

Systems Biology Foundations & Mathematical Modeling — Hands-on

Develop a strong foundation in systems biology and quantitative modeling. Learn how to represent biological processes as networks and equations, build ODE-based models, analyze stability and steady states, and run simulations using open-source tools for real-world omics and pathway data.

Systems Biology Foundations & Mathematical Modeling

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Session 1

Fee: Rs 8800 [Apply Now](#)

Systems Thinking & Biological Networks

Systems biology principles & levels of organization

emergent properties **feedback & feedforward**
robustness & fragility

Network representations of biological systems

gene regulatory networks **signaling & metabolic**
networks **motifs & modules**

Toolchain for network-centric modeling

Python / networkx **R / igraph** **Cytoscape basics**

Session 2

Fee: Rs 11800 Apply Now

Mathematical Modeling with ODEs

From reactions to equations: mass-action kinetics

reaction schemes **rate laws** **nonlinear ODEs**

Steady states & basic stability concepts

equilibria **Jacobian intuition** **phase-plane sketches**

Implementation toolkit

Python / SciPy solve_ivp **R / deSolve** **SBML basics**

Session 3

Fee: Rs 14800 Apply Now

Simulation, Stability & Sensitivity

Time-course simulation workflows

deterministic vs stochastic **stiff systems** **simulation**
diagnostics

Sensitivity analysis & parameter exploration

local sensitivity **parameter scans** **uncertainty bands**

Dedicated modeling tools

COPASI workflows **CellDesigner views** **COBRApy**
preview

Session 4

Fee: Rs 18800 Apply Now

Mini Capstone: Model a Pathway

Build an ODE model for a small pathway

Theory + Practical

Simulate, analyze and interpret dynamics

time-course plots **perturbation scenarios** **stability**
commentary

Deliverables: notebook, model file & report

Python/R notebook **SBML / COPASI file** **PDF/HTML**
summary