#### 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	e name		Dat	abase sy	ystei	ms + (	Comp	puter networks course code 2					24				
			orga	anizational unit re	sponsib	le fo	or teacl	ning	Institute of Engineering and Technology									
	Leve	l of edu	cation	first-c	ycle stu	ıdies	5		Programme profile <b>practice-oriented</b>									
	-	Field of	f study	control engin	eering a	and	roboti	cs	Specialization									
	Educational module fundamental									La	angua	ige			E	Inglish		
	Semester winter									ass	Form essmo	of ent			gra	nded test		
	Number of teaching hours																	
			Ful	ll-time studies														
	Lecture		Exe	ercises/Tutorials	Labora	tory	Proj	ect										
15		1			30	2	30	2										
					Tota	l nu	mber	of t	eaching	g hou	irs							
							Full-ti	me s	tudies									
				Lecture										15				
				Laboratory										30				
				Project										30				
			Tota	al 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         W2.1         Student knows the operating principles of computer hardware, network devices, and transmission media.									
W3	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 be descriptions and technical documentation for a specific purpose and task.	based on							
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	Comp media	outer architectu a used in comp	ure. Basic networks.	ork devices. Definitions a Routing and NAT. TCP a	nd types of networks. Transmission nd UDP protocols.					
2	Secur	ity in IT. Anti	virus preventio	n. Relative datebases. Dat	abase designing.					
1	Using	g MS WORD, 1	Excell and Pov	verPoint.						
2	Introc for sta	Introduction to operating systems. Windows - User interface and its basic applications. Software for statistical processing and data visualization.								
3	Relat	Relative databases. Databases - MS Access. Number systems. IP addressing principles.								
				Project						
1	Using	g MS WORD,	Excell and Pov	verPoint.						
2	Introc for sta	luction to oper atistical proces	rating systems. ssing and data v	Windows - User interface visualization.	and its basic applications. Software					
3	Relat	ive databases.	Databases - M	S Access. Number systems	s. IP addressing principles.					
	1			Verification of lear	ning outcomes					
Co	de			Descri	ption					
				Knowledge	Lecture					
W	/1	W1.1	1	graded test						
		W2.1	1	graded test						
w	3	W3.1	1	graded test						
•••	-									

				Skills	Lecture			
U	1	U1.1	1	graded test	·			
U	2	U2.1	1	graded test				
U	3	U3.1	1	graded test				
			·	Knowlege	Laborator	y	•	
W	/1	W1.1	1	graded test				
W	2	W2.1	1	graded test				
W	/3	W3.1	1	graded test				
				Skills	Laborator	y		
U	1	U1.1	1	graded test				
U	2	U2.1	1	graded test			]	
U	3	U3.1	1	graded test				
				Knowlege	Project			
W1         W1.1         1         Project/Report/Multimedia presentation								
				Skills	Project			
U	1	U1.1	1	Project/Report/Multimed	lia presentati	ion		
U	2	U2.1	1	Project/Report/Multimed	lia presentati	ion		
U	3	U3.1	1	Project/Report/Multimed	lia presentati	ion		
				Forms of ass	sessment			
F	For each	learning out	ome defined for th	ne course in terms of knowled	lge, skills, and	l competencies, the grading criteria are as fo	llows:	
2,0	The stu	dent obtains l	ess than 51% of the r	naximum number of points	4,0	The student obtains between 71% and 80% of maximum number of points.	the	
3,0	The stupoints.	dent obtains b	etween 51% and 60%	% of the maximum number of	4,5	The student obtains between 81% and 90% of maximum number of points.	the	
3,5	The stupoints.	dent obtains b	etween 61% and 70%	% of the maximum number of	5,0	The student obtains more than 90% of the max number of points	timum	
				Grading criteria accor	ding to the s	cale:		
baı	dzo dobr	у	5	The student knows, understands practice at a very good level.	s, and explains th	ne expected learning outcomes and is able to apply the	nem in	
dobry plus 4			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				

