*Course syllabus*

# Fysiologiska modeller och beräkningar
# Physiological Models and Computations

## FRTF01, 5 credits, G2 (First Cycle)

**Valid for:** 2023/24
**Faculty:** Faculty of Engineering, LTH
**Decided by:** PLED F/Pi
**Date of Decision:** 2023-04-18

## General Information

**Main field:** Technology.
**Compulsory for:** BME3
**Elective for:** Pi4
**Language of instruction:** The course will be given in English

## Aim

The aim of the course is to introduce important concepts, notions and methods in physiological modeling and computations including quantitative comparisons with physiological och medical measurements and phenomena. The course also provides a solid introduction to studies of biological and medical control systems based on feedback.

## Learning outcomes

*Knowledge and understanding*
For a passing grade the student must

- have an understanding of dynamic physiological processes and identify their occurrence in different organ systems;
- have an understanding of the relevance, strength and limitations of dynamic models of physiological systems;
- know how different types of differential equation-based models can be used to describe, simulate and analyze physical processes;

- have an understanding of how the seemingly different physiological systems that are considered fit well into the modeling framework that is built up during the course.

*Competences and skills*
For a passing grade the student must

- be able to decompose modeling problems into smaller subproblems;
- be able to make basic quantitative analysis of various physiological systems, including both unit analysis and plausibility analysis of the model's time scale and the size of internal states and signals;
- be able to make use of physiological modeling knowledge in simulations;
- be able to apply physiological modeling in order to judge the relevance of different medical engineering solutions.

*Judgement and approach*
For a passing grade the student must

- be able to interpret and discuss information from medical literature;
- be able to communicate with healthcare professionals about physiological modeling and technical systems.

## Contents

- Physiological complexity: statics, equilibrium, homeostasis, dynamics, simulation.
- Modeling: dynamic systems, differential equations, linear dynamics, transfer functions, compartment models.
- Linear dynamics: linearization of nonlinear dynamics, state-space form, transfer functions, time and frequency response, circuit equivalents, block diagrams.
- Simulation: ODE solvers, implementation of simulation models in software.
- Modeling and measurement data.
- Examples of physiological systems that occur in the course: Enzyme dynamics: Michalis Menten kinetics. Pharmacokinetics: compartment models. Biomechanics: constitutive models. Dynamics of the respiratory system: RIC and Mead models. Blood vessel dynamics: Windkessel models.

## Examination details

**Grading scale:** TH - (U,3,4,5) - (Fail, Three, Four, Five)
**Assessment:** Written exam. Four hand-in exercises and one project. In the case of less than 5 registered students, the retake exams may be given in oral form.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

**Parts**
**Code:** 0114. **Name:** Physiological Models and Computations.
**Credits:** 4. **Grading scale:** TH. **Assessment:** Passed exam
**Code:** 0214. **Name:** Hand-In 1.
**Credits:** 0. **Grading scale:** UG.
**Code:** 0314. **Name:** Hand-In 2.
**Credits:** 0. **Grading scale:** UG.
**Code:** 0414. **Name:** Hand-In 3.
**Credits:** 0. **Grading scale:** UG.
**Code:** 0514. **Name:** Hand-In 4.
**Credits:** 0. **Grading scale:** UG.

**Code:** 0614. **Name:** Project.
**Credits:** 1. **Grading scale:** UG. **Assessment:** Written report and oral presentation

## Admission

**Assumed prior knowledge:** FMAB45/50/60 Calculus in One Variable A1/A2/A3, FMAB20 Linear Algebra and BMEA05 Signals and Systems.
**The number of participants is limited to:** No

## Reading list

- A course compendium and a collection of exercises will be available free of charge as a pdf for students in the course.

## Contact and other information

**Course coordinator:** Kristian Soltesz, kristian.soltesz@control.lth.se
**Director of studies:** Björn Olofsson, bjorn.olofsson@control.lth.se
**Course homepage:** http://www.control.lth.se/course/FRTF01