SYLLABUS

Modelling and Control 7.5 credits R0004E

Modellering och reglering

Course syllabus admitted: Spring 2024 Sp 3 - Present

DECISION DATE
2023-06-16

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LULEÅ TEKNISKA UNIVERSITET

Modelling and Control 7.5 credits R0004E

Modellering och reglering

First cycle, R0004E

Education level	Grade scale	Subject	Subject group (SCB)
First cycle	G U 3 4 5	Reglerteknik	Automation Technology

Entry requirements

In order to meet the general entry requirements for first cycle studies you must have successfully completed upper secondary education and documented skills in English language and Basic knowledge about the Laplace transform, for example as acquired in the course M0018M Linear Analysis or S0004E Signals and Systems.
Alternative:
Alternative to completed courses can be corresponding knowledge acquired through work within the processindustry or electronics sector.

Selection

The selection is based on 1-165 credits.

Course Aim

The aim of the course is that the student should acquire basic knowledge of feedback systems, their design and how they are used in control applications.

For a passing grade, the student shall:

• be able to define basic control techniques and terminology.

• demonstrate basic knowledge about proven methods for design of feedback controllers.

• demonstrate the ability to model and simulate dynamic systems based on balance equations and constitutive relationships.

• be able to analyze the static, dynamic and frequency characteristics of dynamic systems using mathematical methods.

• be able to use common methods for dimensioning and analyzing feedback controllers.

• demonstrate the ability to design and implement controllers in teams, and evaluate their performance for a real process.

• demonstrate ability to teamwork and teamwork in group workings

• be able to Identify the usability of simple regulators and identify the need for more advanced methods

Contents

Automatic control is the theory of control of processes. A typical example is the cruise control in a car (the car is in this case the "process"), which by varying the throttle ("input" to the process) seeks to keep the speed ("output" of the process) constant despite uphill and counterwind (so-called "Disturbances"). Other common examples include, among other things, the process industry, where it can be used to control pressures and temperatures, and in communication technology where you want to control data transfer rates and transmitter effects.

Control theory, however, is not limited to technical processes but can also be applied in eg Economics and Medicine. One example is the human body's own, highly sophisticated control system, capable of keeping body temperature constant at 37 degrees Celsius despite variations in ambient temperature and keeping body weight constant despite persistently trying for better diet and exercise.

This course is our basic course in automatic control and covers the most common classical methods for analysis and synthesis of feedback control systems for a wide range of technical processes. The course provides thorough knowledge of the subject, sufficient for non-specialists in control engineering to develop simple control systems. The course is a necessary basis for further studies on the subject.

During the course, the following methods and concepts will be discussed:

Introduction: Introduction of common control concepts, such as static systems, dynamic systems, processes, reference signals (setpoint), control signal, output signal (value), interference, open system, measurement signal, feedback, regulator.

Dynamic Models: Mathematical Modeling of Physical Systems. Differential equations. Differential equations on state of the order. Linearization.

Simulation: Introduction to simulation of dynamic systems.

Mathematical Aid: The Laplace Transform and its properties. Transfer function. Static gain. Super-positions principle. Block schemes. Specifications. Rise time. Settling time. Overshoot. Poles. Zeros. Experimental model building. State space models.

Feedback system: PID controller. Feedforward control. Cascade control. Pole placement. Process disturbances. control error. Ziegler-Nichol's methods. Stability concept. Control structures.

Frequency methods: Frequency function. Frequency analysis. Bode plot. Asymptotic Bode plot. Stability. Stability margins. Compensation. Sensitivity. Time delays.

Digital Control: Discretisation. Sampling.

Realization

Each course occasion´s language and form is stated and appear on the course page on Luleå University of Technology's website.

The teaching consists of lectures, lessons, computer exercises and compulsory laboratory exercises. The lectures are devoted to the review of theory sections with problem solving. The lessons are devoted to problem solving and preparation of laboratory exercises.

Examination

If there is a decision on special educational support, in accordance with the Guideline Student's rights and obligations at Luleå University of Technology, an adapted or alternative form of examination can be provided.
Written exam with differentiated grades and approved lab work

Unauthorized aids during exams and assessments

If a student, by using unauthorized aids, tries to mislead during an exam or when a study performance is to be assessed, disciplinary measures may be taken. The term “unauthorized aids” refers to aids that the teacher has not previously specified as permissible aids and that may assist in solving the examination task. This means that all aids not specified as permissible are prohibited. The Swedish version has interpretative precedence in the event of a conflict.

Overlap

The course R0004E is equal to R0003E, R0001E

Course offered by

Department of Computer Science, Electrical and Space Engineering

Modules

Code	Description	Grade scale	Cr	Status	From period	Title
0002	Laboratory work	U G#	1.5	Mandatory	S18	
0003	Written exam	G U 3 4 5	6	Mandatory	S22	

Study guidance

Study guidance for the course is to be found in our learning platform Canvas before the course starts. Students applying for single subject courses get more information in the Welcome letter. You will find the learning platform via My LTU.

Last revised

by Robert Brännström 2023-06-16

Syllabus established

by Jonny Johansson, HUL SRT 2017-06-15