Module description ME_401 Control Engineering

Code and name of module	ME_401 Control Engineering
ECTS-credits	5
Attribute	mandatory
Contact hours	75
Self-study hours	75
Language of instruction	English
Module owner	Prof. Dr.-Ing. Gerd Wittler
Last update	28-Jul-15

Submodules

a) Control Engineering (4 Credits)
b) Control Engineering Laboratory (1 Credit)

Content

a) Control Engineering
- introduction: block diagram, standard controller, examples for application
- description and behavior of control systems: transfer elements, differential equations, Laplace transformation, frequency response , Bode diagram, roots locus curve, transfer function, system responses, block diagram
- modelling of control plants, identification in the time- and frequency-response-domain
- analysis of closed loop control circuits: stability criteria, steady-state accuracy, reference and disturbance behavior
- controller synthesis: requirements and performance criteria, practical design rules, compensation method, controller design using Bode plot, lead-lag compensation, analogue standard controllers (PID-Controller).

b) Control Engineering Laboratory:
- test 1: identification of a control plant in the time domain
- test 2: identification of a control plant in the frequency response
- test 3: servo control
- test 4: airflow control.

Prerequisites

- According to the study and examination regulations:
  mathematics 1 und mathematics 2 (especially complex calculation, differential equations, Laplace-transformations, Electrical Engineering 2 (especially frequency path, Bode plot) electronics (especially operational amplifiers).

- Recommended:
  none

Literature

-

Target

knowledge and understanding
The students
- know and understand the meaning of control engineering in the field of mechatronics.
- know the standard transfer elements (e.g. P,I, PT1, PT2), the standard controllers (e.g. P, PI, PID) as well as the structure and the scope of standard control circuits.
- know and understand mathematical methods for describing, analysing and sythesising control systems.

applying skills
The students
- are capable of solving general differential equations by means of Laplace transformation
- are capable of describing linear control systems by means of transfer elements in the s-area
- are capable of calculating various transfer functions based on a block diagram
- are capable of drawing frequency response by a Bode plot
- are capable of applying different stability criteria (e.g. Hurwitz, Poles, Nyquist criteria)
- are capable of classifying system responses to the adequate transfer functions (time-

	and frequency response) • are capable of setting up time continuous controller by the use of different design methods (e.g. compensation method, design by phase margin, design by pole specification). **analysing and evaluating skills** The students • are capable of analysing and evaluating the stationary and dynamic behavior respectively the control precision of control circuits as well as their components (e.g. stability, stationary accuracy, settling characteristics) based on transfer function, poles and system response. • are capable of choosing and applying suitable controllers and suitable design methods based on the transfer function of the control system.
Type of instruction	a) lecture b) laboratory
Assessment	a) written exam (90min) b) successful implementing of the laboratory tasks together with the team The module is assessed. The assessment is subject to the result of the written exam. All parts of the module have to be passed.