COURSE DESCRIPTION CARD - SYLLABUS

Course name
Building automation systems

Course

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

Year/Semester
1/1
Profile of study
general academic
Course offered in
Polish
Requirements
compulsory

Number of hours

Lecture
15
Laboratory classes
30
Other (e.g. online)
-0
Tutorials
-0
Projects/seminars
-0

Number of credit points

3

Lecturers

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Prerequisites

The student starting this subject should have basic knowledge of electrical engineering (with particular emphasis on AC circuits), automation (automatic control systems, controllers) and measurement of non-electrical quantities (e.g. measurement of temperature, pressure). Should have the ability to solve basic problems in the design of automatic control systems (selection of controller settings, stability testing, selection of sensors) and the ability to obtain information from indicated sources. He should also understand the need to broaden his competences and be ready to cooperate within a team. In addition, in the field of social competence, students must present attitudes such as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, and respect for other people.

Course objective

Providing students with basic knowledge of automation, in the selection of elements, design and programming of integrated building automation systems. Developing students' skills to solve design problems related to electrical installation and automation used in residential and public buildings. Developing students' teamwork skills in solving simple engineering tasks.

Course-related learning outcomes

Knowledge

1. has specialized knowledge of distributed systems and communication protocols used in building automation systems; [K2_W3]

2. has theoretically founded detailed knowledge related to heating, air conditioning, ventilation and lighting control systems, as well as control and measurement systems used in the above control systems; [K2_W11]

3. has knowledge of modern solutions for supplying buildings with electricity and heat; [K2_W12]

4. has basic knowledge about the life cycle of building automation systems and control and measurement systems; [K2_W13]

5. has the knowledge necessary to understand the economic aspects of engineering activities and the possibilities of their application in the optimal management of building automation systems (optimal use of installations to reduce the costs of operating buildings); [K2_W14]

6. has the knowledge necessary to perform electrical measurements in buildings; [-]

Skills

1. can analyze and interpret project technical documentation systems installed in buildings and the use of scientific literature related to the problem; [K2_U2]

2. is able to select and integrate the elements of a multi-specialized building management system including: a control unit, sensors, actuators (actuators), and communication modules; [K2_U13]

3. is able to identify non-technical aspects, including environmental (e.g. reduction of pollutant emissions, use of alternative energy sources), economic (energy saving) when formulating and solving tasks involving the design of control systems; [K2_U14]

4. can design improvements (improvements) existing design solutions and elements of automation and robotics; [K2_U20]

5. is able to make electrical measurements and develop appropriate test reports. [-]

Social competences

1. understands the non-technical aspects and effects of engineering activities, including its impact on the environment and the associated responsibility for decisions made; [K2_K2]

2. is aware of the responsibility for own work and readiness to comply with the principles of teamwork and taking responsibility for jointly implemented tasks; [K2_K3]

3. understands that a professional approach to technical issues, meticulous familiarization with the documentation and environmental conditions in which devices and their components may function are necessary; [K2_K4]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Knowledge acquired as part of the lecture is verified based on the assessment of the implementation of the electrical installation project and the automation of the selected residential building. The project is implemented in a group of 2 people. The project assesses the calculation of the estimated power demand for electricity, the selection of appropriate protections for electrical devices and cables used in buildings, the selection of the automation system (pipe system), electrical switchgear diagrams, automation connection diagram.

Skills acquired during laboratory classes are verified on the basis of the final test consisting of 5-7 questions / tasks bulleted differently depending on their degree of difficulty and on the basis of an audit report electrical system. Passing threshold: 50% of points.

