Linnæus University

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# Course syllabus

Faculty of Technology
Department of Physics and Electrical Engineering

## 4ED414 Reglerteknik fortsättningskurs, 7,5 högskolepoäng
## Automatic Control Advanced Course, 7.5 credits

**Main field of study**
Electrical Engineering

**Subject Group**
Electrical Engineering

**Level of classification**
Second Level

**Progression**
A1N

**Date of Ratification**
Approved by Faculty of Technology 2014-10-03
The course syllabus is valid from autumn semester 2015

**Prerequisites**
Automatic Control 7.5 higher education credits (2ED313) or the equivalent.

## Objectives

Upon completition of the course the student should be able to:

- analyse a linear system with the use of state space models in continuous, as well as in discrete time
- to design controllers for linear systems based on state space models when poles are given or when a given quadratic loss function is to be minimized
- analyse non linear systems, including controlled non linear systems, with respect to stability with the help of some standard methods
- Be able to analyse simple, non linear systems with phase plane analysis.

## Content

**Part 1 Analysis and synthesis based on state space models**

- State space models of linear systems.
- State feedback control and feedback from reconstructed states. Controllability and observability and their relations to state feedback control and feedback from reconstructed states.
- Sampling of linear systems
- Optimal control of linear system, especially the method based on minimization of a quadratic criterion is treated.

**Part 2 Analysis of non linear control systems**

- A number of stability concepts. Linearization of a non linear system. Phase plane analysis.
- Prediction of the amplitude and frequency of stable periodic solutions using the describing function method.
- Using Lyapunov functions to prove stability of a system. Lyapunov's linearization method.
- Introduction to the theory of input-output stability, the circle criterion.

**Part 3 Laboratory work**

- Control of a physical process. State estimation based on data from a physical process.
- Simulation of dynamical systems using programs as Matlab, Simulink, Dymola or 20-sim.

## Type of Instruction
Teaching consists of lectures, seminars and practical work. Attendance at some activities may be mandatory.

## Examination
The course is assessed with the grades A, B, C, D, E, Fx or F.
The grade A constitutes the highest grade on the scale and the remaining grades follow in descending order where the grade E is the lowest grade on the scale that will result in a pass. The grade F means that the student's performance is assessed as fail (i.e. received the grade F).

Assessment of the student's performance is made through written examination and/or orally and/or presentation of mandatory assignments. The assessment method is decided at the start of the course.

Students who do not pass the regular examination are given the opportunity to do a resit examination shortly after the regular examination.

## Course Evaluation
A written course evaluation will be carried out at the end of the course in accordance with the guidelines of the University. The course evaluation will be filed at the department.

## Credit Overlap
4ED114 Automatic Control Advanced Course, 7.5 credits

## Other
Grade criteria for the A–F scale are communicated to the student through a special document. The student is to be informed about the grade criteria for the course by the start of the course at the latest.

## Required Reading and Additional Study Material
**Required reading**
Torkel Glad, Lennart Ljung, *Control theory, Multviariable and Nonlinear Methods*, Taylor and Francis, 2000. Pages 250 (467)
Gene F. Franklin, J. David Powell, Abbas Emami-Naeini, *Feedback Control of Dynamic Systems*, Prentice Hall. Pages 300 (928).