COURSE DESCRIPTION CARD - SYLLABUS

Course name

Monitoring and control in environmental engineering

Course

Field of study

Automatic Control and Robotics

Area of study (specialization)

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

4/7

Profile of study

general academic

Course offered in

Polish

Requirements

elective

Number of hours

Lecture

15

Tutorials

0

Laboratory classes

30

Projects/seminars

0

Other (e.g. online)

0

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

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Responsible for the course/lecturer:

Prerequisites

The student starting this subject should have a basic knowledge of the basics of automation, executive elements of automation, metrology and electronics. Should also have a basic knowledge of heat transfer and thermodynamics. Should have the ability to solve basic problems in the design of control systems, testing the stability of linear systems, the selection of regulators and the ability to obtain information from the indicated sources. He should also understand the need to expand his competences. The student should demonstrate the ability to work in a team. In addition, in terms of social competences, 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 about the characteristics and principles of selecting actuators and measuring elements of automatic control systems for ventilation, air conditioning and heating systems. Acquiring knowledge by students about basic concepts and understanding of obtaining energy from unconventional sources. Developing students' skills in the design and operation of automatic control systems for ventilation, air conditioning and heating systems.

Course-related learning outcomes

Knowledge

1. has expanded and in-depth knowledge of the characteristics and principles of selection of actuators and measuring elements necessary for the design of automatic control systems for ventilation, air conditioning and heating systems, knows the principles of creating project documentation - [K1_W10]

2. has structured knowledge of the structures and operating principles of analog control systems (electric and pneumatic), direct-action controllers, and analog and digital continuous and two-position controllers used in air conditioning, ventilation and heating systems - [K1-W16]

3. knows and understands the need to use analog and digital peripheral systems of industrial controllers used in ventilation, air conditioning and heating systems, knows and understands the principle of operation of basic communication interfaces used in industrial control systems - [K1-W19]

4. has knowledge of the basic concepts and understands how to obtain energy from renewable sources, their construction and operation of devices used in unconventional energy [K1-W23]

Skills

1. is able to use models of simple industrial systems and processes, as well as use them for the purposes of analysis and design of automation systems of ventilation, air conditioning and heating systems [K1_U11]

2. is able to model building automation systems and use selected tools for rapid prototyping of automation systems in the MATLAB / SIMULINK environment - [K1_U13]

3. can configure and program the industrial programmable controller - [K1_U18]

4. is able to assess the usefulness of routine methods and tools for the design of automation systems; can apply these methods to the design of automatic control systems for ventilation, air conditioning, heating systems - [K1_U24]

5. is able to design and implement a system for monitoring and controlling ventilation, air conditioning, and heating systems based on an industrial communication network (RS-485, CAN, BACnet, Lan), is able to integrate various wired and wireless communication systems into one working system - [K1_U28]

Social competences

1. is aware of the responsibility for own work and willingness to comply with the principles of teamwork and taking responsibility for jointly implemented tasks - [K1_K3]

2. is able to properly define priorities for the implementation of the task specified by him or other - [K1_K4]

3. is aware of the need for a professional approach to technical issues, meticulous reading of technical documentation, compliance with professional ethics - [K1_K5].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Knowledge acquired during lectures is verified during oral defense of the implemented project of the automatic control system for ventilation, air conditioning, and heating. The correctness of the project implementation, proper selection of elements (measuring sensors, control systems, e.g. controllers, programmable controllers, etc., as well as executive elements and safety elements) of the designed system based on calculations and catalog notes are assessed.

Skills acquired as part of the laboratory classes are verified on the basis of a final test, consisting of 5-7 tasks with various points depending on their level of difficulty and based on the evaluation of laboratory exercises reports. Passing threshold: 50% of points. During the implementation of laboratory exercises, there is the possibility of obtaining additional points for preparation for classes (oral answer) and / or activity during classes.

Programme content

The lecture program includes the following topics:

1. Tasks of automation systems (general introduction to the subject of the lecture) include the definition of the following concepts: control process, object control purpose, sensors, control system architectures. Normalized energy types and control signals used in the automation of production processes will be presented. Requirements for technological schemes and technical documentation will be discussed.

2. Introduction to the design of automation systems: the ability to read technical documentation, graphic symbols, introduction to SEE Electric software, analysis of the power demand of electrical systems, selection of power and control cables used in control systems. rules for selecting short-circuit, overload and overvoltage protections. Application of electric shock protection.