Programme content

The lecture program covers the following topics: definition of basic concepts such as intelligent building, sensor actor, stage, telegram, BMS, HMS. Architecture of integrated automation systems, which can distinguish between open and closed systems and systems for centralized and decentralized. Tasks of building automation systems such as lighting, heating, air conditioning and ventilation control. Control methods in building automation systems: individual, group, central, scenes, manual, automatic, time control, etc. Characteristic features of integrated systems including advantages (e.g. comfort, ecology, economy, security). Information transfer methods (communication buses) using radio and infrared waves, electrical cables (separate control and power bus) and power grid (use of high frequency control signal and PLC modules). Discussion of examples of building automation systems such as KNX, Teletask, LCN, Sienna, systems using IQ3 and IQ4 controllers. Discussion of the open communication protocol on

the example of the BACnet protocol and Trend controllers as well as the integration of various automation systems. Types of heating control and their practical application: two-position, PWM control, control with a continuous output controller. Construction and operation of heat distribution centers of air-conditioning units, selection of control elements for the air-handling unit (examples). The use of alternative energy sources such as solar systems, heat pumps, photovoltaic cells. Methods for calculating the power and electricity demand for a residential facility: unitary electricity consumption method, surface average method, power demand factor method, two-factor method, substitute number of consumers method, statistical method. Based on the determined electrical power, the selection of protections for electrical devices and power cables including short-circuit currents as well as electric shock and overvoltage protection. Analysis of sample building automation projects.

Laboratory classes are conducted in the form of fifteen 2-hour exercises that take place in the laboratory, preceded by a 2-hour instructional session at the beginning of the semester. Exercises are carried out by 2-person or 3-person (depending on the size of the group) teams of students. The laboratory's program includes the following issues: methods of operational measurements used in residential and public buildings such as: testing the effectiveness of electric shock protection in the event of damage by means of automatic power-off (zeroing efficiency), checking the operation of residual current protective devices (devices for protection against dangerous shock currents - protection supplementary and before the installation fire), testing the insulation resistance of electrical circuits, testing the intensity of the primary and emergency lighting. Elaboration of obtained test results and their analysis in terms of compliance with standards and building law. Implementation of simple automation tasks in Teletask and KNX systems: lighting, ventilation, scenes (moods) control, manual, group, central and time control. Application of the Satel - Integra alarm control panel to control the building: control panel configuration, definition of security zones, lighting control, blinds and other devices. The use of wireless communication to control various devices in the building. The use of the Internet in the building automation system. The use of IQ3 and IQ4 controllers to control systems in the building, device configuration, programming controllers using the SET environment, testing various function blocks of the SET environment such as external sensor, driver, PID controller, scheduler, OSS block, etc. Using a web server (embedded in the IQ3 controller) to control building installations. Integration of the IQ3 controller with IQeco controllers or other devices (e.g. water pump) using the BACnet protocol.

Teaching methods

Teaching methods:

1. lecture: multimedia presentation, illustrated with examples of project tasks,

2. laboratory exercises: practical exercises, performing experiments, discussion, teamwork

3. a visit to a public facility with an automation system installed

Bibliography

Basic

1. M. Parol, Ł. Rokicki, Instalacje i systemy w inteligentnych budynkach, Laboratorium, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2017.

2. A. Kamińska, L. Muszyński, Z. Boruta, R. Radajewski, Nowoczesne techniki w projektowaniu energooszczędnych instalacji budynkowych w systemie KNX, Medium, Warszawa 2011.

3. P. Petykiewicz Nowoczesne instalacje elektryczne w inteligentnym budynku, Warszawa 2004

4. J. Wiatr, A. Boczkowski, M. Orzechowski, Ochrona przeciwporażeniowa oraz dobór przewodów i ich zabezpieczeń w instalacjach elektrycznych niskiego napięcia, Seria: Zeszyty dla elektryków nr 8, Medium, 2017

5. H. Markiewicz, Instalacje elektryczne, WNT Warszawa.

Additional

1. G. W. Scheider, W. Tschischka, T. Heinje, Handbook for Home and Building Control. Basic Principles, ZVEI, Frankfurt and Menem, 2006

2. J. Strzałka, Instalacje elektryczne i teletechniczne. Poradnik montera i inżyniera elektryka, Verlag Dahofer, Warszawa 2009.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	45	2,0
Student's own work (literature studies, preparation for laboratory classes, preparation for tests, project preparation) [1]	30	1,0

[1] delete or add other activities as appropriate