COURSE DESCRIPTION CARD - SYLLABUS

Course name
Precise motion control of electromechanical systems

Course

Field of study
Automatic Control and Robotics
Area of study (specialization)
Intelligent control systems
Level of study
Second-cycle studies
Form of study
full-time

Year/Semester
1/2
Profile of study
general academic
Course offered in
polish
Requirements
elective

Number of hours

Lecture
15
Laboratory classes
15
Other (e.g. online)
0
Tutorials
0
Projects/seminars
0

Number of credit points

2

Lecturers

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

Prerequisites

A student starting this course should have basic knowledge of electric drives, including automatic control of electric drives, basics of automation and metrology in the field of measurements of various mechanical quantities. He/she should have the ability to solve basic problems in the design of automatic control systems including: selection of the structure and settings of controllers, selection of measuring sensors. He/she should also have the ability to acquire information from indicated sources, understand the necessity of broadening his/her competence and be ready to start cooperation within a team.

Course objective

1. To teach students students modeling complex electromechanical systems, design and application of motion control systems in industrial automation.

2. To develop in students the ability to solve design problems concerning control systems for electromechanical objects, especially those with complex structures.

3. To develop in students teamwork skills in solving advanced control problems.

Course-related learning outcomes

Knowledge

1. knows and understands selected areas of mathematics in enhanced level; has extended and deepened knowledge necessary to formulate and solve complex tasks in the field of control theory, optimization, modelling, identification and signal processing; [K2_W1].

2 has an organized and in-depth knowledge of modelling and identification of linear and non-linear systems; [K2_W5].

3. has advanced detailed knowledge of the construction and use of advanced sensors and actuators; [K2_W6]

Skills

1. is able to formulate and verify (by simulation or experimentally) hypotheses related to engineering tasks and simple research problems in the field of automatic control and robotics; [K2_U15].

2. is able to identify elements and control systems and to formulate a design specification of a complex control system taking into account non-technical aspects; [K2_U2]

Social competences

1. understands the need and knows the opportunities of continuous education - improving professional, personal and social competences, able to inspire and organize the learning process of others; [K2_K1].

2. is aware of the responsibility for his/her own work and is ready to comply with the rules of teamwork;

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Knowledge acquired in lecture is verified by a 60-minute colloquium and individual discussion of issues in the last lecture. The test consists of 5-10 questions (test and open), with varying scores. The pass mark is 50%. Issues on which the questions are based are made available to students during the semester.

The skills acquired in the laboratory classes are verified on the basis of reports.

Programme content

1. Introduction - precise motion control in industrial systems and scientific equipment. Mechanical structures of drive systems - 1-mass, 2-mass, flexible.

2. Shaping of input signals for systems with an oscillatory characteristic, creation of a motion trajectory with the limitation of state variables - velocity, acceleration and jerk.

3. Modeling, identification and compensation of friction phenomenon and electromagnetic torque ripple effect.

4. Synthesis of a position control system, selection of controller characteristics, control for multi-mass objects.

5. Measurement and reconstruction of mechanical quantities - review of measurement methods, observation of position, velocity and acceleration for a very low velocity motion

6. Selected advanced control algorithms for precision motion control, including ADRC and sliding mode control.

7. Selected actuators for precision motion control systems.

Laboratory Topics: In this class, simulation models are developed and analyzed, corresponding to the issues discussed in the lecture.

Students during classes analyze and implement topics of projects related to the scientific research of the department, especially in the area of robust control of very low-speed drives.

Teaching methods

1. Lecture: multimedia presentation, illustrated by examples given on the board.

2.Laboratory exercises: performing laboratory exercises based on simulation models - practical exercises.

Bibliography

Basic

1. Lecture materials progressively provided by the instructor in electronic form.

2. A. Sabanovic i K. Ohnishi, Motion Control Systems, 1. wyd. Wiley-IEEE Press, 2011.

3. W. Singhose, Command generation for dynamic systems. [S.l.]: William Singhose, 2009.

4. K. Zawirski, J. Deskur, i T. Kaczmarek, Automatyka napędu elektrycznego. Wydawnictwo Politechniki Poznańskiej, 2012.

5. S. Brock, Struktury odpornego sterowania elektrycznego napędu bezpośredniego przy wykorzystaniu koncepcji sterowania ślizgowego, Poznań 2013

Additional

1. J. Liu Wang, Xinhua, Advanced Sliding Mode Control for Mechanical Systems Design, Analysis and MATLAB Simulation. Berlin: Springer Berlin, 2011.

2. C. K. Pang, High-Speed Precision Motion Control, CRC Press, 2011.

3. D. Schröder, Elektrische Antriebe - Regelung von Antriebssystemen. Berlin, Heidelberg: Springer Berlin Heidelberg, 2015.

4. K. K. Tan, T. H. Lee, i S. Huang, Precision Motion Control: Design and Implementation, 2nd wyd. Springer, 2008.

5. Y. Hori, H. Sawada, i Y. Chun, „Slow Resonance Ratio Control for Vibration Suppression and Disturbance Rejection in Torsional System”, IEEE Trans. Ind. Electron., t. 34, nr 5, s. 162—168, 1999.

Breakdown of average student's workload

	Hours	ECTS
Total workload	45	2,0
Classes requiring direct contact with the teacher	30	1,5
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	15	0,5

[1] delete or add other activities as appropriate