Automatic Control

Study programme, specialization: B0715A270012 Engineering, S05 Machine and Process Control
Academic year: 2024/2025

1. Main definitions from area of control theory (control systems structures, open-loop, close-loop, sensitivity and robustness, types of signals, types of systems, block scheme algebra).
2. Laplace and Z-transforms (definition formulas, properties, solutions of differential and difference equations).
3. Mathematical models of linear continuous dynamic systems and their properties (differential equations, transfer function, frequency transfer function, step and impulse functions, state space, condition of feasibility, steady-state).
4. Mathematical models of linear discrete dynamic systems and their properties (difference equations, transfer function, frequency transfer function, step and impulse functions, state space, conditions of feasibility, steady-state).
5. Transport delay and its approximations (properties, Taylor and Padé development, step and frequency responses).
6. Linear analog controllers (basic types and their tuneable parameters, properties, responses, interaction, modification, conditions of feasibility, filtration of derivative part).
7. Linear discrete (digital) controllers (basic types and their tuneable parameters, properties, responses, absolute and incremental descriptions, modification, feasibility).
8. Stability of linear close-loop control systems (basic transfer functions, stability definition, characteristic equation, conditions and criteria).
9. Hurwitz and Routh-Schur criteria for stability verification (applications, advantages and disadvantages).
10. Mikhailov and Nyquist criteria (applications, advantages and disadvantages).
11. Stability of linear discrete (digital) close-loop control systems (basic transfer functions, characteristic equation, definition, bilinear transform).
12. Performance of continuous and discrete control process (description in time domain, complex variable domain, frequency domain, steady state errors).
13. Empirical Ziegler-Nichols methods (properties, advantages and disadvantages).
14. Standard form method and synthesis according frequency responses (application, time constant compensation, advantages and disadvantages).
15. Optimum modulus method and symmetric optimum method (application, time constant compensation, advantages and disadvantages).
16. Desired model method, multiple dominant pole method and SIMC method (application, advantages and disadvantages).
17. Experimental identification methods based on step responses. (Strejc's method, one point or two points approximation). Simplification of transfer functions (dominant time constant, half rule method).
18. Synthesis of linear discrete control systems (small, medium and large sampling period, dead-beat controller, Dahlin controller).
19. Mathematical model determination of mechanical systems, basic principles for modelling during linear and rotational motion.
20. Mathematical model determination of electrical systems – basic laws, circuits with operational amplifiers.

21. Mathematical model determination of hydraulic systems – basic laws, tank systems modelling, hydraulic drives.
22. Mathematical model determination of pneumatic systems – basic laws, application to pneumatic drives.
23. Mathematical model determination of thermal systems – basic laws and principles, application for modelling of liquids with different temperatures mixing in tanks with thermal capacity.
24. Simulation software – basic types, main feature, properties, steps for solution of simulation tasks. Physical analogies and their using in systems modelling and simulation processes.

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