Course Title (Code): Systems Medicine (EE798Q)

Instructor: Dr Abhilash Patel (apatel[at]iitk.ac.in)

Teaching Assistants: TBD

Course webpage: https://home.iitk.ac.in/~apatel/teaching.html

Lectures Time: MW, 5.15PM-06.30PM

Lectures Venue: 213, ACES

Office Hour: on email request

Prerequisites: Basics of calculus

Objective of the course: This course aims to equip students with a deep understanding of the feedback mechanisms regulating human physiology and their relation to disease. Through the development and simulation of mathematical models, students will gain insights into disease dynamics, therapeutic interventions, and personalized medicine approaches, bridging different healthcare perspectives.

Tentative Contents:

- Preliminaries of feedback systems
- Central dogma and cell as system
- Modeling in molecular scale
- Feedback and feedforward circuits
- Cardiac control
- Vestibular control system
- Respiratory control system
- Dynamical analysis of physiological models
- Insulin-Glucose circuit
- Dynamical compensation, mutant resistance, and Type 2 diabetes
- The stress hormone axis as a two-gland oscillator
- The thyroid and its discontents
- Autoimmune diseases as a fragility of mutant surveillance
- Inflammation and fibrosis as a bistable system
- Basic facts of aging
- Aging and saturated repair
- Age-related diseases
- Case studies of other diseases
- Medicine as control mechanisms
- Precision medicine and targeted therapeutics

Grading Policy:
Mid Sem Exam- 20%
End Sem Exam- 30%
Course Project- 30%
Quizzes & Assignments-20%

Recommended Textbooks:
1. Uri Alon, *Systems Medicine: physiological circuits and the dynamics of disease*, CRC Press, 2024
2. Charles Lessard, *Basic feedback controls in biomedicine*, Morgan & Claypool Publishers, 2009
3. James Keener and James Sneyd, *Mathematical physiology: II: Systems physiology*, Springer, 2009.