ZARZĄDZENIE NR 11/2025

Rektora Państwowej Akademii Nauk Stosowanych w Głogowie

z dnia 17 lutego 2025 r.

w sprawie realizacji programu studiów dla osób przyjeżdżających w ramach współpracy międzynarodowej

Na podstawie art. 23 ust.2 pkt 2 ustawy z dnia 20 lipca 2018 r. - Prawo o szkolnictwie wyższym i nauce (Dz. U. z Dz.U. z 2024 r. poz. 1571), Rektor Państwowej Akademii Nauk Stosowanych w Głogowie, zarządza, co następuje:

§ 1

Ustala się ofertę przedmiotów prowadzonych w języku angielskim dla kierunku Automatyka i Robotyka przeznaczoną dla studentów przyjeżdżających w ramach programu Erasmus+ na semestr zimowy oraz semestr letni roku akademickiego 2024/2025.

§ 2

Szczegółowy wykaz przedmiotów, wraz z przypisaną liczbą punktów ECTS oraz harmonogramem zajęć stanowi załącznik do niniejszego zarządzenia.

§ 3

Zarządzenie wchodzi w życie z dniem podpisania.

Course catalogue for incoming Erasmus+ students

Control engineering and robotics

2024/2025

Course title	Semester	ECTS	Lecture	Lab	Project
SCADA systems	winter	6	15	30	30
Industrial controllers	winter	6	15	30	30
Essentials of control engineering	winter	6	15	30	30
Control theory	winter	6	15	30	30
3D Software	winter	6	15	30	30
Essentials of robotics	summer	6	15	30	30
Databases and computer networks	summer	6	15	30	30
System analysis and modelling	summer	6	15	30	30
Artificial intelligence	summer	6	15	30	30
Sensorics	summer	6	15	30	30

I. Winter semester

BASIC INFORMATION ABOUT THE COURSE			
course name	**Database systems + Computer networks**	course code	**24**
organizational unit responsible for teaching	**Institute of Engineering and Technology**		
Level of education	**first-cycle studies**	Programme profile	**practice-oriented**
Field of study	**control engineering and robotics**	Specialization	
Educational module	**fundamental**	Language	**English**
Semester	**winter**	Form of assessment	**graded test**

Number of teaching hours																							
Full-time studies																							
Lecture			Exercises/Tutorials			Laboratory			Project														
15		1				30		2	30		2												

Total number of teaching hours	
Full-time studies	
Lecture	15
Laboratory	30
Project	30
Total contact hours	**75**
Self-study	75
Total	**150**
ECTS	**6**

Course objective

Familiarization with the basic components of a computer workstation and the central unit's hardware. Ability to identify, specify, and describe the key parameters of a given hardware component. Introduction to the capabilities of the Office Web Apps suite. Gaining knowledge about fundamental network devices, network cabling, and network topologies. Advantages and disadvantages of different network solutions. Understanding basic data transmission techniques in networks (routing, protocols, NAT). Identification of cybersecurity threats and methods to counteract them. Comprehensive exploration of the capabilities of the Office suite (Word, Excel, PowerPoint, Access). Basic tools in the Windows operating system. Software for data processing and visualization. Basic information on relational databases. Understanding numbering systems and their practical use in IP addressing.

Learning outcomes for the course			
Code	**Description**		
Knowledge			
W1	**W1.1**	Student knows the basic components of a computer and computer networks.	
W2	**W2.1**	Student knows the operating principles of computer hardware, network devices, and transmission media.	
W3	**W3.1**	Student knows the types of databases and the principles of their design.	
Skills			
U1	**U1.1**	Student can select the appropriate computer hardware and network devices based on descriptions and technical documentation for a specific purpose and task.	
U2	**U2.1**	Student can design a simple computer network.	
U3	**U3.1**	Student can design and create a simple database.	
U4	**U4.1**	Student can configure a computer according to software requirements.	
Course content			
Subject			
Lecture			

1	Computer architecture. Basic network devices. Definitions and types of networks. Transmission media used in computer networks. Routing and NAT. TCP and UDP protocols.		
2	Security in IT. Antivirus prevention. Relative datebases. Database designing.		
Laboratory			
1	Using MS WORD, Excell and PowerPoint.		
2	Introduction to operating systems. Windows - User interface and its basic applications. Software for statistical processing and data visualization.		
3	Relative databases. Databases - MS Access. Number systems. IP addressing principles.		
Project			
1	Using MS WORD, Excell and PowerPoint.		
2	Introduction to operating systems. Windows - User interface and its basic applications. Software for statistical processing and data visualization.		
3	Relative databases. Databases - MS Access. Number systems. IP addressing principles.		

Verification of learning outcomes

Code			**Description**	
			Knowledge	**Lecture**
W1	**W1.1**	1	graded test	
W3	**W2.1**	1	graded test	
	W3.1	1	graded test	

		Skills	**Lecture**	
U1	**U1.1**	1	graded test	
U2	**U2.1**	1	graded test	
U3	**U3.1**	1	graded test	
		Knowlege	**Laboratory**	
W1	**W1.1**	1	graded test	
W2	**W2.1**	1	graded test	
W3	**W3.1**	1	graded test	
		Skills	**Laboratory**	
U1	**U1.1**	1	graded test	
U2	**U2.1**	1	graded test	
U3	**U3.1**	1	graded test	
		Knowlege	**Project**	
W1	**W1.1**	1	Project/Report/Multimedia presentation	
		Skills	**Project**	
U1	**U1.1**	1	Project/Report/Multimedia presentation	
U2	**U2.1**	1	Project/Report/Multimedia presentation	
U3	**U3.1**	1	Project/Report/Multimedia presentation	

Forms of assessment

For each learning outcome defined for the course in terms of knowledge, skills, and competencies, the grading criteria are as follows:

2,0	The student obtains less than 51% of the maximum number of points	**4,0**	The student obtains between 71% and 80% of the maximum number of points.
3,0	The student obtains between 51% and 60% of the maximum number of points.	**4,5**	The student obtains between 81% and 90% of the maximum number of points.
3,5	The student obtains between 61% and 70% of the maximum number of points.	**5,0**	The student obtains more than 90% of the maximum number of points

Grading criteria according to the scale:

bardzo dobry	**5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a very good level.
dobry plus	**4,5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at an above-good level

Dobry	**4**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a good level
dostateczny plus	**3,5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a fairly good level
Dostateczny	**3**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a sufficient level
Niedostateczny	**2**	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.
Zaliczone	**Zal**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice.
Niezaliczone	**Nzal**	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.

