LUNDS UNIVERSITET
Lunds Tekniska Högskola

*Course syllabus*

# Reglerteknik, allmän kurs
# Automatic Control, Basic Course

## FRTF05, 7,5 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:** D3, E3, F3, I3, M3, MD3, N3, Pi2
**Elective for:** BME4, C4
**Language of instruction:** The course will be given in Swedish

## Aim

The aim of the course is to give knowledge about the basic principles of feedback control. The course will give insight into what can be achieved with control, and the possibilities and limitations. The course covers linear continuous-time systems.

## Learning outcomes

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

- be able to define the fundamental concepts of control
- be able to linearise nonlinear dynamical models
- be able to compute the relations between dynamical models in the form of transient responses, transfer functions, differential equations on state-space form, and frequency responses described with Bode or Nyquist diagrams
- be able to analyse dynamical systems with respect to stability, robustness, stationary characteristics, controllability, and observabilility
- be able to implement controllers using discretization of analog controllers

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

- be able to design controllers from given specifications on robustness and performance based on models on state-space form, transfer function form, Bode diagrams or Nyquist diagrams
- be able to design controllers based on cascade connections, feedforward, and delay compensation
- be able to evaluate controllers by analysing transient and frequency responses, and via laboratory experiments on real processes

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

- understand relationships and limitations when simplified models are used to describe complex dynamical systems
- show ability for teamwork and collaboration at laboratory exercises

## Contents

Introduction; overview of control; describing dynamical systems using time-invariant ordinary differential equations, transfer function, frequency responses, Bode and Nyquist diagrams; relations between different representations; controllability and observability; analysis of feedback systems, signal following and disturbance rejection; stability; overview of stability analysis methods: root locus and Nyquist criterion; practical stability; phase and amplitude marginals; synthesis and implementation of controllers; specifications; control principles and controller structures: PID control, cascade control, feedforward; synthesis of systems with a given transfer function: pole-placement through state feedback and output feedback; reconstruction suing Kalman filter; Bode and Nyquist compensation; delay compensation; application examples

## Examination details

**Grading scale:** TH - (U,3,4,5) - (Fail, Three, Four, Five)
**Assessment:** Written exam (5 hours), three laboratory exercises. 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:** 0117. **Name:** Examination.
**Credits:** 6. **Grading scale:** TH. **Assessment:** Passed exam.
**Code:** 0217. **Name:** Laboratory Work 1.
**Credits:** 0,5. **Grading scale:** UG. **Assessment:** Preparation exercises and participation in laboratory.
**Code:** 0317. **Name:** Laboratory Work 2.
**Credits:** 0,5. **Grading scale:** UG. **Assessment:** Preparation exercises and participation in laboratory.
**Code:** 0417. **Name:** Laboratory Work 3.
**Credits:** 0,5. **Grading scale:** UG. **Assessment:** Preparation exercises and participation in laboratory.

## Admission

**Assumed prior knowledge:** Compulsory courses in mathematics.
**The number of participants is limited to:** No
**The course overlaps following course/s:** FRT010, FRT065, FRT081, FRT110,

## Reading list

- Glad T, Ljung L: Reglerteknik – grundläggande teori, Studentlitteratur, 2006 or.
- Åström KJ, Murray RM: Feedback systems, Princeton 2008.
- Compendium in Control, Hägglund, T.
- Compendia with examples, formulas and instructions for laboratory work.

## Contact and other information

**Director of studies:** Björn Olofsson, bjorn.olofsson@control.lth.se
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