Course syllabus

Systemteknik
Systems Engineering

FRTF10, 6 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: W3
Language of instruction: The course will be given in English

Aim

The aim of the course is to give an overview of systems engineering, in particular control engineering, and its concepts, methods, and application areas. The course also develops the skills in using computer-based analysis and simulation tools.

Control plays a major role in most parts of our society. In earlier courses the students have learnt how to model and understand system behaviour. The aim of this course is to learn the students how to make a system operate more reliable, in a more environment-friendly way, with better precision, or in a more economical way, in spite of external disturbances acting on the system. The word system has a very general interpretation. It can, for example, be an atomic energy microscope or a waste water treatment plant.. The course teaches a systems-oriented way of thinking which the students can make use of in their future careers, independent of the actual application area.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- understand what a linear time-invariant dynamical system is
- be able to grasp the basic concepts of control

- understand how a dynamical system can be modelled using different model representations, for example transient responses, transfer functions, differential equations on state-space form and input-output form, and frequency responses described using Bode or Nyquist diagrams
- have knowledge about the concepts that are used to describe the performance of a dynamical system, for example stability and stationary characteristics
- have knowledge about the most common controller types and their mathematical basis
- understand the advantages and disadvantages of different controller structures

Competences and skills
For a passing grade the student must

- be able to use the basic concepts of control correctly both in speaking and writing
- be able to approximate a nonlinear dynamical system using linearization
- be able to describe a dynamical systems using different representations, including transient responses, transfer functions, state-space model, differential equations on state-space form, and frequency response
- be able to compute the relationships between different model representations
- be able to analyse dynamical systems and reason about ther behaviour
- be able to design controllers and controller structures from given specifications
- be able to use modern computer tools for control
- be able to perform smaller experiments on laboratory setups to derive a system that behaves according to a given specification

Judgement and approach
For a passing grade the student must

- be capable of solving new previously unknown controller problems of smaller size
- be able to communicate in a professional way with persons working with control
- show ability for teamwork and group collaboration in laboratory exercises
- be able to read and give feedback on project reports, and be able to produce written reports of the solutions to the hand-in problems

Contents

The course gives insight in the use of systems engineerings-based analysis methods and dynamical models for feedback systems. It also provides tools for the design of simple controllers.

Important areas are mathemical models of simple control loops and analysis of their dynamics. Computer tools are used for analysis, synthesis, and implementation.

The course contains computer-based exercises and laboratory experiments on real model processes.

Course modules: Introduction, Modelling, Dynamical systems, Feedback, PID design, Controller structures, Frequency domain analysis

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Written exam (5 hours), hand-in problems, 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:** Systems Engineering.
Credits: 5. **Grading scale:** TH. **Assessment:** Passed exam.
Code: 0217. **Name:** Laboratory 1.
Credits: 0,5. **Grading scale:** UG. **Assessment:** Preparation exercises and approved participation in laboratory.
Code: 0317. **Name:** Laboratory 2.
Credits: 0,5. **Grading scale:** UG. **Assessment:** Preparation exercises and approved participation in laboratory.
Code: 0417. **Name:** Hand In Problem 1.
Credits: 0. **Grading scale:** UG.
Code: 0517. **Name:** Hand In Problem 2.
Credits: 0. **Grading scale:** UG.

Admission

Assumed prior knowledge: FMAB30 Calculus in Several Variables, FAFA70 Energy and Environmental Physics, Matlab.
The number of participants is limited to: No
The course overlaps following course/s: FRT110, FRTN25, FRT010, FRT081

Reading list

- Systems Engineering and Process Control - Lecture Notes (Kompendium). KFS.
- Exercises in Systems Engineering and Process Control (Kompendium), Reglerteknik, KFS.
- Automatic Control - Collection of Formulae. KFS.

Contact and other information

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Course homepage: http://www.control.lth.se/course/FRTF10
Further information: May not be part of an exam together with FRTF05 or FRTN25.