COURSE DESCRIPTION CARD - SYLLABUS

Course name
Basics of control system

Course

Field of study Electromobility	Year/Semester 2/3
Area of study (specialization)	Profile of study general academic
Level of study First-cycle studies	Course offered in Polish
Form of study full-time	Requirements compulsory

Number of hours

Lecture 30	Laboratory classes 15	Other (e.g. online)
Tutorials	Projects/seminars	

Number of credit points

4

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:

Prerequisites

Students are expected to have abasic knowledge concerning maths, electrical engineering, and science. They should be characterized with the ability to work in teams, as far as the laboratory classess are concerned.

Course objective

To present the students with synthesis and analysis methods related to control systems, basics of linear continuous-time and discrete-time closed-loop system models, as well as with the possible effects of nonlinearities on control performance.

Course-related learning outcomes

Knowledge

Knowledge related to tools and techniques necessary to describe and analyze control systems. Also, related to stability analysis of linear continuous- and discrete-time control systems. Knowledge concerning the interplay between control performance and gains of basic controllers, as well as a relation between time and frequency reponses of linear systems.

Skills

Is capable of using appropriate methods to analyze stability of control systems, and can use the block diagram algebra to reduce complex control systems to an auxiliary transfer function, to perform further analysis of the system. Can select an appropriate controller with its gains for a particular control task.

Social competences

Recognizes the value of bacis analysis and synthesis methods of control systems in engineering practice.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: the knowledge gained during lectures if verified by means of a written exam during the session period, comprising both open- and closed-ended questions, graded with respect to their difficulty level. The threshold to pass the exam is set at 50% of a maximum number of points. The exam topics are shared with students using the Moodle platform.

Laboratory exercises: with both tutorial and seminar character, extending the ideas presented during the lectures. The skills gained during these exercises are verified by means of short report-like outputs written at home. During the exercises the preparation of students for a specific topies is verified. In order to pass the laboratory exercises, the students are expected to complete a specific set of classe, individually selected by a tutor.

Programme content

1) Introduction to control engineering. Model of dynamics. 2) Transfer function. Block diagram algebra. 3) Time domain analysis of linear systems. Frequency response. 4) Analytical stability criteria. Transport delay. 5) Nyquist and Nichols plots. Nyquist stability criterion. Stability margins. 6) Linear controllers. 7) Impact of controller gains and its type on control performance. Output- and velocity-feedback control. 9) Fuzzy control. Anti-windup compensators. 10) Introduction to discrete-time systems. Sampler and hold units. 11) Reconstruction of original signals from samples. 12) Discretization methods. Discrete-time model of a PID controller. 13) Synthesis of discrete-time control system models based on conventional methods. 14) Transient- and steady-state response analysis. 15) Frequency reponse of discrete-time models. Analytical stability criteria of discrete-time models.

Teaching methods

Lecture: multimedia presentation accompanied by examples presented using a whiteboard, including short calculation-based tasks. The introduction of a new tpic is preceded by a short recap of the connected topics, known to students from other lectures. The handouts/presentations are made available from the Moodle server.

Laboratory exercises: team work on selected exercises, with the aid and under supervision of tutors.

Bibliography

Basic

1. Horla D., Podstawy automatyki. Ćwiczenia rachunkowe. Część I, wyd. 6, poprawione, Poznań, Wydawnictwo Politechniki Poznańskiej 2019

2. Horla D., Podstawy automatyki. Ćwiczenia rachunkowe. Część II, wyd. 4, poprawione, Poznań, Wydawnictwo Politechniki Poznańskiej 2019

3. Horla D., Podstawy automatyki. Ćwiczenia laboratoryjne, wyd. 4, poprawione i uzupełnione, Poznań, Wydawnictwo Politechniki Poznańskiej 2015.

4. Rumatowski K., Podstawy regulacji automatycznej, Poznań, Wydawnictwo Politechniki Poznańskiej 2008.

Additional

1. Franklin F.G., Powell J.D., Emami-Naeini A., Feedback Control of Dynamic Systems, wyd. 4, New Jersey, Prentice Hall 2002.

2. Kaczorek T., Teoria sterowania i systemów, wyd. 2, Warszawa, PWN 1996.

4. Ogata K., Discrete-time Control Systems, wyd. 2, Prentice Hall International 1995.

5. Ogata K., Modern Control Engineering, wyd. 4, Prentice Hall 2002.

6. Ryniecki A., Wawrzyniak J., Gulewicz P., Horla D., Nowak D., Bioprocess feedback control. A case study of the fed-batch biomass cultivation bioprocess, Przemysł Spożywczy, t. 72, nr 8, s. 34-39, 2018.

7. Sadalla T., Horla D., Analysis of simple anti-windup compensation in approximate pole-placement control of a second order oscillatory system with time-delay, 20th International Conference on Methods and Models in Automation and Robotics (MMAR), Miedzyzdroje, IEEE, 2015, s. 1062-1067.

8. Shinners S.M., Modern Control System Theory and Design, wyd. 3, Nowy Jork, John Wiley & Sons, 1992.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,0
Classes requiring direct contact with the teacher	50	2,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	50	2,0

[1] delete or add other activities as appropriate