Biological Automatic Control

Programme course

6 credits

Reglerteknik

TSRT03

Valid from: 2017 Spring semester

Determined by
Board of Studies for Chemistry, Biology and Biotechnology

Date determined
2017-01-25

Main field of study
Biotechnology, Electrical Engineering

Course level
First cycle

Advancement level
G2X

Course offered for
- Chemical Biology, M Sc in Engineering
- Engineering Biology, 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
Linear Algebra, Calculus

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:

- 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 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 criteria respectively.
- Formulate the specifications for a feedback control system for a lab-process, then model, construct and verify that system. The work should be documented in writing.

Course content

Dynamical systems. The feed-back principle. Differential equations, transfer functions, stability, error constants. PID control, relationships between dynamical properties and pole location. Root locus. Frequency response, Bode diagram, Nyquist diagram, stability analysis using Bode and Nyquist diagrams, phase and ampitude margin. Specifications in the frequency domain, lead-lag compensation, sensitivity and robustness. State space models. State feedback, observers.

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:

Department
Institutionen för systemteknik

Director of Studies or equivalent
Johan Löfberg

Examiner
Johan Löfberg

Course website and other links
http://www.control.isy.liu.se/student/tsrt03/

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

Course literature

Additional literature

Books

Glad T., Ljung L., (2006) *Reglerteknik. Grundläggande teori.*

Compendia

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.