Possible Project Topics

First of all, please note that, this document gives you rough idea what type of projects you may choose for your final project. Therefore, you are not limited to the projects presented here. It is possible to choose any topic that includes mathematical modeling and control of biological/physiological systems.

- **Modelling and simulation of the human renal system**

You are expected to research mathematical models developed for the human renal system. It is not necessary to model corresponding systems (such as cardiovascular system) but only the dynamics regarding to filtration of blood (nephrons).

- **Detailed modelling of the regulation of blood glucose via insulin**

You need to look for detailed models (such as Sorensen), understand them and implement them in any simulation environment (it is not allowed to use Bergman's minimal model).

- **Modelling of the human immune response**

Here, it is aimed to research some articles on this topic, understand them and implement one of them in a simulation environment to show the immune response and corresponding control loops (For example, papers like, "The role of models in understanding CD8(+) T-cell memory", "A basic mathematical model for the immune response").

- **Modelling of blood cell production**

Research hematopoiesis, read articles such as "Cyclical neutropenia and other periodic hematological disorders: A review of mechanisms and mathematical models", and try to express the mathematical model of blood cell production.

- **Tumor Growth**

Learn about the biology of tumor growth, invasion, and metastasis, then read and try to understand the papers like "A Reaction-Diffusion Model of Cancer Invasion". If necessary, perform the simulation in any simulation environment and comment on the results.

- **Modelling of the infectious diseases**

Learn about any infectious disease (such as aids, leprosy, tuberculosis, etc.) and research corresponding mathematical models. Also, perform the required simulation studies in any simulation environment.

- **Type-II diabetes**

Research about type II diabetes and understand the mathematical models. Choose one of the model (complex enough) from the literature and carry out the simulations.

- **Modelling of the lung diseases**

Research and try to understand the pathophysiology of the one of the lung diseases (such as COPD, IPF, asthma, etc.). After that by introducing the required mathematical models for respiratory system, try to model the disease under consideration and perform simulations.

- **Modeling of the cardiovascular diseases**

Research and try to understand the pathophysiology of the one of the cardiovascular diseases (such as coronary artery disease, heart valve diseases, left heart failure, etc.). After that by introducing the required mathematical models for cardiovascular system, try to model the corresponding cardiovascular disease and perform the required simulations.

- **Cancer chemotherapy**

Research the traditional and novel chemotherapeutic strategies for cancer treatment. Read and understand articles such as “Optimizing Drug Regimens in Cancer Chemotherapy by an Efficacy-Toxicity Mathematical Model”. Try to obtain required mathematical models and carry out the simulation as necessary.

- **Cancer immunology**

Research the immunological implications of cancer and cancer treatment. Read and understand articles like “A Validated Mathematical Model of Cell-Mediated Immune Response to Tumor Growth”. Try to obtain required mathematical models and carry out the simulation as necessary.

- **Human biomechanics**

Research any biomechanical system in human body such as human gait or modeling of the human walking. Obtain the necessary free body diagrams and create the model equations. It is also necessary to perform the required simulations in any simulation environment.

- **Ovulation in mammals**

Research and understand the articles about the ovulation in mammals. A mathematical model and the model parameters of the menstrual cycle should be found (check authors Selgrade and Schlosser) and the required simulations need to be performed in any simulation environment.

- **Gastroinstentinal system**

Such as modeling of the fluid absorption, gastric protection or coupled oscillations in the small intestine.

- **Other related topics**

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