Self-study hours			Average number of hours to complete the activity	
		Form of activity		
		Class hours (according to the study plan) with the instructor	75	
Self-study	1	Preparation for classes	20	
	2	Reading the assigned literature	20	
	3	Preparation for the exam / assessment	20	
	4	Preparing reports on completed tasks	15	
		Total number of hours:	150	
		ECTS:	**6**	

Literature

Primary

1	Tezuysal, A., & Ahmed, I. (2024). Database Design and Modeling with PostgreSQL and MySQL: Build Efficient and Scalable Databases for Modern Applications Using Open Source Databases.
2	Dauti, B. (2018). CCENT/CCNA: ICND1 100-105 Certification Guide: Learn computer network essentials and enhance your networking skills by obtaining the CCENT certification. Packt Publishing Ltd.

Supplementary

1	

BASIC INFORMATION ABOUT THE COURSE			
course name	**3D Programs**	course code	**27**
organizational unit responsible for teaching	**Institute of Engineering and Technology**		
Level of education	**first-cycle studies**	Programme profile	**practice-oriented**
Field of study	**control engineering and robotics**	Specialization	
Educational module	**specialized**	Language	**English**
Semester	**winter**	Form of assessment	**graded test**

Number of teaching hours																							
Full-time studies																							
Lecture			Exercises/Tutorials			Laboratory			Project														
15		1				30		2	30		2												

Total number of teaching hours	
Full-time studies	
Lecture	15
Excercises/Tutorials	30
Project	30
Total contact hours	**75**
Self-study	75
Total	**150**
ECTS	**6**

Course objective

The aim of the course is to master product design, including simulation, FEM calculations, and documentation management. The course is conducted using the INVENTOR software.

Learning outcomes for the course

Code		Description	
Knowledge			
W1	**W1.1**	Student can create 3D objects and perform their strength analysis.	
W2	**W2.1**	Student can use libraries of ready-made components.	
Skills			
U1	**U1.1**	Student can create an animation of the assembly process for individual structural elements.	
U2	**U2.1**	Student can create 2D documentation based on a 3D object.	

Course content			
Subject			
Lecture			
1	Definition of a project file, its settings, and organization of work with files in the Inventor application. Relative, absolute, and polar coordinates. Characteristic points and object grips.		
2	Creating solid elements by rotating profiles around an axis and discussing modification operations through patterning and adding assembly elements such as threaded holes. Restricting degrees of freedom between assembly components – enforcing motion in the assembly, detecting collisions between elements.		
Excercises/Tutorials			
1	Creating simple models of objects built from rotational and planar solids.		
2	Excercise in applying constraints between components of an assembly consisting of multiple subassemblies. Excercise in strength calculations of an object subjected to a concentrated force and continuous load – application of the FEM module.		

3	Drawing 2D documentation based on a 3D drawing – views, sections, and breakouts.				
Project					
1	Designing a gear transmission with given parameters using the INVENTOR software.				
2	Load simulations and strength calculations of the gearbox.				
Verification of learning outcomes					
Code		**Description**			
		Knowledge	**Lecture**		
W1	**W1.1**	1	graded test		
W2	**W2.1**	1	graded test		
		Skills	**Lecture**		
U1	**U1.1**	1	graded test		
U2	**U2.1**	1	graded test		
		Skills	**Laboratory**		
U1	**U1.1**	1	Project/Report/Multimedia presentation		
U2	**U2.1**	1	Project/Report/Multimedia presentation		
		Knowlege	**Project**		
W1	**W1.1**	1	Project/Report/Multimedia presentation		
W2	**W2.1**	1	Project/Report/Multimedia presentation		
		Skills	**Project**		
U1	**U1.1**	1	Project/Report/Multimedia presentation		
U2	**U2.1**	1	Project/Report/Multimedia presentation		

Forms of assessment			
For each learning outcome defined for the course in terms of knowledge, skills, and competencies, the grading criteria are as follows:			
2,0	The student obtains less than 51% of the maximum number of points	**4,0**	The student obtains between 71% and 80% of the maximum number of points.
3,0	The student obtains between 51% and 60% of the maximum number of points.	**4,5**	The student obtains between 81% and 90% of the maximum number of points.

3,5	The student obtains between 61% and 70% of the maximum number of points.	**5,0**	The student obtains more than 90% of the maximum number of points

Grading criteria according to the scale:		
bardzo dobry	**5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a very good level.
dobry plus	**4,5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at an above-good level
Dobry	**4**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a good level
dostateczny plus	**3,5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a fairly good level
Dostateczny	**3**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a sufficient level
Niedostateczny	**2**	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.
Zaliczone	**zal**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice.
Niezaliczone	**nzal**	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.

Self-study hours			Average number of hours to complete the activity	
		Form of activity		
		Class hours (according to the study plan) with the instructor	75	
Self-study	1	Preparation for classes	20	
	2	Reading the assigned literature	20	
	3	Preparation for the exam / assessment	20	
	4	Preparing reports on completed tasks	15	
		Total number of hours:	150	
		ECTS:	**6**	

Literature

Primary

1	Bordino A., Autodesk Inventor 2023 Cookbook. A guide to gaining advanced modeling and automation skills for design engineers through actionable recipes. Packt Publishing, 2022

2	Derakhshani R. L., Derakhshani D., Autodesk 3ds Max 2014 Essentials: Autodesk Official Press. Helion, 2014
Supplementary	
1	

BASIC INFORMATION ABOUT THE COURSE			
course name	**Fundamentals of automatic control**	course code	**32**
organizational unit responsible for teaching	**Institute of Engineering and Technology**		
Level of education	**first-cycle studies**	Programme profile	**practice-oriented**
Field of study	**control engineering and robotics**	Specialization	
Educational module	**specialized**	Language	**English**
Semester	**winter**	Form of assessment	**exam**

Number of teaching hours

Full-time studies																							
Lecture			Exercises/Tutorials			Laboratory			Project														
15		1				30		2	30		2												

Total number of teaching hours

Full-time studies	
Lecture	15
Laboratory	30
Project	30
Total contact hours	**75**
Self-study	75
Total	**150**
ECTS	**6**

Course objective

Introducing students to basic techniques for designing automatic control systems.
Developing an understanding of control quality indicators among students.
Acquiring the ability to select controllers and tuning methods.

Learning outcomes for the course			
Code	**Description**		
Knowledge			
W1	**W1.1**	The student understands the concepts of stability, observability, and controllability of physical systems.	
W2	**W2.1**	The student understands the need for the mathematical description of automation systems and the design of control systems based on established quality criteria.	
	W2.2	The student has general knowledge of linear controllers, including PID controllers and their tuning methods.	
	W2.3	The student has basic knowledge of designing automatic control systems in the time and frequency domains.	
Skills			
U1	**U1.1**	The student has the ability to model dynamic systems.	
	U1.2	The student can use modern tools for designing automatic control systems.	
	U1.3	The student has the skills to design and evaluate the performance quality of automatic control systems.	
U2	**U2.1**	The student can build and tune a PID controller using the 'Autotune' method in Simulink.	
U3	**U3.1**	The student can select a controller and its parameters for digital systems.	
Course content			
Subject			
Lecture			

1	Basic concepts and definitions. Mathematical modeling of dynamic systems, block diagrams. Transfer function of automation systems. Linearization. Error transfer function. Steady-state error. Basic control quality indicators. Phase-lag and phase-lead compensators.		
2	PID controller. Tuning methods: step response method, Ziegler-Nichols method, analytical method. Control system design in the frequency domain, root locus method. Stability of automatic control systems.		
Laboratory			
1	MATLAB-Simulink Environment. Block diagrams. Modeling dynamic systems in the MATLAB/Simulink environment.		
2	Analysis of basic dynamic elements. Designing control systems using the analytical method. Analysis of steady-state control error. Selection of controller structure.		
3	Designing control systems using the root locus method. PID controller tuning. Using SISO TOOL toolbox for designing the control systems.		
Project			
1	MATLAB-Simulink Environment. Block diagrams. Modeling dynamic systems in the MATLAB/Simulink environment.		
2	Analysis of basic dynamic elements. Designing control systems using the analytical method. Analysis of steady-state control error. Selection of controller structure.		
3	Designing control systems using the root locus method. PID controller tuning. Using SISO TOOL toolbox for designing the control systems.		

