Control Theory & Feedback in Biology — Hands-on

Explore how control theory concepts such as feedback, stability and robustness apply to biological pathways and regulatory circuits. This module develops intuition for negative and positive feedback, homeostasis, disturbance rejection and simple control strategies, with applications to signaling, metabolism and physiological regulation.

Control Theory & Feedback in Biology

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Session Index

Session 1

Fee: Rs 8800 Apply Now

Feedback, Homeostasis & Control Intuition

Feedback loops in biology and engineering analogy

negative vs positive feedback **set points and controlled variables** **examples from physiology and pathways**

Homeostasis and disturbance handling

input, output and disturbance view **buffering and adaptation ideas** **robustness vs fragility intuition**

Block diagrams and simple loop sketches

controller, plant and sensor concepts | feedback block diagrams | mapping biological circuits to blocks

Session 2

Fee: Rs 11800 Apply Now

Stability, Gain & Dynamic Responses

Stability concepts for feedback systems

steady states and basins idea | overshoot, oscillations, divergence | biological examples of stable vs unstable loops

Gain, sensitivity and response speed (intuitive)

high vs low gain trade offs | response time and settling time ideas | sensitivity of output to parameters

Step, pulse and sinusoidal like inputs

how pathways respond to jumps and pulses | adaptation and perfect adaptation ideas | frequency response intuition (high level)

Session 3

Fee: Rs 14800 Apply Now

Control Strategies in Biological Circuits

Proportional, integral and derivative like motifs

P, I, D ideas without heavy math | integral feedback and perfect adaptation | derivative sensing and anticipation

Feedforward, cascade and nested control

decoupling disturbances concept | hierarchies of regulation | examples in signaling and metabolism

Control design mindset for pathway engineering

choosing feedback placement | targeting gain and response shape | stability and robustness checks

Session 4

Fee: Rs 18800 Apply Now

Mini Capstone: Control Aware Pathway Analysis

Select a pathway and identify control features

theory plus guided practical

Sketch a feedback block diagram and explore scenarios

identify inputs, outputs and disturbances | qualitative gain and stability discussion | compare wild type vs perturbed loops

Deliverables: notebook, pathway sketch and short note

Python or R notebook or slides | block diagram and loop annotations | PDF or HTML summary