3. Measurement methods of non-electrical quantities: tasks and requirements of measuring devices (systems), conditions for the installation of measurement sensors on site, the methods of measuring non-electrical quantities and principles of operation of the following sensors will be discussed: position measurement sensors (resistance, capacitive, inductive), velocity and acceleration, load and force sensors, flow rate sensors, pressure sensors, liquid level sensors or bulk materials in tanks, temperature sensors (resistance, e.g. PT100, thermocouples), environmental parameters sensors (e.g., carbon dioxide concentration, humidity). The protection of measuring sensors against overvoltages will be presented on the example of a measuring system with a temperature sensor.

4. Automation boiler plants: construction and equipment of nodes or hot water rules for the selection of heat exchangers, the method of temperature control pomieszceniach, selection of security elements.

5. Automation of ventilation and air-conditioning units: construction and automation elements of a ventilation and air-conditioning unit, selection of individual elements due to the type of the unit and technological requirements, example of selection of the unit and automation elements with the controller.

6. Building automation systems that use energy from renewable sources: definition and classification of renewable sources, use of solar energy (basic definitions, concepts, solar collectors and photovoltaic cells, control algorithms and methods of selecting elements and devices, security systems), possibilities of energy use wind, water, work rules and types of heat pumps.

7. Integrated building automation systems (BMS): types and architectures of automation systems, system tasks, computer energy management system (BEMS), visualization of processes occurring in ventilation, air conditioning, heating and heating systems,

8. Basics of building information modeling (BIM): algorithms and mathematical models in BMS and BEMS systems, application of rapid prototyping technology in MATLAB / SIMULINK environment, BIM technologies and design communication, design principles using BIM technology.

Laboratory classes are conducted in the form of seven 2-hour exercises, held in the laboratory, preceded by one 2-hour instructional session at the beginning of the semester, which includes familiarizing yourself with the health and safety regulations in the laboratory, issues presented in the laboratory exercises. Exercises are carried out by teams of three to four students (depending on the number of groups). The laboratory program includes the following issues:

1. Designing control systems with CAD environment - getting to know the environment for designing electrical systems and automation on the example of the SEE Electrical environment.

2. Water level control system in the tank: implementation of the water level control system in the tanks using relays. The use of a simple programmable controller to regulate water levels in tanks.

3. Methods of measuring the flow rate: using the circuit of the primary substation model, in which two flow rate sensors are installed: a rotameter and a measuring orifice. Performing flow measurements at different pump capacities.

4. Testing the efficiency of the pump: implementation of a laboratory exercise on a laboratory stand consisting of a cascade of tanks. Analysis of electrical diagrams and control switchboard.

5. Temperature control system: analysis of measurement sensors, examination of the thermal object characteristics. Development of the control algorithm. Application of an industrial controller, selection of industrial controller tuning (optional).

6. Introduction to the InTouch visualization application on the example of the aggregation of a simple industrial process model operation: setting up a new application, managing ArchestrA symbols, creating new symbols, creating scripts.

7. A practical introduction to mapp View visualization technology.

8. 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, schedule, OSS block, etc. Wykorzystanie serwera WWW do sterowania instalacjami w budynku.

9. Integration of the IQ3 / IQ4 controller with IQeco controllers or other devices (e.g. water pump) using the BACnet protocol.

Teaching methods

1. lecture: multimedia presentation,

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

Bibliography

Basic

1. B. Zawada, Układy sterowania w systemach wentylacji i klimatyzacji, Warszawa 2006.

2. W. Chmielnicki, Regulacja automatyczna urządzeń cieplowniczych, warszawa 1997

3. J. Bogdanienko, Odnawialne źródła energii, PWN, Warszawa 1989

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

Additional

1. G. Wiśniewski, Kolektory słoneczne. Poradnik wykorzystania energii słonecznej, Centralny Ośrodek Informacji Budownictwa, Warszawa 1992,

2. D. Kasznia, J. Magiera, P. Wierzowiecki: BIM w praktyce. Standardy. Wdrożenie. Case Study, Wydawnictwo Naukowe PWN, 2016

3. A. Tomana: BIM Innowacyjna technologia w budownictwie. Podstawy, standardy, narzędzia, Wydawnictwo Builder, 2016

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