	Dobr	у	4	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a good level								
dosta	ateczn	ny plu	<sup>15</sup> 3,5	The student knows, understands, and explains the expected learning practice at a fairly good level	outcomes and is	able to apply them in						
Do	ostated	czny	3	The student knows, understands, and explains the expected learning practice at a sufficient level	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a sufficient level							
Nied	dostat	eczny	у 2	The student does not know, understand, or explain the expected learn practice.	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.							
Z	aliczo	one	Zal	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice.								
Nie	ezalic	zone	Nzal	The student does not know, understand, or explain the expected learn practice.	ning outcomes ar	nd is unable to apply them in						
			S	Average	number of hours to							
				comp	plete the activity							
			Class hours (according to	the study plan) with the instructor	75							
tudy	1		Preparation for classes		20							
elf-si	2		Reading the assigned lite	rature	20							
Ň	3		Preparation for the exam	/ assessment	20							
	4		Preparing reports on con	pleted tasks	15							
				Total number of hours:	150							
				ECTS:	6							
				Literature								
				Primary								
1	Tez Sca	zuys alabl	sal, A., & Ahmed, I. (202 le Databases for Modern	4). Database Design and Modeling with PostgreSQL and Applications Using Open Source Databases.	MySQL: Bu	ild Efficient and						
2	Da you	uti, I ur ne	B. (2018). CCENT/CCN etworking skills by obtain	A: ICND1 100-105 Certification Guide: Learn computer ning the CCENT certification. Packt Publishing Ltd.	network esse	entials and enhance						
				Supplementary								
1												

BASIC INFORMATION ABOUT THE COURSE																
course name			31	) Pro	gram	s				C	ourse code		27			
	orga	anizational unit re	sponsible fo	or teac	hing	Institute of	f Eng	inee	ring a	and T	Fechnolo	ogy				
Level of ed	ucation	first-c	ycle studies	5		Programme	gramme profile practice-oriented									
Field o	of study	control engin	eering and	robot	ics	Specia	alizat	ion								
Educational	module	spe	ecialized			Language English										
S	Semester winter							Form of graded test								
			Numl	f teac	hing hours											
	Fu				1		1									
Lecture	Exe	ercises/Tutorials	Laboratory	Pro	ject											
15 1			30 2	30	2											
			Total nu	mber	r of te	eaching hou	ırs									
				Full-t	ime s	tudies										
		Lecture				15										
	Exc	ercises/Tutorials				30										
		Project								3	0					
	Tota	al contact hours								7:	5					
		Self-study								7	5					
		Total								15	50					
		ECTS								6	5					
			(	Cours	e obj	ective										
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	outc	omes	for the cou	irse									

Co	de	Description										
			Knowledge									
W	/1	W1.1	Student can create 3D objects and perform their strength analysis.									
W	2	W2.1	Student can use libraries of ready-made components.									
	Skills											
U1         U1.1         Student can create an animation of the assembly		Student can create an animation of the assembly process for individual struc	tural elements.									
U	2											
			Course content									
			Subject									
			Lecture									
1	Definit applica	tion of a proj tion. Relativ	ect file, its settings, and organization of work with files in the Inventor re, absolute, and polar coordinates. Characteristic points and object grips.									
2	Creatin operati degrees detectin	ng solid elem ons through s of freedom ng collisions	nents by rotating profiles around an axis and discussing modification patterning and adding assembly elements such as threaded holes. Restricting between assembly components – enforcing motion in the assembly, between elements.									
			Excercises/Tutorials									
1	1     Creating simple models of objects built from rotational and planar solids.											
2	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	Desig	ning a gear tra	nsmission with	n given parameters using t	ne INVENTC	DR software.						
2	Load	simulations an	d strength calc	ulations of the gearbox.								
	1			Verification of lear	ning outcor	nes	-					
Co	de			Descri	ption							
				Knowledge	Lecture							
W	1	W1.1	1	graded test								
W	2	W2.1	1	graded test	ided test							
				Skills	Lecture							
U	1	U1.1	1	graded test	ded test							
U	2	U2.1	1	graded test								
				Skills	Laboratory	7						
U	1	U1.1	1	Project/Report/Multimed	lia presentatio	on						
U	2	U2.1	1	Project/Report/Multimed	lia presentatio	on						
				Knowlege	Project							
w	1	W1.1	1	Project/Report/Multimed	lia presentatio	on						
w	2	W2.1	1	Project/Report/Multimed	lia presentatio	on						
				Skills	Project							
U	1	U1.1	1	Project/Report/Multimed	lia presentatio	on						
U	2	U2.1	1	Project/Report/Multimed	lia presentatio	on						
				Forms of ass	essment							
F	or each	learning outcom	ne defined for th	e course in terms of knowled	ge, skills, and	competencies, the grading criteria are as fo	llows:					
2,0	The stu	ident obtains less	than 51% of the n	naximum number of points	4,0	The student obtains between 71% and 80% of maximum number of points.	the					
3,0	The student obtains between 51% and 60% of the maximum number of points. <b>4,5</b> The student obtains between 81% and 90% of the maximum number of points.											

