	Studiengang: *Program:*	**Bachelor of Science Maschinenbau** *Bachelor of Science in Mechanical Engineering*			FACH HOCHSCHULE LÜBECK University of Applied Sciences
1	Modul: *Module:*	**Automatic Control Systems** *Regelungstechnik*			**English** *Englisch*
	Fach-Nr. *Course number*	**Semester** *Semester*	**Dauer** *Duration*	**Status** *Status*	**Turnus** *Regular cycle*
		5. Semester	1 Semester	compulsory	annually
	Kreditpunkte *Credits*	**Aufwand** *Workload*	**Kontaktzeit** *Contact-hours*	**Selbststudium** *Student's efforts*	
	4 ECTS	150 h	3 hrs/week = 45 hrs Lecture with integrated Exercises 1 hr/week = 15 hrs Lab Exercise	45 hrs Preparation and post processing of the lecture and exercises 15 hrs Preparation and post processing of the lab exercises 30 hrs exam preparation	

2 Beschreibung
Description

The goal of a controller is to change the dynamical properties of a technical device (the "plant"). The controller is typically electronically realized by an analogous circuit or by a computer. Some of these new properties of the plant are to reject a disturbance or to track a command. In some cases, the controller is used to make an unstable system stable. Automatic control systems is an interdisciplinary subject.

3 Lernziele
Learning Outcomes

- To understand the mathematical description and the most important properties of a plant
- To understand the basic properties of closed-loop system
- To learn how to design a controller
- To learn the application of SW tools for controller synthesis and analysis
- To design a controller and to test it with a simulation model or for the hardware realization of the plant (Lab)

4 Schlüsselqualifikationen
Key qualifications

Sozialkompetenz	Methodenkompetenz	Selbstkompetenz / Personenkompetenz	Interkulturelle Kompetenz	Medienkompetenz
	X	X		

5 Lehrveranstaltung/ -methoden
Course type and methods

- Lectures with exercises
- Lab

6 Vorbedingungen / Vorkenntnisse
Prerequisites

S**trongly recommended:**

- Calculus
- Electrotechnics
- Dynamics

7 Arbeitsmittel / Literatur
Required material / Literature

- Projector/Laptop/Electronic Panel
- Presentations
- Exercises within the lecture
- Further reading according to the current list published in the lecture

Detailinformationen

8 Inhalte

Course topics

- **Single input single output systems**
  Systems of first and second order, transfer functions, rational and nonrational systems, state space description, step response, impulse response, poles and zeros, block diagrams, stability, Hurwitz criterion, frequency response, Nyquist curve, Bode diagram, nonminimum phase systems, linearization, identification
- **Basic properties of controlled systems**
  Level control, control of rate and position, pressure control, temperature control, control of a chemical concentration, position control for an unstable plant
- **Closed-loop systems**
  Basic configuration of feedback systems, the fundamental transfer functions of a closed-loop system, internal stability, stationary behavior, controller design for plant of first or second order
- **PID controllers**
  Description in the time and frequency domain, realization of controllers, actuators and sensors
- **Nyquist stability criterion**
  General Nyquist criterion, specialization to stable plants with integrators, formulation of the Nyquist criterion with the Bode diagram of the loop transfer function, phase margin, gain crossover frequency
- **Synthesis methods**
  Requirements concerning stability and performance, robust stability and Nyquist criterion, controller design based on the Bode plot of the loop transfer function, symmetrical optimum, case study (controller design for a dc motor, e.g.), cascaded loops, two-degree-of-freedom-design
- **Blockdiagram-based Tools**
  Use of blockdiagram-editors for Modelling and Simulation of automatic control systems. Use of block-libraries for the realization of closed loop systems
- **Laboratory**
  The lab will be carried out with a changing selection related to the following topics:
  - Modelling using transfer functions
  - Modelling using state space representation
  - System identification
  - Position Control
  - Rate Control
  - Frequency Response
  - Function Development

  The experiments are realized with a real-time electronic control unit and lab-hardware containing encoders, dc-motors and motor-controllers. The experimental set-up includes a detailed nonlinear model of the plant which runs in parallel to the measurements

9 Prüfungsform

Assessment

Prüfungsvorleistung / Prerequisite: none

Fachprüfung / Examination: written exam

10 Voraussetzung für die Vergabe von Kreditpunkten

Requirements for granting of credits

Successfully passing all individual parts of the examination according to row 9 „Assessment“

11 Weiterführende Veranstaltungen

Related courses

None

12 Zuordnung

Classification

Mathematik & Naturwissenschaft	Ingenieur-wissenschaften	Ingenieur-anwendungen	Entwicklung & Konstruktion	Werkstoffe	Wirschaft, Management, Sprachen	Anderes
	X	X	X			

13 Modulbeauftragter / Lehrpersonen

Responsible person / Lecturers

Prof. Dr.-Ing. M. Hahn / Prof. Dr.-Ing. M. Hahn