POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Control of motion and electric vehicles [S1AiR1E>PO2-SUiPE]

Course

Field of study
Automatic Control and Robotics

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
english

Form of study
full-time

Requirements
elective

Number of hours

Lecture
30

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
15

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

Has well-ordered, theoretically grounded general knowledge in the field of electric circuit theory and DC and AC (including three-phase) electrical engineering [K1_W6 (P6S_WG)]. Has a comprehensive knowledge of the structures and operating principles of analogue and discrete control systems (open-loop and feedback) and linear and simple non-linear analogue and digital controllers [K1_W16 (P6S_WG)]. Knows and understands to an advanced extent the basic criteria for synthesis and methods of controller tuning, tools and techniques for automatic selection of controller settings and identification of control objects [K1_W17 (P6S_WG)]. Is able to read with understanding technical project documentation and simple technological diagrams of automation and robotics systems [K1_U2 (P6S_UW)]. Is able to use information engineering and communication techniques [K1_U8 (P6S_UW)]. Is aware of the importance and understands the non-technical aspects and consequences of engineering activities, including their impact on the environment and the related responsibility for decisions; is ready to care for the achievements and traditions of the profession [K1_K2 (P6S_KR)].

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:
Has basic knowledge of materials-science, strength and fatigue of materials, knows typical manufacturing technologies of machine components [K1_W4 (P6S_WG)].
Knows and understands typical engineering technologies, principles and techniques of construction of simple automation and robotics systems; knows and understands the principles of selection of executive systems, computational units and measurement and control elements and devices [K1_W20 (P6S_WG)].
Knows and understands the basic processes in the life cycle of devices and selected safety systems used in automation and robotics [K1_W22 (P6S_WG)].
Skills:
Is able to obtain information from literature, databases and other sources also in a chosen foreign language [K1_U1 (P6S_UW)].
Can determine and use models of simple electromechanical systems and selected industrial processes, and use them for analysis and design of automation and robotics systems [K1_U11 (P6S_UW)].
Social competences:
Is aware of the responsibility for his/her own work and is ready to follow the rules of teamwork and take responsibility for jointly implemented tasks; is able to lead a small team, set goals and determine priorities leading to the realisation of the task; is ready to fulfil professional roles responsibly [K1_K3 (P6S_KR)].
Is aware of the need to approach technical issues in a professional manner, to be meticulously familiar with the documentation and the environmental conditions in which the equipment and its components may function; is ready to adhere to the principles of professional ethics and to demand this from others, to respect the diversity of views and cultures [K1_K5 (P6S_KR)].

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 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
Is able to read with understanding technical project documentation and simple technological diagrams of automation and robotics systems [K1_U2 (P6S_UW)].

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 napędami elektrycznymi, Wydawnictwo AGH, Kraków 2014.
Additional:
1. Leonhard W., Control of Electrical Drives, Springer, Berlin, New York, 2001
2. Leonhard W., Control of Electrical Drives, Springer, Berlin, New York, 2001
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4. Kaźmierkowski M.P, Tunia H., Automatic Control of Converter-Fed Drives, ELSEVIER, Amstertdam, London, New York, Tokyo, Warszawa , 1994
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.
6. Brock S., Łuczak D., Nowopolski K., Pajchrowski T., Zawirski K.: Two Approaches to Speed Control for Multi-Mass System With Variable Mechanical Parameters, IEEE Transactions on Industrial Electronics, VOL. 64, NO. 4, APRIL 20
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	150	5,00
Classes requiring direct contact with the teacher	75	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	75	2,50