3,5	The stu points.	ident obt	ains between 61% and 7	0% of the maximum number of	5,0	The student obtains more than 90% of the maximum number of points					
				Grading criteria accor	ding to the so	ale:					
bar	dzo dobi	ry	5	The student knows, understands practice at a very good level.	, and explains th	e expected learning o	utcomes and is	able to apply them in			
do	obry plus	5	4,5	The student knows, understands practice at an above-good level	, and explains th	e expected learning o	utcomes and is	able to apply them in			
	Dobry		4	The student knows, understands practice at a good level	, and explains th	e expected learning o	utcomes and is	able to apply them in			
dosta	iteczny p	olus	3,5	The student knows, understands practice at a fairly good level	, and explains th	e expected learning o	utcomes and is	able to apply them in			
Do	stateczn	у	3	e expected learning o	utcomes and is	able to apply them in					
Niec	lostatecz	zny	2	in the expected learni	ng outcomes a	nd is unable to apply them in					
Z	aliczone		zal	The student knows, understands practice.	, and explains th	e expected learning o	utcomes and is	able to apply them in			
Nie	ezaliczor	ne	nzal	The student does not know, und practice.	erstand, or expla	in the expected learni	ng outcomes a	nd is unable to apply them in			
			Se	lf-study hours			Average number of hours to				
				Form of activity			complete the activity				
		Class	hours (according to	the study plan) with the inst	tructor		75				
tudy	1	Prepa	ration for classes				20				
elf-s	2	Read	ing the assigned liter	ature			20				
Ň	3	Prepa	ration for the exam	assessment			20				
	4	Prepa	ring reports on com	pleted tasks			15				
					Total nu	mber of hours:	150				
						ECTS:	6				
				Literat	ure						
				Prima	ry						
1	Bordi engin	no A., eers th	Autodesk Inventor 2 ough actionable rec	023 Cookbook. A guide to gipes. Packt Publishing, 2022	gaining advai	nced modeling a	nd automati	on skills for design			

