will cover the systems biology approach, foundational training on organ-on-chip technologies and 3D cell culture systems, and an industry visit to gain first-hand insights into cutting-edge work in 3D cell culture and bioprinting.

#### **Schedule:**

Date	Time	Topic
11 <sup>th</sup> Nov 2024	9:00 am - 10:00 am	Introducing the content, its philosophy, and its aims. Understanding the basics of the cell cycle and its regulation in normal as well as in diseased conditions such as cancer. Further, using the FUCCI reporter system, how the different phases of the cell cycle can be visualized at a single level will be demonstrated. Demonstration of how employing a mathematical modelling approach, one can understand the complex cell cycle regulatory processes more simplistically. How the cell cycle gets regulated under different physiological conditions, and how to get insights from these single-cell level observations to figure out novel therapeutic strategies to tackle diseases such as cancer.
	10:30 am - 11:30 am	What do we mean by heterogeneity in cell cycle regulation? What are the different sources of heterogeneities in the cell cycle regulation? How modulating these heterogeneities can help in improving the therapeutic outcomes? To understand the origin of this heterogeneity, how the Stochastic modelling approach (Numerical method such as Gillespie's stochastic simulation algorithm) can be used? Some of the

		simple stochastic mathematical models will be discussed. Lastly, we will try to verify model predictions to gain further insights for therapeutic development.
	12:00 pm - 1:00 pm	Student groups will review and discuss the status of different mathematical models and how they help in resolving biological problems related to cancer therapeutics.
	3:00 pm - 4:30 pm	Hands-on training session: Demonstration of FUCCI reporter-containing live cell imaging to track the different cell cycle phases and how to analyse this imaging data to quantify the cell cycle duration heterogeneities. Tutorials based on performing some simple deterministic and stochastic modelling problems to quantify cell cycle duration heterogeneities from the model analysis.
	5:00 pm - 5:30 pm	Self-study time for the students
12 <sup>th</sup> Nov 2024	9:00 am - 10:00 am	We will dig deeper to understand molecular regulation such as restriction point control which is responsible for cell cycle commitment in mammalian cells. How in the absence of this regulation, does cell cycle commitment occur in Cancer cell lines, and how single cell level studies can provide greater insights in this regard? How these insights obtained at the single cell level can be connected to proliferative response at the phenotypic level will be illustrated to predict therapeutic interventions.
	10:30 am - 11:30 am	We will understand how the cancer cells behave in a tumour microenvironment and how the cells spread to the other parts of the body. In connection with this, we will introduce a hypoxic condition to mimic the tumour microenvironment to understand how it affects cell cycle dynamics. Further, we will discuss the need to understand the epithelial-to-mesenchymal transition phenomenon in the context of metastasis using single-cell level studies.
	12:00 pm - 1:00 pm	Student groups will discuss the importance of single-cell level studies and their implication, challenges in their implementation, and the way forward for such kinds of studies by highlighting their relevance in the context of personalized cancer therapeutics.
	3:00 pm - 4:30 pm	Hands-on training session: To understand the regulation of the above-mentioned processes in depth, we will show how by using different florescence-based reporter systems, we can investigate the restriction point control in cancer cells, and understand the cell cycle dynamics under hypoxic and EMT-inducing conditions. Students will get to know how to quantify the single-cell experimental data and get an understanding of how to use mathematical models to understand these regulations comprehensively.
	5:00 pm - 5:30 pm	Self-study time for the students
13 <sup>th</sup> Nov 2024	9:00 am - 9:30 am	Lab visits by the participants. Various microfluidic organ on chip models will be demonstrated and explained. The participants will get a first-hand idea of these systems.
	10:00 am - 11:00 am	Lectures on Alternative to Animal Models: Needs, Means and Challenges
	11:30 am - 1:00 pm	Student groups will review the status of different models. Each group will be given one model to explore.

	3:00 pm - 5:30 pm	Hands-on training session Organ on Chip Models: Fabrication Demonstration
14 <sup>th</sup> Nov 2024	9:00 am – 11:00 am	Student groups discussion on different organ on chip models that they studied on the previous day. The critical parameters, regulatory, and policy issues will be discussed.
	11:30 am – 1:00 pm	A detailed lecture on Placenta on Chip as developed by IITB and ICMR researchers. Using this one model, the critical engineering issues will be analyzed.
	3:00 pm – 5:30 pm	Hands-on training session To fabricate organ on chip models for quasi-3D and 3D cell culture.
15 <sup>th</sup> Nov 2024	9:00 am – 11:30 am	Imaging and visualization of the cellular models prepared on the previous day.
	12:00 pm – 1:00 pm	Integration of Module 1 and 2: The road ahead
	3:00 pm – 5:00 pm	Industry visits with a focus on 3D cell and tissue culture system
16 <sup>th</sup> Nov 2024	Full Day	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) Stipend of USD 500 for airfare
- (2) Invitation Letters
- (3) Airport Transfers
- (4) On campus accommodation on twin sharing basis (10<sup>th</sup> November 2024 to 17<sup>th</sup> November 2024)
- (5) Meals (Breakfast, Lunch, Dinner)
- (6) Forum Registration fee waived
- (7) Local Conveyance for City Tour

#### **Invite:**

We would like to invite all members of AUA to nominate up to 3 students from their university to attend this forum and have 2 more students on a waiting list. If a university does not nominate any students, or nominates less than 3 students, then the unfilled places might be used by students on the waiting list.

**Deadline for Registration:** Kindly send the nominations in the attached excel sheet by 20<sup>th</sup> September 2024 to [tanvi.mehta@iitb.ac.in](mailto: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:** Ms. Tanvi Mehta – AUA Liaison, IIT Bombay - [tanvi.mehta@iitb.ac.in](mailto:tanvi.mehta@iitb.ac.in)