Module description_401 Control Engineering

Last update:
December, 20th 2016

Degree: Bachelor of Engineering

1	**module no.** ME 401	**degree programme** ATB/ETB/FTB	**semester** 4	**starts in** ☒WS ☒SS	**duration** 1 Semester	**module type** mandatory	**workload (h)** 150	**ECTS Credits** 5

2	**courses**	**type of instruction**	**language**	**contact hours (SWS) (h)**	**self-study (h)**	**ECTS Credits**
	a) Control Engineering	lectures including practice	English	4 **60**	**60**	**4**
	b) Control Engineering Laboratory	laboratory	English	1 **15**	**15**	**1**
	c)					
	d)					
	e)					
	f)					

3	**table of qualifications**	expertise	methodological skills	personal & social skills
	knowledge & understanding	☒	☒	☒
	applying	☒	☒	☒
	analysing and evaluating	☐	☒	☐
	acquiring & broadening knowledge	☒	☐	☐

4 **learning outcome and competences**
After having successfully passed the module the students are capable of:

knowledge & 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, analyzing and synthesizing 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 diagrams.
- 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
The students
- are capable of analyzing 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.

acquiring and broadening skills
- none

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5	**content** a) lecture: • introduction: block diagrams, standard controller, examples for application. • description and behavior of control systems: transfer elements, differential equations, Laplace transformation, frequency response , Bode diagrams, roots locus curve, transfer function, system responses, block diagrams • 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-Regler) b) 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
6	**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
7	**type of assessment and requirements for credits** a) written exam (exam 90 minutes)
8	**use of the module** mandatory module in the bachelor degree programme of ATB, ETB, FTB
9	**person responsible for the module and other lecturers involved** Prof. Dr.-Ing. Wolf-Dieter Lehner Prof. Dr.-Ing. Ralf Rothfuß Prof. Dr.-Ing. Gerd Wittler
10	**literature** • •
11	**contribution to the educational aims of the degree programme** Providing basic knowledge in mechatronics. The students gain interdisciplinary skills in understanding the interaction of different system elements and in thinking in systems.
12	**last update** December 16