The course introduces key concepts from systems biology and systems engineering methodologies used for the study of complex biological networks. It presents and analyzes the methodologies for the development of models of biological networks.

The course will include the following topics:

- Methods and technologies for monitoring cell-wide gene expression
- Mathematical and computational analysis of gene expression data
- Methods and technologies for monitoring cell-wide protein expression
- Mathematical and computational analysis of protein expression data
- Methods and technologies for identification of protein-protein interaction
- Mathematical and computational analysis of protein-protein interaction data
- Methods and technologies for identification of DNA-protein interaction
- Mathematical and computational analysis of DNA-protein interaction data
- Genetic networks
- Mathematical methods for the identification of genetic regulatory networks
- Modeling and Simulation of gene expression networks
- Translation networks
- Modeling and Simulation of protein expression networks
- Methods and technologies for monitoring metabolic reaction networks
- Mathematical and computational analysis of metabolic reaction networks
- The course offers computer laboratory.

Learning Prerequisites

Recommended courses
Analysis I-III, linear algebra, probability and statistics, physical chemistry.

The building of working groups will make it possible for people with partial knowledge in these fields to contribute depending on their formation.

For SSV students: Dynamical Systems Theory for Engineers or "Mathematical and Computational Models in Biology" course, Felix Naef
Important concepts to start the course
For the computational exercises, MATLAB® will be used intensively.

Learning Outcomes
By the end of the course, the student must be able to:
• Formulate mass balances of reaction networks
• Solve mass balance equations using linear programing solvers
• Analyze papers on modeling and analysis of biological networks
• Assess / Evaluate alternative methods for the study of biological networks
• Construct kinetic models of biological reactions

Transversal skills
• Plan and carry out activities in a way which makes optimal use of available time and other resources.
• Access and evaluate appropriate sources of information.
• Summarize an article or a technical report.
• Demonstrate the capacity for critical thinking
• Negotiate effectively within the group.

Teaching methods
Teaching in classroom, paper reviews, project.

Expected student activities
Presentations and critical analysis of papers.
Project.

Assessment methods
- Presentations of papers from the literature (30%)
- Mid-semester and final project presentation (70%)

Supervision
Office hours Yes
Assistants Yes

Resources
Bibliography
Foundations of System Biology, Edited by Hiraoki Kitano. MIT Press 2001

Ressources en bibliothèque
• An Introduction to Systems Biology / Alon
• Modeling differential equations in biology / Taubes
• Foundations of System Biology / Nagasaki
Websites

- http://scgc.epfl.ch/telechargement_cours_chimie