COURSE DESCRIPTION CARD - SYLLABUS

Course name

Energy management and energy-efficient control

Course

Field of study	Year/Semester
Automation and Robotics	1/2
Area of study (specialization)	Profile of study
IS	general academic
Level of study	Course offered in
Second-cycle studies	Polish
Form of study	Requirements
part-time	compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
8	8	
Tutorials	Projects/seminars	

Number of credit points

2

Lecturers

Responsible for the course/lecturer:

dr hab. inż. Tomasz Pajchrowski

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tel. 61 6652385

Wydział Automatyki, Robotyki i Elektrotechniki

ul. Piotrowo 3A 60-965 Poznań

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Prerequisites

He/she knows and understands at an advanced level selected facts, objects and phenomena and the methods and theories concerning them, explaining the complex relationships between them, understanding the basic physical phenomena occurring in and around elements and systems of automation and robotics. Can obtain information from literature, databases and other sources; has the ability to self-learn in order to improve and update professional skills.

Course objective

The aim of this course is to familiarize students with current regulations, methods and ways of energy-saving control and management in popular, widely available industrial systems (buildings, vehicles).

Course-related learning outcomes

Knowledge

1. has a structured knowledge of structures and principles of operation of analogue and discrete control systems (open and feedback) and linear and simple non-linear analogue and digital controllers - [K_W16 (P6S_WG)]

2) knows and understands the design and operation of programmable industrial controllers and their analogue and digital peripherals; knows and understands the operation of basic communication interfaces used in industrial control systems - [K_W18 (P6S_WG)]

3. has a structured knowledge of the construction, application and control of automation and robotics actuators - [K_W19 (P6S_WG)]

Skills

1.can make a critical analysis of how control and robotics systems work; also has the ability to select automation systems using programmable controllers;[K2_U19+, P7S_UW].

2. can design improvements to existing design solutions for automation and robotics components and systems; [K2_U20+,P7S_UW].

3. can critically assess and select appropriate methods and tools to solve an automation and robotics task; can use innovative and unconventional automation and robotics tools;[K2_U22+,P7S_UW]

4. can design and manufacture a complex device, object or system taking into account non-technical aspects; [K2_U23+, P7S_UW]

Social competences

1. is aware of the importance of and understands the non-technical aspects and effects of engineering activities, including their environmental impact and the related responsibility for decisions; is ready to develop his professional achievements;[K2_K2+, P7S_KR]

2. is aware of the social role of a technical university graduate and understands the need to formulate and communicate to the public (in particular through the mass media) information and opinions on the achievements of automation and robotics in the field of research and application work and other aspects of engineering activities; makes efforts to communicate such information and opinions in a way that is widely understood and justifies different points of view;[K2_K6+, P7S_KR]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: exam or credit, consists of a test in the form of a written answer to a question and an interview (optional) on a selected issue(s) with an explanation of written answers in terms of curriculum content.

Laboratories: practical skills in programming intelligent building automation systems, assessment from tests and reports.

Programme content

Lecture:

Definition of energy-saving control and energy management, application overview. Automated energy management systems in buildings at different levels of control hierarchy, ways of intelligent energy management and control in buildings of different categories. Examples of cogeneration, trigeneration and polygeneration applications in energy efficient energy management in industrial systems. Analysis of an energy management system according to ISO standard. Current problems of energy-efficient control and energy management in electric and hybrid vehicles. Analysis and modelling of energy-efficient technical solutions in hybrid and electric vehicles. Introduction to energy-efficient energy management in Smart Girg installations (RES issues, energy storage tanks).Laboratory.

Laboratory exercises. The plan of the laboratory assumes getting acquainted with the practical aspect of modelling selected issues of energy-saving building control or electric vehicle verification of the experimental convergence of the developed mathematical model (with independent identification of parameters) in order to make students aware of good practices of research methodology and acquire the belief that the presented theory has a direct impact on practice.

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.

Bibliography

Basic

1. Qicheng Xue, Xin Zhang *, Teng Teng, Jibao Zhang, Zhiyuan Feng and Qinyang Lv, A Comprehensive Review on Classification,Energy Management Strategy, and Control Algorithm for Hybrid Electric Vehicles, Energies 2020, 13, 5355; doi:10.3390/en13205355

2. Zhang, P.; Yan, F.; Du, C. A comprehensive analysis of energy management strategies for hybrid electric vehicles based on bibliometrics. Renew. Sustain. Energy Rev. 2015, 48, 88–104.

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4. Wang, L.; Zhang, Y.; Yin, C.; Hu, Z.; Cunlei, W. Hardware-in-the-loop simulation for the design and verification of the control system of a series–parallel hybrid electric city-bus. Simul. Model. Pract. Theory 2012, 25, 148–162.

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6. Kessels, J. T. B. A. (2007). Energy management for automotive power nets. Eindhoven: Technische Universiteit Eindhoven. https://doi.org/10.6100/IR617399

7. John T. Wen • Sandipan Mishra, Intelligent Building Control Systems, Springer 2018.

8. Paweł Roszczyk, Analiza pracy przekształtnikowego źródła napięcia z silnikiem spalinowym i elektrochemicznym magazynem energii przeznaczonego dla pojazdu hybrydowego, rozprawa doktorska, promotor , dr hab. inż. Lech M. Grzesiak, prof. PW. Warszawa 2012.

9. Lechowicz Andrzej, Własciwości trakcyjne układu napędowego z elektrycznie sterowaną przkekładnią planetarną, Rozprawa doktorska, Politechnika Opolska, Opole 2013.

Additional

Literatura uzupełniająca:

1. ZARZĄDZANIE ENERGIĄ W BUDYNKACH KOMUNALNYCH - PORADNIK, Stowarzyszenie Gmin Polska Sieć „Energie Cités, Kraków 2009.

2. Li, W.M.; Xu, G.Q.; Xu, Y.S. Online Learning Control for Hybrid Electric Vehicle. Chin. J. Mech. Eng. 2012,25, 98–106.

3. Lin, C.C.; Peng, H.; Grizzle, J.W.; Jun-Mo, K. Power management strategy for a parallel hybrid electric truck. IEEE Trans. Control. Syst. Technol. 2003, 11, 839–849

4. Kwon, T.S.; Lee, S.W.; Sul, S.K. Power control algorithm for hybrid excavator with supercapacitor. IEEE Trans.Ind. Appl. 2010, 46, 1447–1455.

5. Geng, B.; Mills, J.K.; Sun, D. Energy management control of microturbine-powered plug-in hybrid electric vehicles using the telemetry equivalent consumption minimization strategy. IEEE Trans. Veh. Technol. 2011, 60, 4238–4248.

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,0
Classes requiring direct contact with the teacher	16	1,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	34	1,0

[1] delete or add other activities as appropriate