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

BASIC INFORMATION ABOUT THE COURSE																				
	course	e name		F	unda	menta	ls of :	auton	matic control course code 32						32					
			orga	anizational unit r	espons	ible fo	or teac	hing	Institute of Engineering and Technology											
	Leve	l of edu	ication	first-	cycle s	tudies	5		Programme profile practice-oriented											
		Field of	f study	control engin	eerin	g and	robot	ics	Specialization											
	Educational module specialized								L	angu	iage	2				E	nglish			
	Semester winter									as	Forr sessn	n o nen	f t				e	exam		
	Number of teaching hours																			
			Ful	ll-time studies			_													
	Lecture	_	Exe	ercises/Tutorials	Labo	oratory	Pro	ject											-	_
15		1			30	2	30	2												
					To	tal nu	ımbe	r of t	eachii	ng ho	urs									
							Full-	time s	tudies											
				Lecture											1	5				
				Laboratory											3	0				
				Project											3	0				
			Tota	al contact hours											7	5				
Self-study													7	5						
	Total								150											
				ECTS											(	5				
	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.							
	W2.1	The student understands the need for the mathematical description of automa and the design of control systems based on established quality criteria.	ation systems					
W2	W2.2	<b>V2.2</b> The student has general knowledge of linear controllers, including PID controllers and their tuning methods.						
	W2.3	W2.3The student has basic knowledge of designing automatic control systems in the time and frequency domains.						
		Skills						
	U1.1	The student has the ability to model dynamic systems.						
U1	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			Descrij	ption				
	Knowledge Lecture							
W/1	W1.1	1	exam					
•••1	W1.2	1	exam					
	W2.1	1	exam					
W2	W2.2	1	exam					
	W2.3	1	exam					
Skills Lecture								
	U1.1	1	exam					
U1	U1.2	1	exam					
	U1.3	1	exam					
U2	U2.1	1	exam					
Knowlege Laboratory								
W1	W1.1	1	Project/Report/Multimed	lia presentation				
	W2.1	1	Project/Report/Multimed	lia presentation				
W2	W2.2	1	Project/Report/Multimed	lia presentation				
	W2.3	1	Project/Report/Multimed	lia presentation				
			Skills	Laboratory				
	U1.1	1	Project/Report/Multimed	lia presentation				
U1	U1.2	1	Project/Report/Multimed	lia presentation				
	U1.3	1	Project/Report/Multimed	lia presentation				
U2	U2.1	1	Project/Report/Multimed	lia presentation				
			Knowlege	Project				
W1	W1.1	1	Project/Report/Multimed	lia presentation				
		•	Skills	Project				
	U1.1	1	Project/Report/Multimed	lia presentation				
U1	U1.2	1	Project/Report/Multimed	lia presentation				
	U1.3	1	Project/Report/Multimed	lia presentation				

U	U2         U2.1         1         Project/Report/Multimedia presentation									
				Forms of ass	essment					
F	or each	learning outco	me defined for	the course in terms of knowled	ge, skills, and	competencies, th	e grading crite	eria are as fol	lows:	
2,0	2,0 The student obtains less than 51% of the maximum number of points 4,0 The student obtains number of points							ins between 71% and 80% of the er of points.		
<b>3,0</b> The student obtains between 51% and 60% of the maximum number of <b>4,5</b> The student obtain maximum number of						ins between 81% and 90% of the er of points.				
3,5	The stupoints.	ident obtains be	tween 61% and 7	0% of the maximum number of	5,0	The student obta number of points	ins more than 90	0% of the max	imum	
	Grading criteria according to the scale:									
bar	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.						em in			
dobry plus4,5The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at an above-good level						em in				
Dobry         4         The student knows, understands, and explains the expected learning outcomes and is able to apply practice at a good level						able to apply th	em in			
dostateczny plus3,5The student knows, understands, and explains the expected learning outcomes and is able to apply practice at a fairly good level						able to apply th	em in			
Do	ostateczn	у	3	The student knows, understands practice at a sufficient level	, and explains th	e expected learning	outcomes and is a	able to apply th	em in	
niec	lostatecz	ny	2	The student does not know, und practice.	erstand, or expla	in the expected learn	ning outcomes and is unable to apply them in			
Z	aliczone		zal	The student knows, understands practice.	, and explains th	e expected learning	outcomes and is able to apply them in			
nie	ezaliczon	e	nzal	The student does not know, und practice.	erstand, or expla	in the expected learn	ning outcomes an	d is unable to a	pply them in	
			Se	lf-study hours			Average	number of ]	hours to	
				Form of activity			comp	lete the acti	ivity	
		Class hours	(according to	the study plan) with the inst	ructor		75			
tudy	1	Preparation	for classes				20			
elf-st	2	Reading the	assigned liter	ature			20			
Š	3	Preparation	for the exam /	assessment			20			
	4	Preparing r	eports on com	pleted tasks			15			
					Total nu	mber 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	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							ial C	ontr	ollers				c	ourse code		36		
			orga	anizational unit re	esp	onsi	ble fo	or 1	teacl	ning	Institute of	Eng	inee	ring	and [	Геchr	olo	ogy
	Level	of edu	acation	first-	cyc	cle st	udie	S			Programme	e pro	file			pra	ctio	ce-oriented
	I	Field of	f study	control engin	nee	ring	and	ro	oboti	cs	Specia	lizat	ion					
	Educat	ional r	nodule	sp	oeci	ializo	ed				La	ngu	age	E				nglish
Semester			mester	winter			ass	Form essm	of ent		exam			exam				
						Ν	Juml	be	r of	teac	hing hours							
			Fu	ll-time studies														
	Lecture		Exe	ercises/Tutorials	Ι	Labor	atory		Proj	ect								
15		1			3	30	2	3	30	2								
					1	Tota	al nu	ım	ıber	of t	eaching hou	rs						
	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								
Co	de	Description						
Knowledge								
w	W1.1	The body of knowledge enables actions in accordance with the ethics of the engineering profession.						
	W1.2	W1.2Student can program PLC controllers in accordance with the applicable standards - IEC 61131.						
W	W2W2.1Applies the regulations on intellectual property protection.							
W	W3     W3.1     Konws the algorithms of a discrete control							
		Skills						
U	1 U1.1	Can update their knowledge and utilize technical and corporate knowledge is software.	esources and					
Už	2 U2.1	Can verify the correctness of control system descriptions.	_					
		Course content						
		Subject						
		Lecture						
1	Basic concepts r controllers. Ana	elated to PLC controllers. PLC programming languages. Construction of PLC log 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.							
	•							
1	Basic execu	concepts relat tion. Construc	ed to PLC cont tion of PLC co	trollers – research. PLC pr ntrollers – disassembling	ogramming languages – sample 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           1         execution. Construction of PLC controllers – disassembling damaged controllers.							
2	Analo Install Senso	og and digital i lation of contr ors for PLC sys	nputs and outp ollers in mecha stems – connec	uts of the PLC controller - ttronic systems – connecti- tion and input configuration	- setting inputs and reading outputs. ng the controller to the system. on.			
3	3Industrial 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 lear	ning outcomes			
Co	de			Descri	ption			
				Knowledge	Lecture			
w	1	W1.1	1	graded test				
	_	W1.2	1	graded test				
W	W2   W2.1   1   graded test							

