COURSE DESCRIPTION CARD - SYLLABUS

Course name

Control_of_motion of electric vehicles

Course

Field of study

Automation and Robotics

Year/Semester

3/6

Area of study (specialization)

Profile of study

general academic

Level of study

First-cycle studies

Course offered in

English

Form of study

full-time

Requirements

elective

Number of hours

Lecture

30

Laboratory classes

30

Other (e.g. online)

Tutorials

Projects/seminars

15

Number of credit points

5

Lecturers

Responsible for the course/lecturer:

dr hab. inż. Tomasz Pajchrowski

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ul. Piotrowo 3A, 60-965 Poznań

Responsible for the course/lecturer:

mgr inż. Bogdan Fabiański

email: bogdan.fabianski@put.poznan.pl

Prerequisites

Knowledge:

Skills:

Social competences:

Course objective

To learn about the construction, principle of operation and methods and structures of advanced control systems of electric drive systems used in heavy industry, industrial robots, electric vehicles, aircraft, domestic appliances.

Course-related learning outcomes

Knowledge

K1_W4 has basic knowledge of materials science, strength and fatigue of materials, knows typical manufacturing technologies of machine elements;

K1_W24 has basic knowledge necessary to understand non-technical conditions of engineering activities and the process of automation and robotisation in industry and households; he/she knows basic safety and hygiene principles applicable in industry;

Skills

K1_U1 is able to acquire information from literature, databases and other sources, also in a foreign language of choice;

K1_U11 can determine and use models of simple electromechanical systems and selected industrial processes, and use them for the analysis and design of automation and robotics systems;

Social competences

K1_U3 is able to communicate using a variety of techniques in professional and other environments;

K1_U5 is able to present a presentation of results on an engineering task in Polish and a foreign language;

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: pass/fail, consists of a test in the form of a written response to the question and a conversation (optional) on selected issue(s) with the explanation of written answers from the range of program content.

Laboratory classes: attendance at classes and performing laboratory exercises in groups and submitting written reports.

Programme content

Lecture:

General structure of an automated drive system. Drive control systems used in heavy industry (drives with DC and AC motors (ACIM - squirrel-cage motors)). Control systems for electric drives in industrial robots (drives with PMSM motors), drones (drives with BLDC motors), household appliances (drives with universal motors, 1-phase induction, DC). Control of drive systems with complex and variable dynamic structure (friction, variable moment of inertia, backlash, elasticity in two-mass and multi-mass systems); Control problems of positioning servo drives. Control of electric drives used in cars, buses, trains, autonomous vehicles (electromobility, specific control of electric drives in vehicles, control in Zone II with weakened magnetic flux); (drives with ACIM motors, synRM (synchronous reluctance motors), SRM (switched reluctance motors). Electric drives used in aircraft - inertial drive, high speed drives.

Laboratory exercises. The program of laboratory exercises includes getting acquainted with the design, software, commissioning and testing of static and dynamic properties of selected physical drive systems discussed at lectures.

Project: simulation-based drive system design

Teaching methods

Lecture

Lecture with multimedia presentation (including: drawings, photos, animations, sound, films) supplemented by examples given on the board. Initiating discussion during the lecture.

Laboratory.

Working in teams and team programming, carrying out tasks given by the teacher - practical exercises.

Project: simulation-based drive system design

Bibliography

Basic

1. Zawirski K., Deskur J., Kaczmarek T., Automatyka napędu elektrycznego, Wydawnictwo Politechniki Poznańskiej, Poznań, 2012.

2. Kaczmarek T. , Napęd elektryczny robotów, Wydawnictwo Politechniki Poznańskiej, Poznań, 1998

3. Kaźmierkowski M.P, Tunia H., Automatic Control of Converter-Fed Drives, ELSEVIER, Amstertdam, London, New York, Tokyo, Warszawa , 1994

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

5. Lech Grzesiak L., Kaszewski A., Ufnalski B.: Sterowanie napędów elektrycznych. Analiza, modelowanie, projektowanie. Wydawnictwo Naukowe PWN, Warszawa 2016.

6. Sieklucki G., Bisztyga B., Zdrojewski A., Orzechowski T., Sykulski R.: Modele i zasady sterowania napedami elektrycznymi, Wydawnictwo AGH, Kraków 2014.

Additional

1. Leonhard W., Control of Electrical Drives, Springer, Berlin, New York, 2001

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5. Deskur J., Pajchrowski T., Zawirski K.: ?Speed Controller for a Drive With Complex Mechanical Structure And Variable Parameters?, Proceedings of 16th International Power Electronics and Motion Control Conference and Exposition, PEMC?2014, 21-24 September 2014, Antalya/Turkey, CD.

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7. Zawirski K., Janiszewski D., Muszyński R.: Unscented and Extended Kalman filters study for Sensorless Control of PM Synchronous Motors with Load Torque Estimation, Bulletin of Polish Academy of Sciences ? Technical Sciences, vol. 61, No. 4, 2013

8. Fabiański B., Zawirski K.: Simplified model of Switched Reluctance Motor for real-time calculations, Przegląd Elektrotechniczny, ISSN 0033-2097, R. 92 NR 7/2016

9. Nowopolski K., Wicher B., Zawirski K.: Experimental Analysis of Selected Control Algorithms of Electromechanical Object with Backlash and Elastic Joint, IEEE 17th International Conference on Power Electronics and Motion Control, Varna, Bulgaria, 25 ? 30 of September 2016

10. Szczesniak P., Urbanski K., Fedyczak Z., Zawirski K.: Comparative study of drive systems using vector-controlled PMSM fed by a matrix converter and a conventional frequency converter, TURKISH JOURNAL OF ELECTRICAL ENGINEERING & COMPUTER SCIENCES, vol. 24, pp. 1516?1531, 2016

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,0
Classes requiring direct contact with the teacher	75	3,0
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