



Subject card

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|---|--|--|---|-------------------------------------|---------|--|-----|
| Subject name and code | Analog Control, PG_00047575 | | | | | | |
| Field of study | Automatic Control, Cybernetics and Robotics | | | | | | |
| Date of commencement of studies | October 2020 | Academic year of realisation of subject | | | | 2021/2022 | |
| Education level | first-cycle studies | Subject group | | | | Obligatory subject group in the field of study Subject group related to scientific research in the field of study | |
| Mode of study | Full-time studies | Mode of delivery | | | | at the university | |
| Year of study | 2 | Language of instruction | | | | Polish | |
| Semester of study | 4 | ECTS credits | | | | 3.0 | |
| Learning profile | general academic profile | Assessment form | | | | exam | |
| Conducting unit | Department of Automatic Control -> Faculty of Electronics, Telecommunications and Informatics | | | | | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | | dr inż. Piotr Kaczmarek | | | | |
| | Teachers | | dr inż. Piotr Kaczmarek | | | | |
| Lesson types and methods of instruction | Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
| | Number of study hours | 30.0 | 0.0 | 0.0 | 0.0 | 0.0 | 30 |
| | E-learning hours included: 0.0 | | | | | | |
| Learning activity and number of study hours | Learning activity | Participation in didactic classes included in study plan | | Participation in consultation hours | | Self-study | SUM |
| | Number of study hours | 30 | | 3.0 | | 42.0 | 75 |
| Subject objectives | Introduction of linear analysis using state space methods. Introduction of nonlinear system analysis (describing function, phase plane method). | | | | | | |
| Learning outcomes | Course outcome | | Subject outcome | | | Method of verification | |
| | [K6_W03] Knows and understands, to an advanced extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum | | Student can design complex control systems based on state space methods | | | [SW1] Assessment of factual knowledge | |
| | [K6_W05] Knows and understands, to an advanced extent, methods of supporting processes and functions, specific to the field of study | | Student can design nonlinear control systems. | | | [SW1] Assessment of factual knowledge | |

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| Subject contents | 1. Introduction to state-space modelling for linear continuous-time dynamic systems. Transfer function versus state-space modelling. 2. State space model - diagonalization. 3. Stability of linear dynamical systems. 4. Controllability. Algebraic criteria for controllability. 5. Non-optimal control. Reachability. 6. Observability. Algebraic criteria for observability. Detectability. 7. Synthesis of state space feedback control: pole assignment. Ackermann method. 8. Tracking (servo) problem. 9. State estimation problem. Ackermann's formula for observer design. Minimal order observer. 10. Observer-state feedback control systems. A separation rule for designing.. Decoupling. 11. Kalman's decomposition. Numerical problems of linear control systems. 12. Eigenstructure assignment for control system design. 13. Diagnostic observer design. 14. Optimal control - linear quadratic regulator (LQR) problem. 15. Introduction to non-linear control. 16. Non-linear differential equations. Fixed-point methods. 17. Phase plane analysis of non-linear control systems. 18. Phase-plane method: relay control. Saturation. 19. Phase-plane method: sliding-mode control. 20. Stability of equilibrium points in the sense of Lyapunov. 21. Lyapunov's linearisation method for stability analysis. 22. Lyapunov's direct method for stability analysis. Region of attraction. 23. Stability of state trajectory of non-autonomous systems. 24. Input-output (I/O) stability. 25. Relationships between I/O stability and Lyapunov stability. Time-varying and non-linear systems. 26. Approximate analysis methods for non-linear systems. Describing function analysis of non-linear control systems 27. Describing-function method: periodic solutions, limit cycles. | | |
| Prerequisites and co-requisites | Advanced mathematics, fundamentals of control engineering | | |
| Assessment methods and criteria | Subject passing criteria | Passing threshold | Percentage of the final grade |
| | Written test | 55.0% | 100.0% |
| Recommended reading | Basic literature | J. Nowakowski "Podstawy automatyki" tom 2 skrypt PG | |
| | Supplementary literature | C.-T. Chen: Control System Design, Saunders College Publishing, 1993 | |
| | eResources addresses | | |
| Example issues/ example questions/ tasks being completed | | | |
| Work placement | Not applicable | | |