Verification of learning outcomes					
Code	**Description**				
		Knowledge	**Lecture**		
W1	**W1.1**	1	exam		
	W1.2	1	exam		
W2	**W2.1**	1	exam		
	W2.2	1	exam		
	W2.3	1	exam		
		Skills	**Lecture**		
U1	**U1.1**	1	exam		
	U1.2	1	exam		
	U1.3	1	exam		
U2	**U2.1**	1	exam		
		Knowlege	**Laboratory**		
W1	**W1.1**	1	Project/Report/Multimedia presentation		
W2	**W2.1**	1	Project/Report/Multimedia presentation		
	W2.2	1	Project/Report/Multimedia presentation		
	W2.3	1	Project/Report/Multimedia presentation		
		Skills	**Laboratory**		
U1	**U1.1**	1	Project/Report/Multimedia presentation		
	U1.2	1	Project/Report/Multimedia presentation		
	U1.3	1	Project/Report/Multimedia presentation		
U2	**U2.1**	1	Project/Report/Multimedia presentation		
		Knowlege	**Project**		
W1	**W1.1**	1	Project/Report/Multimedia presentation		
		Skills	**Project**		
U1	**U1.1**	1	Project/Report/Multimedia presentation		
	U1.2	1	Project/Report/Multimedia presentation		
	U1.3	1	Project/Report/Multimedia presentation		

U2	U2.1	1	Project/Report/Multimedia presentation		

Forms of assessment			
For each learning outcome defined for the course in terms of knowledge, skills, and competencies, the grading criteria are as follows:			
2,0	The student obtains less than 51% of the maximum number of points	**4,0**	The student obtains between 71% and 80% of the maximum number of points.
3,0	The student obtains between 51% and 60% of the maximum number of points.	**4,5**	The student obtains between 81% and 90% of the maximum number of points.
3,5	The student obtains between 61% and 70% of the maximum number of points.	**5,0**	The student obtains more than 90% of the maximum number of points

Grading criteria according to the scale:		
bardzo dobry	**5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a very good level.
dobry plus	**4,5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at an above-good level
Dobry	**4**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a good level
dostateczny plus	**3,5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a fairly good level
Dostateczny	**3**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a sufficient level
niedostateczny	**2**	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.
zaliczone	**zal**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice.
niezaliczone	**nzal**	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.

Self-study hours			Average number of hours to complete the activity	
		Form of activity		
		Class hours (according to the study plan) with the instructor	75	
Self-study	1	Preparation for classes	20	
	2	Reading the assigned literature	20	
	3	Preparation for the exam / assessment	20	
	4	Preparing reports on completed tasks	15	
		Total number of hours:	150	

	ECTS:	**6**	

Literature	
Primary	
1	Astrom S, Murray R., Feedback systems: An introduction for scientists and enginners, Princetown University Press, Princetown and Oxford, 2010 - online
2	Dorf R., Bishop R., Modern control systems, Prentice Hall, New Jersey, 2011.
Supplementary	
1	Nice N., Control systems engineering, Wiley, New Jersey, 2011.

BASIC INFORMATION ABOUT THE COURSE			
course name	**Industrial Controllers**	course code	**36**

organizational unit responsible for teaching	**Institute of Engineering and Technology**		
Level of education	**first-cycle studies**	Programme profile	**practice-oriented**
Field of study	**control engineering and robotics**	Specialization	
Educational module	**specialized**	Language	**English**
Semester	**winter**	Form of assessment	**exam**

Number of teaching hours																							
Full-time studies																							
Lecture			Exercises/Tutorials			Laboratory			Project														
15		1				30		2	30		2												

Total number of teaching hours	
Full-time studies	
Lecture	15
Laboratory	30
Project	30

Total contact hours	**75**
Self-study	75
Total	**150**
ECTS	**6**

Course objective

Knowledge of the structure and operating principles of PLC controllers. Familiarity with basic programming languages. Knowledge of peripheral devices for PLC systems.

Learning outcomes for the course

Code		Description	
Knowledge			
W1	**W1.1**	The body of knowledge enables actions in accordance with the ethics of the engineering profession.	
	W1.2	Student can program PLC controllers in accordance with the applicable standards - IEC 61131.	
W2	**W2.1**	Applies the regulations on intellectual property protection.	
W3	**W3.1**	Konws the algorithms of a discrete control	
Skills			
U1	**U1.1**	Can update their knowledge and utilize technical and corporate knowledge resources and software.	
U2	**U2.1**	Can verify the correctness of control system descriptions.	

Course content			
Subject			
Lecture			
1	Basic concepts related to PLC controllers. PLC programming languages. Construction of PLC controllers. Analog and digital inputs and outputs of the PLC controller		

2	Installation of controllers in mechatronic systems. Sensors for PLC systems. Industrial networks in PLC controllers. Mathematical operations in the PLC controller. SCADA systems.		
Laboratory			
1	Basic concepts related to PLC controllers – research. PLC programming languages – sample execution. Construction of PLC controllers – disassembling damaged controllers.		
2	Analog and digital inputs and outputs of the PLC controller – setting inputs and reading outputs. Installation of controllers in mechatronic systems – connecting the controller to the system. Sensors for PLC systems – connection and input configuration.		
3	Industrial networks in PLC controllers – programming network operations (e.g., in Profinet) depending on the controller. Mathematical operations in the PLC controller – using mathematical function blocks in the program. SCADA systems – system programming.		
Project			
1	Basic concepts related to PLC controllers – research. PLC programming languages – sample execution. Construction of PLC controllers – disassembling damaged controllers.		
2	Analog and digital inputs and outputs of the PLC controller – setting inputs and reading outputs. Installation of controllers in mechatronic systems – connecting the controller to the system. Sensors for PLC systems – connection and input configuration.		
3	Industrial networks in PLC controllers – programming network operations (e.g., in Profinet) depending on the controller. Mathematical operations in the PLC controller – using mathematical function blocks in the program. SCADA systems – system programming.		

