5.4 Modul Control Systems I

Modulbezeichnung	**Control Systems I**
Kürzel für Stundenplan	**CS1**
Semester	5
Modulverantwortliche(r)	Prof. Dr. Jörg Bayerlein
Dozent(in)	Prof. Dr. Jörg Bayerlein
Sprache	Englisch
Zuordnung zum Curriculum	KIM – ISE (Pflichtmodul)
Lehrform / SWS	4 V + 1 Pr with integrated exercises, 80 students (V), 12 (Pr) per group
Arbeitsaufwand	64 h presence (lecture), 16 h Lab 100 h preparation, evaluation afterwards and report Lab
Kreditpunkte	6
Voraussetzungen	Knowledge of "Signale und Systeme", "Messtechnik und Sensorik", "Analoge Elektronik I"
Lernziele / Kompetenzen	The students should learn to describe systems via signal block diagrams and reduce them. They should be able to analyze dynamical system behaviour using Bode plots and complex transfer functions. Standard blocks should be used to design simple loops with 1 or 2 PT1- processes. With the FRA (frequency response approach) – design the students learn to design and optimize general single and multiloop-systems using PIDT1- controller.
Inhalt	**Basics of control systems** Introduction reference and disturbance behaviour. drawing and reduction of signal block diagrams **Modelling and analysis of dynamical systems** Characterizing of dynamic systems. Mathematical methods to describe Differential equation in time domain and transfer function in frequency domain. Use of step- impulse and frequency response, bode plot and mesh plot. **Use of transfer function** Application of Laplace-Transform to calculate system responses. Graphical display methods of transfer function (Pole-zero plot, polar plot, mesh plot bode plot. Laplace conversion of differential equation. **Frequency response** Definition of frequency response, bode plot. Drawing of bode plots. **Standard linear blocks** P-behaviour. I- behaviour. D- behaviour. PT1- behaviour, PT2- behaviour, delay time blocks.

	Standard controllers P-controller. I- controller. PI- controller. PD- controller. PDT1-controller. PIDT1- controller. Analogue realisation **Simple control loops** Open loop, closed loop. Reference and disturbance behaviour. Simple examples with PT1- and 2PT1- process with PI and PIDT1- controller (Cruise control, temperature control) **Stability** Definition of stability. BIBO-stability, pole criterion. Hurwitz-criterion, special Nyquist-criterion. **Design with Frequency Response Approach (FRA)** Principals of FRA- Design with P, PI, PDT1 and PIDT1-controller. Design parameters, settling time. Pole compensation. Symmetrical Optimum. **Improvement methods** Precontrol, Disturbance feed forward, cascaded loops. **Lab experiments:** There are three experiments: • Identification of step responses of different processes • Measurement of bode plots of a PIDT1, DT2 and of a digital filter • Controller design and implementation of a speed control system
Literatur	• Bayerlein, J.: *Workbook control systems*, available press FHL • Phillips, C. L.: *Feedback Control Systems*, Prentice Hall newest version • Ogata, K.: *Modern Control Engineering*, Prentice Hall, newest version • Saadat, Hadi**:** *Computational Aids in Control Systems Using MATLAB*, McGrawHill, newest version
Studien-/Prüfungsleistungen	P (Studienleistung), V (Prüfungsleistung): Klausur (120 Minuten)