Automatic Control

Programme course

6 credits

Reglerteknik

TSRT12

Valid from: 2017 Spring semester

Determined by
Board of Studies for Electrical Engineering, Physics and Mathematics

Date determined
2017-01-25

Main field of study
Electrical Engineering

Course level
First cycle

Advancement level
G2X

Course offered for
- Computer Science and Engineering, M Sc in Engineering
- Applied Physics and Electrical Engineering - International, M Sc in Engineering
- Applied Physics and Electrical Engineering, M Sc in Engineering
- Mathematics
- Industrial Engineering and Management, M Sc in Engineering
- Industrial Engineering and Management - International, 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, Complex Analysis, Fourier analysis, Circuit theory

Intended learning outcomes

After completing this course students should be able to describe the basic requirements for and limitations of automatic control systems. The student should also be able to perform analysis and model based design of feedback control systems. the student is expected to be able to do:

- Define basic concepts in automatic control.
- Transform mathematical models of linear dynamical systems between time domain input/output form, transfer function form, and state space form.
- Analyse models of linear dynamic systems that given in the above forms with respect to stability, pole placement, rise time, damping, controllability and observability.
- Demonstrate the relationship between the system properties of stability, rise time and damping in time and frequency domains.
- Derive input/output signal relationships for feedback control systems using block diagram calculations.
- Perform stability analysis of feedback control systems using Bode diagrams and Nyquist diagrams.
- Design controllers in PID-form, lead-lag form, state space form, and feedforward form fullfilling given specifications.
- Perform stability and robustness analysis of feedback control systems.
- Formulate the specifications for a feedback control system for a lab-process, and then model, construct and verify control system. The work should be documented in writing.

Course content

Introduction: Dynamic systems. Feedback principles.
Mathematical models I: Differential equations. Transfer functions. Stability. Error coefficients.
Synthesis I: Correspondence dynamic properties - pole placement. Interpretation of Root Locus. The Nyquist criterion.
Mathematical models II: Frequency description. Bode plots. Phase and amplitude margins.
Synthesis II: Specifications in the frequency domain. Lead-lag compensation. Sensitivity and robustness.
Mathematical description III. State space equations. Controllability and observability.
Synthesis III: State feed back. Observers. Elimination of stationary errors.

Teaching and working methods

The course consists of lectures, lessons and laboratory work.

Examination

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: Control theory, Digital control, Modeling and simulation, Control project laboratory

Department
Institutionen för systemteknik

Director of Studies or equivalent
Johan Löfberg

Examiner
Anders Hansson

Course website and other links

Education components
Preliminary scheduled hours: 64 h
Recommended self-study hours: 96 h

Course literature
Glad T., Ljung L.: Reglerteknik. Grundläggande teori. 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.