Verification of learning outcomes

Code			**Description**	
			Knowledge | **Lecture**	
W1	**W1.1**	1	graded test	
	W1.2	1	graded test	
W2	**W2.1**	1	graded test	

		Skills	**Lecture**	
U1	**U1.1**	1	graded test	
		Knowlege	**Laboratory**	
W1	**W1.1**	1	Project/Report/Multimedia presentation	
W2	**W2.1**	1	Project/Report/Multimedia presentation	
		Skills	**Laboratory**	
U1	**U1.1**	1	Project/Report/Multimedia presentation	
		Knowlege	**Project**	
W1	**W1.1**	1	Project/Report/Multimedia presentation	
W2	**W2.1**	1	Project/Report/Multimedia presentation	
		Skills	**Project**	
U1	**U1.1**	1	Project/Report/Multimedia presentation	

Forms of assessment

For each learning outcome defined for the course in terms of knowledge, skills, and competencies, the grading criteria are as follows:

2,0	The student obtains less than 51% of the maximum number of points	**4,0**	The student obtains between 71% and 80% of the maximum number of points.
3,0	The student obtains between 51% and 60% of the maximum number of points.	**4,5**	The student obtains between 81% and 90% of the maximum number of points.
3,5	The student obtains between 61% and 70% of the maximum number of points.	**5,0**	The student obtains more than 90% of the maximum number of points

Grading criteria according to the scale:

bardzo dobry	**5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a very good level.
dobry plus	**4,5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at an above-good level
dobry	**4**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a good level
dostateczny plus	**3,5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a fairly good level
dostateczny	**3**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a sufficient level
niedostateczny	**2**	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.

zaliczone	**zal**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice.
niezaliczone	**nzal**	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.

Self-study hours			Average number of hours to complete the activity	
		Form of activity		
		Class hours (according to the study plan) with the instructor	75	
Self-study	1	Preparation for classes	20	
	2	Reading the assigned literature	20	
	3	Preparation for the exam / assessment	20	
	4	Preparing reports on completed tasks	15	
		Total number of hours:	150	
		ECTS:	**6**	

Literature	
Primary	
1	White, M. T. (2024). PLCs for Beginners: An introductory guide to building robust PLC programs with Structured Text.
2	Bee, L. (2022). PLC and HMI Development with Siemens TIA Portal: Develop PLC and HMI programs using standard methods and structured approaches with TIA Portal V17. Packt Publishing Ltd.
Supplementary	
1	

BASIC INFORMATION ABOUT THE COURSE			
course name	**SCADA systems**	course code	**38**
organizational unit responsible for teaching	**Institute of Engineering and Technology**		
Level of education	**first-cycle studies**	Programme profile	**practice-oriented**
Field of study	**control engineering and robotics**	Specialization	

Educational module	**specialized**	Language	**English**
Semester	**winter**	Form of assessment	**graded test**

Number of teaching hours

Full-time studies																							
Lecture			Exercises/Tutorials			Laboratory			Project														
15			1				30			2	30			2									

Total number of teaching hours

Full-time studies	
Lecture	15
Laboratory	30
Project	30
Total contact hours	**75**
Self-study	75
Total	**150**
ECTS	**6**

Course objective

Familiarizing students with the basics of SCADA systems using the Wonderware Intouch program, introducing methods for visualizing industrial processes, and acquainting students with ways to interface communication between controllers and the SCADA system.

Learning outcomes for the course

Code		Description	
Knowledge			
W1	**W1.1**	Knows the basic properties of the Wonderware Intouch environment.	
	W1.2	Has knowledge of the basic tools for interfacing communication between the SCADA system, PLC controllers, and HMI panels.	
Skills			

U1	**U1.1**	Can design and implement a simple SCADA visualization.	
	U1.2	Can dynamically use the SCADA system for remote monitoring and control of remote devices and automation systems	
Course content			
Subject			
Lecture			
1	Introduction. Introduction to the TIA Portal environment. Principles of designing visualizations in the Wonderware Intouch system. Constructing simple HMI applications. Integration of SCADA applications with HMI and PLC.		
2	Creating scripts in the SCADA system. Generating current and historical trend charts in the SCADA system. Handling alarms in the SCADA system. Implementing advanced visualization in the Wonderware Intouch environment.		
Laboratory			
1	Introduction. Introduction to the TIA Portal environment. Principles of designing visualizations in the Wonderware Intouch system. Constructing simple HMI applications. Integration of SCADA applications with HMI and PLC.		
2	Creating scripts in the SCADA system. Generating current and historical trend charts in the SCADA system. Handling alarms in the SCADA system. Implementing advanced visualization in the Wonderware Intouch environment.		
Project			
1	Introduction. Introduction to the TIA Portal environment. Principles of designing visualizations in the Wonderware Intouch system. Constructing simple HMI applications. Integration of SCADA applications with HMI and PLC.		
2	Creating scripts in the SCADA system. Generating current and historical trend charts in the SCADA system. Handling alarms in the SCADA system. Implementing advanced visualization in the Wonderware Intouch environment.		

Verification of learning outcomes				
Code	**Description**			
		Knowledge	**Lecture**	
W1	**W1.1**	1	graded test	
	W1.2	1	graded test	
		Skills	**Lecture**	
U1	**U1.1**	1	graded test	
	U1.2	1	graded test	
		Knowlege	**Laboratory**	
W1	**W1.1**	1	Project/Report/Multimedia presentation	
	W1.2	1	Project/Report/Multimedia presentation	
		Skills	**Laboratory**	
U1	**U1.1**	1	Project/Report/Multimedia presentation	
	U1.2	1	Project/Report/Multimedia presentation	
		Knowlege	**Project**	
W1	**W1.1**	1	Project/Report/Multimedia presentation	
	W1.2	1	Project/Report/Multimedia presentation	
		Skills	**Project**	
U1	**U1.1**	1	Project/Report/Multimedia presentation	
	U1.2	1	Project/Report/Multimedia presentation	

Forms of assessment			
For each learning outcome defined for the course in terms of knowledge, skills, and competencies, the grading criteria are as follows:			
2,0	The student obtains less than 51% of the maximum number of points	**4,0**	The student obtains between 71% and 80% of the maximum number of points.
3,0	The student obtains between 51% and 60% of the maximum number of points.	**4,5**	The student obtains between 81% and 90% of the maximum number of points.
3,5	The student obtains between 61% and 70% of the maximum number of points.	**5,0**	The student obtains more than 90% of the maximum number of points
Grading criteria according to the scale:			
bardzo dobry	**5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a very good level.	

dobry plus	**4,5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at an above-good level
dobry	**4**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a good level
dostateczny plus	**3,5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a fairly good level
dostateczny	**3**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a sufficient level
niedostateczny	**2**	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.
zaliczone	**zal**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice.
niezaliczone	**nzal**	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.

