Automatic Control

Programme course

8 credits

Reglerteknik

TSRT91

Valid from: 2017 Spring semester

Determined by
Board of Studies for Computer Science and Media Technology

Date determined
2017-01-25

Replaced by
TSRT19

Main field of study
Electrical Engineering

Course level
First cycle

Advancement level
G2X

Course offered for
- Information Technology, M Sc in Engineering

Entry requirements
Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites
Calculus, one variable, Calculus, several variables, Linear algebra, Linear systems for communication

Intended learning outcomes

After completing this course, students should be able to describe the basic requirements for and limitations of automatic control. Students should also be able to perform analysis and systematic construction of feedback control systems. This means that students will be expected to be able to do the following after completing this course:

- Describe and analyse time and frequency domain properties of discrete-time linear dynamic systems.
- Define basic concepts in the area of automatic control.
- Transform mathematical models of linear dynamic systems between time domain input/output form, transfer function form, and state space form.
- Analyse models of linear dynamic systems that are given in the forms above with respect to stability, pole placement, rise time, damping, controllability and observability.
- Demonstrate the connections between the system properties of stability, rise time and damping in time and frequency domains.
- Derive input/output signal relationships in feedback control systems using block diagram calculations.
- Perform stability analysis of feedback control systems using Bode and Nyquist diagrams.
- Construct regulators in PID-form, lead-lag form, state space form, and feedforward form based on given specifications.
- Perform stability and robustness analysis of feedback control systems using the root locus method and robustness criterion, respectively.
- Formulate the specifications for a feedback control system for a lab process, then model, construct and verify that system. The work should be carried out independently and documented in writing.
- Examplify the importance of automatic control for a sustainable development in different application areas.

Course content

- Difference equations, the z transform. Impulse response, step response, stability, and frequency response of discrete-time linear dynamic systems.
- Differential equations. Transfer functions.
- Dynamic systems. Feedback principles.
- Stability. Error coefficients. Correspondence between dynamic properties and pole placement.
- PID control.
- Root loci. The Nyquist criterion.
- Frequency description. Bode plots. Phase and amplitude margins. Specifications in the frequency domain. Lead-lag compensation.
- Sensitivity and robustness.
- State equations. Controllability and observability. State feedback. Observers. Elimination of stationary errors.
- Examples of how automatic control can contribute to a sustainable development, for example in vignettes concerning a common scenario.

Teaching and working methods

The course consists of lectures, exercises, laboratory work, and work in PBL groups. Some of the exercises are computer-based. The students work with vignettes in groups and PBL is the general approach used in the course.

Examination

BAS1	Work in PBL-groups	1 credits	U, G
UPG1	Hand-in assignment	1 credits	U, G
LAB1	Laboratory work	1.5 credits	U, G
TEN1	Written examination	4.5 credits	U, 3, 4, 5

Grades

Four-grade scale, LiU, U, 3, 4, 5

Other information

Supplementary courses: Modeling and simulation, Industrial control systems, Control theory, Automatic control project course

Department

Institutionen för systemteknik

Director of Studies or equivalent

Johan Löfberg

Examiner

Martin Enqvist

Education components

Preliminary scheduled hours: 78 h
Recommended self-study hours: 135 h

Course literature

Additional literature

Books

Glad T., Ljung L, *Reglerteknik. Grundläggande teori*

Other

Studentlitteratur.
Övningsexempel

Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.