Industrial Control Systems

Programme course

6 credits

Industriell reglerteknik

TSRT07

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
Second cycle

Advancement level
A1X

Course offered for
- Computer Science and Engineering, M Sc in Engineering
- Energy-Environment-Management
- Industrial Engineering and Management - International, M Sc in Engineering
- Industrial Engineering and Management, M Sc in Engineering
- Chemical Biology
- Mechanical Engineering, M Sc in Engineering
- Engineering Biology, M Sc in Engineering
- Applied Physics and Electrical Engineering, M Sc in Engineering
- Information Technology, M Sc in Engineering
- Applied Physics and Electrical Engineering - International, M Sc in Engineering
- Computer Science and Software Engineering, 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
Automatic control

Intended learning outcomes

The students should obtain knowledge about the control methods and strategies that are common in industry. In particular, the course should give an understanding for how control problems of different complexity can be solved using various types of computer-implemented controllers. More specifically, the students should know how to

- Use programmable logic controllers (PLCs)
- Analyse sequential control problems with relay ladder diagrams and sequential function charts (GRAFCET)
- Model and analyse discrete-time systems
- Sample continuous-time systems approximately or exactly
- Handle limitations in the design of linear control systems
- Tune PID controllers and implement them in software
- Evaluate the performance of a control system
- Use various linear control system structures
- Design and analyse model predictive controllers (MPCs)
- Use several versions of MPC, e.g., for guaranteeing good reference tracking or stability

Course content

Sequential control: Function charts, relay ladder diagrams, PLC languages.

Basic tools and methods: Discrete-time control theory, sampling of systems, process models.

Design and tuning of controllers: Internal model control, Smith predictor, reference feedforward control, PID tuning.

Implementation and operation of controllers: Digital implementation, anti-windup, mode transitions, performance measures, Harris index, oscillation index.

Nonlinear control strategies: Selector control, gain scheduling, fuzzy control.

Control system structures: Disturbance feedforward control, cascade control, ratio control, mid-range control, split-range control.

Model predictive control: Formulation of optimization problems for MPC, reference tracking, integral action, stability, explicit MPC.

Teaching and working methods

The course consists of lectures, exercise sessions and laboratory work.

Examination

LAB1	Laboratory work	2 credits	U, G
DAT1	Computer examination	4 credits	U, 3, 4, 5

Grades

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

Other information
Supplementary courses: Control Project Laboratory

Department
Institutionen för systemteknik

Director of Studies or equivalent
Johan Löfberg

Examiner
Martin Enqvist

Course website and other links

Education components
Preliminary scheduled hours: 52 h
Recommended self-study hours: 108 h

Course literature
Kompendium: "Industriell reglerteknik".

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.