Self-study hours			Average number of hours to complete the activity	
		Form of activity		
		Class hours (according to the study plan) with the instructor	75	
Self-study	1	Preparation for classes	20	
	2	Reading the assigned literature	20	
	3	Preparation for the exam / assessment	20	
	4	Preparing reports on completed tasks	15	
		Total number of hours:	150	
		ECTS:	**6**	

Literature
Primary

BASIC INFORMATION ABOUT THE COURSE			
course name	**Control Theory**	course code	**41**
organizational unit responsible for teaching	**Institute of Engineering and Technology**		

Level of education	**first-cycle studies**	Programme profile	**practice-oriented**
Field of study	**control engineering and robotics**	Specialization	
Educational module	**specialized**	Language	**English**
Semester	**winter**	Form of assessment	**graded test**

Number of teaching hours

Full-time studies																							
Lecture			Exercises/Tutorials			Laboratory			Project														
15		1				30		2	30		2												

Total number of teaching hours

Full-time studies	
Lecture	15
Laboratory	30
Project	30
Total contact hours	**75**
Self-study	75
Total	**150**
ECTS	**6**

Course objective

Familiarizing students with the basic techniques for designing control systems for continuous processes.
Developing and understanding state-feedback control techniques.
Developing and understanding output-feedback control techniques.

Learning outcomes for the course

Code		Description	
Knowledge			
W1	**W1.1**	Student can draw a block diagram of a control system and create a corresponding mathematical description.	

W2	**W2.1**	Student can describe PID algorithm	
Skills			
U1	**U1.1**	Student can design the controller and specify its control quality	
U2	**U2.1**	Student can simulate of the specific control system	
Course content			
Subject			
Lecture			
1	Basic concepts and definitions. Discussion of lecture structure. Simulating system behavior. Phase plane method. Interconnecting systems. Stability and its analysis methods: Lyapunov method, pole analysis.		
2	Controllability (reachability) and observability. State-feedback control. State-feedback control with specified quality criteria. State-feedback control: state observers, separation principle. Predictive control: accounting for constraints and minimizing a quality criterion.		
Laboratory			
1	Basic concepts and definitions. Discussion of lecture structure. Simulating system behavior. Phase plane method. Interconnecting systems. Stability and its analysis methods: Lyapunov method, pole analysis.		
2	Controllability (reachability) and observability. State-feedback control. State-feedback control with specified quality criteria. State-feedback control: state observers, separation principle. Predictive control: accounting for constraints and minimizing a quality criterion.		
Project			
1	Basic concepts and definitions. Discussion of the project, assignment of topics. Simulating system behavior. Phase plane method. Reference to the project. Interconnecting systems within the project scope.		

2	Project – stability analysis: Lyapunov method, pole analysis. Controllability (reachability) and observability. State-feedback control. Project – discussion of the first stage of the project.		
3	State-feedback control with specified quality criteria. State-feedback control: state observers, separation principle. Predictive control: accounting for constraints and minimizing a quality criterion. Presentation and discussion of the project. Verification that the project includes the prescribed content from lectures and laboratory.		

Verification of learning outcomes					
Code		**Description**			
			Knowledge	**Lecture**	
W1	**W1.1**	1	graded test		
W2	**W2.1**	1	graded test		
			Skills	**Lecture**	
U1	**U1.1**	1	graded test		
U2	**U2.1**	1	graded test		
			Knowlege	**Laboratory**	
W1	**W1.1**	1	Project/Report/Multimedia presentation		
W2	**W2.1**	1	Project/Report/Multimedia presentation		
			Skills	**Laboratory**	
U1	**U1.1**	1	Project/Report/Multimedia presentation		
U2	**U2.1**	1	Project/Report/Multimedia presentation		
			Knowlege	**Project**	
W1	**W1.1**	1	Project/Report/Multimedia presentation		
W2	**W2.1**	1	Project/Report/Multimedia presentation		
			Skills	**Project**	
U1	**U1.1**	1	Project/Report/Multimedia presentation		
U2	**U2.1**	1	Project/Report/Multimedia presentation		

Forms of assessment
For each learning outcome defined for the course in terms of knowledge, skills, and competencies, the grading criteria are as follows:

2,0	The student obtains less than 51% of the maximum number of points	**4,0**	The student obtains between 71% and 80% of the maximum number of points.
3,0	The student obtains between 51% and 60% of the maximum number of points.	**4,5**	The student obtains between 81% and 90% of the maximum number of points.
3,5	The student obtains between 61% and 70% of the maximum number of points.	**5,0**	The student obtains more than 90% of the maximum number of points

Grading criteria according to the scale:		
bardzo dobry	**5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a very good level.
dobry plus	**4,5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at an above-good level
dobry	**4**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a good level
dostateczny plus	**3,5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a fairly good level
dostateczny	**3**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a sufficient level
niedostateczny	**2**	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.
zaliczone	**Zal**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice.
niezaliczone	**nzal**	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.

Self-study hours			Average number of hours to complete the activity	
		Form of activity		
		Class hours (according to the study plan) with the instructor	75	
Self-study	1	Preparation for classes	20	
	2	Reading the assigned literature	20	
	3	Preparation for the exam / assessment	20	
	4	Preparing reports on completed tasks	15	
		Total number of hours:	150	
		ECTS:	**6**	

Literature
Primary

1	Chaber P., Nebeluk R., Wojtulewicz A., Zarzycki K. Dynamic Systems and Control. Laboratory Exercises. Oficyna Wydawnicza Politechniki Warszawskiej, 2023
2	Astrom S, Murray R., Feedback systems: An introduction for scientists and enginners, Princetown University Press, Princetown and Oxford, 2010 - online
Supplementary	
1	Dorf R., Bishop R., Modern control systems, Prentice Hall, New Jersey, 2011.

II. Summer semester

BASIC INFORMATION ABOUT THE COURSE			
course name	**System analysis and modeling**	course code	**20**
organizational unit responsible for teaching	**Institute of Engineering and Technology**		
Level of education	**first-cycle studies**	Programme profile	**practice-oriented**
Field of study	**control engineering and robotics**	Specialization	
Educational module	**fundamental**	Language	**English**
Semester	**summer**	Form of assessment	**exam**

Number of teaching hours																							
Full-time studies																							
Lecture			Exercises/Tutorials			Laboratory			Project														
15		1				30		2	30		2												

Total number of teaching hours	
Full-time studies	
Lecture	15
Laboratory	30
Project	30
Total contact hours	**75**
Self-study	75
Total	**150**
ECTS	**6**

Course objective

Understanding the basic concepts of differential and integral calculus for functions of multiple variables.
Introduction to the theory of ordinary differential equations.
Applying acquired knowledge to create and analyze mathematical models used for solving problems in engineering practice.

Learning outcomes for the course			
Code	**Description**		
Knowledge			
W1	**W1.1**	The student identifies problems where the use of a definite integral, multiple integral, or partial derivative methods is natural. Understands the geometric and physical meaning of the learned concepts.	
Skills			
U1	**U1.1**	Student has the ability to search for information in available sources related to solving problems in mathematical analysis.	