				Skills	Lecture				
U	1	U1.1	1	graded test					
			·	Knowlege	Laborator	y			
W	′1	W1.1	1	Project/Report/Multimed	lia presentati	on			
W	2	W2.1	1	Project/Report/Multimed	lia presentati	on			
				Skills	Laborator	y			
U	1	U1.1	1	Project/Report/Multimed	lia presentati	on			
			·	Knowlege	Project				
W	1	W1.1	1	Project/Report/Multimed	lia presentati	on			
w	2	W2.1	1	Project/Report/Multimed	lia presentati	on			
			· ·	Skills	Project				
U	1	U1.1	1	Project/Report/Multimed	lia presentati	on			
	Forms of assessment								
F	for each	learning outo	ome defined for th	ne course in terms of knowled	lge, skills, and	competencies, the grading criteria are as for	llows:		
<b>2,0</b> 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 stu points.	dent obtains b	etween 51% and 60%	% of the maximum number of	4,5	The student obtains between 81% and 90% of the maximum number of points.			
3,5	The stu points.	dent obtains b	etween 61% and 70%	% of the maximum number of	5,0	The student obtains more than 90% of the max number of points	timum		
				Grading criteria accor	ding to the so	cale:			
bar	dzo dobr	у	5	The student knows, understands practice at a very good level.	, and explains th	e expected learning outcomes and is able to apply the	nem in		
de	obry plus		4,5	The student knows, understands practice at an above-good level	, and explains th	e expected learning outcomes and is able to apply the	nem in		
	dobry		4	The student knows, understands practice at a good level	, and explains th	e expected learning outcomes and is able to apply the	nem in		
dosta	ateczny p	lus	3,5	The student knows, understands practice at a fairly good level	, and explains th	e expected learning outcomes and is able to apply the	nem in		
do	ostateczny	7	3	The student knows, understands practice at a sufficient level	, and explains th	e expected learning outcomes and is able to apply the	nem in		
niec	lostateczi	ny	2	The student does not know, und practice.	erstand, or expla	in the expected learning outcomes and is unable to a	apply the	em in	