Course content			
Subject			
Lecture			
1	Partial derivative. Directional derivative. Gradient. Higher-order derivatives. Extremum of a function of two variables. Extremum of a function of multiple variables. Double integral, calculation methods, applications.		
2	First-order ordinary differential equations. Physical and technical problems leading to differential equations. Numerical series. Comparison test, Cauchy's test, d'Alembert's test. Power series		
Laboratory			
1	Partial derivative. Directional derivative. Gradient. Higher-order derivatives. Extremum of a function of two variables. Extremum of a function of multiple variables. Double integral, calculation methods, applications.		

2	First-order ordinary differential equations. Physical and technical problems leading to differential equations. Numerical series. Comparison test, Cauchy's test, d'Alembert's test. Power series		
Project			
1	Partial derivative. Directional derivative. Gradient. Higher-order derivatives. Extremum of a function of two variables. Extremum of a function of multiple variables. Double integral, calculation methods, applications.		
2	First-order ordinary differential equations. Physical and technical problems leading to differential equations. Numerical series. Comparison test, Cauchy's test, d'Alembert's test. Power series		

Verification of learning outcomes				
Code		**Description**		
		Knowledge	**Lecture**	
W1	**W1.1**	1	exam	
		Skills	**Lecture**	
U1	**U1.1**	1	exam	
		Knowlege	**Laboratory**	
W1	**W1.1**	1	Project/Report/Multimedia presentation	
		Skills	**Laboratory**	
U1	**U1.1**	1	Project/Report/Multimedia presentation	
		Knowlege	**Project**	
W1	**W1.1**	1	Project/Report/Multimedia presentation	
		Skills	**Project**	
U1	**U1.1**	1	Project/Report/Multimedia presentation	

Forms of assessment			
For each learning outcome defined for the course in terms of knowledge, skills, and competencies, the grading criteria are as follows:			
2,0	The student obtains less than 51% of the maximum number of points	**4,0**	The student obtains between 71% and 80% of the maximum number of points.
3,0	The student obtains between 51% and 60% of the maximum number of points.	**4,5**	The student obtains between 81% and 90% of the maximum number of points.

3,5	The student obtains between 61% and 70% of the maximum number of points.	**5,0**	The student obtains more than 90% of the maximum number of points

Grading criteria according to the scale:		
bardzo dobry	**5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a very good level.
dobry plus	**4,5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at an above-good level
dobry	**4**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a good level
dostateczny plus	**3,5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a fairly good level
dostateczny	**3**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a sufficient level
niedostateczny	**2**	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.
zaliczone	**Zal**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice.
niezaliczone	**Nzal**	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.

Self-study hours			Average number of hours to complete the activity	
		Form of activity		
		Class hours (according to the study plan) with the instructor	75	
Self-study	1	Preparation for classes	20	
	2	Reading the assigned literature	20	
	3	Preparation for the exam / assessment	20	
	4	Preparing reports on completed tasks	15	
		Total number of hours:	150	
		ECTS:	**6**	

Literature

Primary

1	Morawski R.Z., Miękina A.. Solved Problems in Numerical Methods for Students of Electronics and Information Technology. Oficyna Wydawnicza Politechniki Warszawskiej. 2021

2	Koźniewski E., Tereszkiewicz A., Mathematics in examples from civil engineering and architecture. Oficyna Wydawnicza Politechniki Białostockiej. 2024
Supplementary	
1	

BASIC INFORMATION ABOUT THE COURSE			
course name	**artificial intelligence**	course code	**22**
organizational unit responsible for teaching	**Institute of Engineering and Technology**		
Level of education	**first-cycle studies**	Programme profile	**practice-oriented**
Field of study	**control engineering and robotics**	Specialization	
Educational module	**fundamental**	Language	**English**
Semester	**summer**	Form of assessment	**graded test**

Number of teaching hours																							
Full-time studies																							
Lecture			Exercises/Tutorials			Laboratory			Project														
15		1				30		2	30		2												

Total number of teaching hours	
Full-time studies	
Lecture	15
Laboratory	30
Project	30
Total contact hours	**75**
Self-study	75
Total	**150**
ECTS	**6**

Course objective			
Familiarizing students with artificial neural network architectures and their learning algorithms. Introducing students to fuzzy set theory and fuzzy inference. Acquainting students with various graph search strategies. Developing skills in applying artificial intelligence methods to solve practical engineering problems.			
Learning outcomes for the course			
Code	**Description**		
Knowledge			
W1	**W1.1**	Student is aware of the computational complexity of the learned artificial intelligence methods	
	W1.2	Student can list the types of artificial neurons and characterize their properties.	
W2	**W2.1**	Student can list and characterize the structures of fuzzy and neuro-fuzzy systems.	
	W2.2	Student can list and define simple and heuristic search algorithms.	
Skills			
U1	**U1.1**	Student can implement models of fuzzy systems	
	U1.2	Student can creatively apply learned artificial intelligence methods to solve new problems.	
	U1.3	Student can design and implement a program for simple and heuristic search	
	U1.4	Student can implement models of artificial neural networks	
U2	**U2.1**	Student can apply artificial intelligence techniques to the decision support process	
Course content			
Subject			
Lecture			

1	Breadth-first and depth-first search algorithms. A algorithm.* Heuristic functions. Memory and time complexity of search strategies. Minimax algorithm. Alpha-beta pruning algorithm. Constraint-based search.		
2	Artificial neural networks. Structure of a biological neuron. Mathematical model of a neuron. Simple perceptron. Perceptron learning rule. Limitations of the simple perceptron. Neuron models and their properties. Adaline and Madaline structures. Multilayer networks. Single-layer network training. Multilayer network training. Backpropagation algorithm. Dynamic neuron models. Dynamic neural networks. Examples of applications of artificial neural networks		
Laboratory			
1	Breadth-first and depth-first search algorithms. A algorithm.* Heuristic functions. Memory and time complexity of search strategies. Minimax algorithm. Alpha-beta pruning algorithm. Constraint-based search.		
2	Artificial neural networks. Structure of a biological neuron. Mathematical model of a neuron. Simple perceptron. Perceptron learning rule. Limitations of the simple perceptron. Neuron models and their properties. Adaline and Madaline structures. Multilayer networks. Single-layer network training. Multilayer network training. Backpropagation algorithm. Dynamic neuron models. Dynamic neural networks. Examples of applications of artificial neural networks		
3	Fuzzy and neuro-fuzzy systems. Fuzzy sets and fuzzy logic. Operations on fuzzy sets. Fuzzy inference. Fuzzy rules. Examples of fuzzy systems. Neuro-fuzzy structures and their learning algorithms.		
Project			
1	Breadth-first and depth-first search algorithms. A algorithm.* Heuristic functions. Memory and time complexity of search strategies. Minimax algorithm. Alpha-beta pruning algorithm. Constraint-based search.		

2	Artificial neural networks. Structure of a biological neuron. Mathematical model of a neuron. Simple perceptron. Perceptron learning rule. Limitations of the simple perceptron. Neuron models and their properties. Adaline and Madaline structures. Multilayer networks. Single-layer network training. Multilayer network training. Backpropagation algorithm. Dynamic neuron models. Dynamic neural networks. Examples of applications of artificial neural networks		
3	Fuzzy and neuro-fuzzy systems. Fuzzy sets and fuzzy logic. Operations on fuzzy sets. Fuzzy inference. Fuzzy rules. Examples of fuzzy systems. Neuro-fuzzy structures and their learning algorithms.		

Verification of learning outcomes				
Code	**Description**			
			Knowledge	**Lecture**
W1	**W1.1**	1	graded test	
	W1.2	1	graded test	
W2	**W2.1**	1	graded test	
	W2.2	1	graded test	
			Skills	**Lecture**
U1	**U1.1**	1	graded test	
	U1.2	1	graded test	
	U1.3	1	graded test	
	U1.4	1	graded test	
			Knowlege	**Laboratory**
W1	**W1.1**	1	Project/Report/Multimedia presentation	
	W1.2	1	Project/Report/Multimedia presentation	
W2	**W2.1**	1	Project/Report/Multimedia presentation	
	W2.2	1	Project/Report/Multimedia presentation	
			Skills	**Laboratory**
U1	**U1.1**	1	Activity during classes	
	U1.2	1	Activity during classes	

	U1.3	1	Activity during classes		
	U1.4	1	Activity during classes		
			Knowlege	**Project**	
W1	**W1.1**	1	Project/Report/Multimedia presentation		
	W1.2	1	Project/Report/Multimedia presentation		
			Skills	**Project**	
U1	**U1.1**	1	Project/Report/Multimedia presentation		
	U1.2	1	Project/Report/Multimedia presentation		
	U1.3	1	Project/Report/Multimedia presentation		
	U1.4	1	Project/Report/Multimedia presentation		

Forms of assessment

For each learning outcome defined for the course in terms of knowledge, skills, and competencies, the grading criteria are as follows:

2,0	The student obtains less than 51% of the maximum number of points	**4,0**	The student obtains between 71% and 80% of the maximum number of points.
3,0	The student obtains between 51% and 60% of the maximum number of points.	**4,5**	The student obtains between 81% and 90% of the maximum number of points.
3,5	The student obtains between 61% and 70% of the maximum number of points.	**5,0**	The student obtains more than 90% of the maximum number of points

Grading criteria according to the scale:

bardzo dobry	**5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a very good level.
dobry plus	**4,5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at an above-good level
dobry	**4**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a good level
dostateczny plus	**3,5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a fairly good level
dostateczny	**3**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a sufficient level
niedostateczny	**2**	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.
zaliczone	**zal**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice.

niezaliczone	**nzal**	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.

Self-study hours		Form of activity	Average number of hours to complete the activity	
		Class hours (according to the study plan) with the instructor	75	
Self-study	1	Preparation for classes	20	
	2	Reading the assigned literature	20	
	3	Preparation for the exam / assessment	20	
	4	Preparing reports on completed tasks	15	
		Total number of hours:	150	
		ECTS:	**6**	

Literature

Primary

1	Purkait, N. (2019). Hands-On Neural Networks with Keras: Design and create neural networks using deep learning and artificial intelligence principles. Packt Publishing Ltd.
2	Müller, A. C., & Guido, S. (2016). Introduction to machine learning with Python: a guide for data scientists. " O'Reilly Media, Inc.".

Supplementary

1	Patan, K. Artificial neural networks for the modelling and fault diagnosis of technical system, Berlin 2008

BASIC INFORMATION ABOUT THE COURSE

course name	**Fundamentals of robotics**	course code	**33**

organizational unit responsible for teaching	**Institute of Engineering and Technology**		
Level of education	**first-cycle studies**	Programme profile	**practice-oriented**
Field of study	**control engineering and robotics**	Specialization	
Educational module	**specialized**	Language	**English**

Semester	**summer**	Form of assessment	**exam**

Number of teaching hours

Full-time studies																							
Lecture			Exercises/Tutorials			Laboratory			Project														
15		1				30		2	30		2												

Total number of teaching hours

Full-time studies	
Lecture	15
Laboratory	30
Project	30
Total contact hours	**75**
Self-study	75
Total	**150**
ECTS	**6**

Course objective

The goal is to familiarize students with basic methods for describing the position and orientation of rigid bodies, as well as the kinematics and dynamics of manipulators as control objects, motion planning, and control. The lectures also cover control issues in the context of industrial applications.

Learning outcomes for the course

Code		Description	
Knowledge			
W1	**W1.1**	Student knows the basic components of an industrial manipulator (including servomechanisms) and types of drives (electric, hydraulic, pneumatic). Can write a simple automated program for an industrial robot.	
W2	**W2.1**	Student knows the most popular manufacturers of manipulators and can determine the possibilities of using robots for process automation.	

Skills			
U1	**U1.1**	Student can solve forward and inverse kinematics problems to determine the position of the robot's end effector. Can identify and address safety-related issues in robotics, such as risks associated with robot motion, equipment failures, and damages caused by the robot	
Course content			
Subject			
Lecture			
1	Basic concepts related to robotics. Manipulator workspaces. Grippers used in robotics. Homogeneous representations of basic transformations. Forward kinematics problem of manipulators.		
2	Inverse kinematics problem of manipulators. Dynamic equations of manipulators. Robot modeling. External systems used in robotics.		
Laboratory			
1	Basic concepts related to robotics. Manipulator workspaces. Grippers used in robotics. Homogeneous representations of basic transformations. Forward kinematics problem of manipulators.		
2	Inverse kinematics problem of manipulators. Dynamic equations of manipulators. Robot modeling. External systems used in robotics.		
Project			
1	Basic concepts related to robotics. Manipulator workspaces. Grippers used in robotics. Homogeneous representations of basic transformations. Forward kinematics problem of manipulators.		
2	Inverse kinematics problem of manipulators. Dynamic equations of manipulators. Robot modeling. External systems used in robotics.		
Verification of learning outcomes			
Code	**Description**		
Knowledge	**Lecture**		

W1	**W1.1**	1	exam		
W2	**W2.1**	1	exam		
			Skills	**Lecture**	
U1	**U1.1**	1	exam		
			Knowlege	**Laboratory**	
W1	**W1.1**	1	Project/Report/Multimedia presentation		
W2	**W2.1**	1	Project/Report/Multimedia presentation		
			Skills	**Laboratory**	
U1	**U1.1**	1	Project/Report/Multimedia presentation		
			Knowlege	**Project**	
W1	**W1.1**	1	Project/Report/Multimedia presentation		
W2	**W2.1**	1	Project/Report/Multimedia presentation		
			Skills	**Project**	
U1	**U1.1**	1	Project/Report/Multimedia presentation		

Forms of assessment

For each learning outcome defined for the course in terms of knowledge, skills, and competencies, the grading criteria are as follows:

2,0	The student obtains less than 51% of the maximum number of points	**4,0**	The student obtains between 71% and 80% of the maximum number of points.
3,0	The student obtains between 51% and 60% of the maximum number of points.	**4,5**	The student obtains between 81% and 90% of the maximum number of points.
3,5	The student obtains between 61% and 70% of the maximum number of points.	**5,0**	The student obtains more than 90% of the maximum number of points

Grading criteria according to the scale:

bardzo dobry	**5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a very good level.
dobry plus	**4,5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at an above-good level
dobry	**4**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a good level
dostateczny plus	**3,5**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a fairly good level
dostateczny	**3**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a sufficient level

niedostateczny	**2**	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.
zaliczone	**zal**	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice.
niezaliczone	**nzal**	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.

Self-study hours			Average number of hours to complete the activity	
		Form of activity		
		Class hours (according to the study plan) with the instructor	75	
Self-study	1	Preparation for classes	20	
	2	Reading the assigned literature	20	
	3	Preparation for the exam / assessment	20	
	4	Preparing reports on completed tasks	15	
		Total number of hours:	150	
		ECTS:	**6**	

Literature	
Primary	
1	Westcott, J. R. (2023). Industrial automation and robotics.
2	Joseph, L., & Cacace, J. (2018). Mastering ROS for Robotics Programming: Design, build, and simulate complex robots using the Robot Operating System. Packt Publishing Ltd.
Supplementary	
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BASIC INFORMATION ABOUT THE COURSE			
course name	**Sensor technology**	course code	**40**
organizational unit responsible for teaching	**Institute of Engineering and Technology**		
Level of education	**first-cycle studies**	Programme profile	**practice-oriented**

Field of study	**control engineering and robotics**	Specialization	
Educational module	**specialized**	Language	**English**
Semester	**summer**	Form of assessment	**graded test**

Number of teaching hours

Full-time studies

Lecture	Exercises/Tutorials	Laboratory	Project
15	1	30 2	30 2

Total number of teaching hours

Full-time studies

Lecture	15
Laboratory	30
Project	30
Total contact hours	**75**
Self-study	75
Total	**150**
ECTS	**6**

Course objective

Familiarizing students with the construction and operating principles of sensors used in robotics and automation. Understanding measurement paths for the aforementioned sensors and devices that collect data from sensors.

Learning outcomes for the course

Code		Description	
Knowledge			
W1	**W1.1**	Student can analyze the operation of a simple electrical/electronic circuit.	
W2	**W2.1**	Student can analyze non-technical aspects of engineering activities and draw conclusions.	

W3	**W3.1**	Student analyzes technical documentation and applies copyright protection principles.	
Skills			
U1	**U1.1**	Student continuously gathers information from multiple sources to improve and apply in professional work	
U2	**U2.1**	Student can create presentations using multimedia techniques and deliver them.	
U3	**U3.1**	Student can select and apply engineering software applications, and model systems using them.	
U4	**U4.1**	Student builds measurement systems, analyzes measurement results, and processes them mathematically to calculate errors and trends.	
Course content			
Subject			
Lecture			
1	Measurement implementation, measurement methods, components of the measurement chain. Measurement inaccuracy, types of errors, processing of measurement results. Calibration of measuring instruments.		
2	Temperature sensors. Position sensors. Vibration sensors. Force, torque, and pressure sensors. Optoelectronic sensors. Sensor management through network systems, HART protocol, Zigbee networks.		
Laboratory			
1	Implementation of measurements, measurement methods, and components of the measurement chain – selection and configuration. Measurement inaccuracy, types of errors, measurement uncertainty, and processing of measurement results – calculations.		
2	Calibration of measuring instruments – applicable regulations and their interpretation. Temperature sensors – types, varieties, connection, and configuration. Position sensors – types, varieties, connection, and configuration. Vibration sensors – types, varieties, connection, and configuration. Force, torque, and pressure sensors – types, varieties, connection, and configuration. Optoelectronic sensors – types, varieties, connection, and configuration.		

3	Management of sensors through network systems, HART protocol, Zigbee networks – module configuration.		
Project			
1	Implementation of measurements, measurement methods, and components of the measurement chain – selection and configuration. Measurement inaccuracy, types of errors, measurement uncertainty, and processing of measurement results – calculations.		
2	Calibration of measuring instruments – applicable regulations and their interpretation. Temperature sensors – types, varieties, connection, and configuration. Position sensors – types, varieties, connection, and configuration. Vibration sensors – types, varieties, connection, and configuration. Force, torque, and pressure sensors – types, varieties, connection, and configuration. Optoelectronic sensors – types, varieties, connection, and configuration.		
3	Management of sensors through network systems, HART protocol, Zigbee networks – module configuration.		

Verification of learning outcomes				
Code	**Description**			
Knowledge			**Lecture**	
W1	**W1.1**	1	graded test	
W2	**W2.1**	1	graded test	
W3	**W3.1**	1	graded test	
Skills			**Lecture**	
U1	**U1.1**	1	graded test	
U2	**U2.1**	1	graded test	
U3	**U3.1**	1	graded test	
U4	**U4.1**	1	graded test	
Knowlege			**Laboratory**	
W1	**W1.1**	1	Project/Report/Multimedia presentation	
W2	**W2.1**	1	Project/Report/Multimedia presentation	

W3	**W3.1**	1	Project/Report/Multimedia presentation		
			Skills	**Laboratory**	
U1	**U1.1**	1	Project/Report/Multimedia presentation		
U2	**U2.1**	1	Project/Report/Multimedia presentation		
U3	**U3.1**	1	Project/Report/Multimedia presentation		
U4	**U4.1**	1	Project/Report/Multimedia presentation		
			Knowlege	**Project**	
W1	**W1.1**	1	Project/Report/Multimedia presentation		
W2	**W2.1**	1	Project/Report/Multimedia presentation		
			Skills	**Project**	
U1	**U1.1**	1	Project/Report/Multimedia presentation		
U2	**U2.1**	1	Project/Report/Multimedia presentation		
U3	**U3.1**	1	Project/Report/Multimedia presentation		
U4	**U4.1**	1	Project/Report/Multimedia presentation		

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	4	Preparing reports on completed tasks	15	
		Total number of hours:	150	
		ECTS:	**6**	

Literature

Primary

1	Szermer, M., Napieralski, A., & Łódzkiej, W. P. (Eds.). (2020). MEMS Fundamentals with ANSYS Simulation of Basic Sensors and Actuators: A Manual for Laboratory Work on Computer-aided MEMS Design. Lodz University of Technology Press.
2	Akande, O. (2023). Industrial Automation from Scratch: A hands-on guide to using sensors, actuators, PLCs, HMIs, and SCADA to automate industrial processes. Packt Publishing Ltd.

Supplementary

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