Z	zaliczone     zal     The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice.							
nie	ezaliczon	e	ng outcomes a	nd is unable to apply them in				
		1	Average number of hours to					
	Form of activity					complete the activity		
		Class h	hours (according to t	he study plan) with the instructor	75			
dy	1	Prepar	ation for classes		20			
elf-st	2	Readir	ng the assigned litera	ture	20			
Š	3	Prepar	ration for the exam /	20				
	4	Prepar	ing reports on comp	15				
				150				
				ECTS:	6			
				Literature				
				Primary				
1	White	e, M. T.	(2024). PLCs for Be	eginners: An introductory guide to building robust PLC p	orograms wi	th 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	cours	38						
orga	anizational unit responsible for teaching	Institute of Engineer	ring and Tech	nology				
Level of education	first-cycle studies	Programme profile	practice-oriented					
Field of study	control engineering and robotics	Specialization						

]	Educational module specialized									Laı	ngua	ge				E	nglish					
		Se	mester		wi	nter					a	F sse	'orm ssme	of ent				gra	ided tes	st		
						N	Jumb	oer (	of tea	chin	g hour	'S										
			Fu	ll-time studies																		
I	Lecture		Exe	ercises/Tutorials	L	Labora	atory	Pı	oject													
15		1			(1)	30	2	30	2													
					,	Tota	al nu	mbe	er of t	each	ing h	our	rs									
								Full	-time s	tudie	es											
				Lecture						15												
				Laboratory												3	0					
	Project														3	0						
	Total contact hours									75												
	Self-study														7	5						
				Total												15	50					
				ECTS												(	6					
							(	Coui	·se ob	jecti	ve											
Familia visualiz SCADA	arizing zing ind A syste	studen dustrial m.	ts with t l process	he basics of SCA	AD/ ting	A sys stuc	stems lents	s usir with	ig the ways	Won to in	derwar terface	e Ir cor	ntouc mmu	ch p inica	rogra ation	m, in betw	itrod een	ucin cont	g metho rollers a	ods f and t	for he	
					L	lear	ning	out	come	s for	the co	our	se								-	
Coc	de								Descri	ptio	1											
								K	nowle	dge												
W	1	W	/1.1	Knows the basi	c p	rope	rties	of th	e Won	derw	are Int	ouc	ch en	viro	onmei	nt.						
WI		W	/1.2	Has knowledge system, PLC co	of ontr	the l oller	basic s, and	tools d HN	s for ir 11 pan	terfa els.	cing co	omr	nuni	cati	on be	twee	n the	e SC	ADA			
		Skills																				

U1	1	U1.1	Can design and implement a simple SCADA visualization.				
U	1	U1.2	Can dynamically use the SCADA system for remote monitoring and control devices and automation systems	of remote			
			Course content				
			Subject				
			Lecture				
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	Introd in the SCAE	luction. Introd Wonderware DA application	uction to the TIA Portal environment. Principles of designing visualizations Intouch system. Constructing simple HMI applications. Integration of as with HMI and PLC.				
2	Creati SCAI in the	ing scripts in t DA system. Ha Wonderware	he SCADA system. Generating current and historical trend charts in the indling alarms in the SCADA system. Implementing advanced visualization Intouch environment.				
			Project				
1	1Introduction. 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	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										
Co	de			Descri	ption					
				Knowledge	Lecture					
W	. W	/1.1	1	graded test						
vv	I W	/1.2	1	graded test						
				Skills	Lecture					
U	1 U	1.1	1	graded test						
	U	1.2	1	graded test						
Knowlege Laboratory										
W1         W1.1         1         Project/Report/Multimedia presentation						on				
W1         W1.2         1         Project/Report/Multimedia presentation										
Skills Laboratory										
TI	1 U	1.1	1	Project/Report/Multimed	roject/Report/Multimedia presentation					
U	U	1.2	1	Project/Report/Multimed	lia presentati	on				
				Knowlege	Project					
14/	1 W	/1.1	1	Project/Report/Multimed	lia presentati	on				
~~~	1 w	1.2	1	Project/Report/Multimedia presentation						
				Skills	Project					
	1 U	1.1	1	Project/Report/Multimed	lia presentati	on				
0.	່ U	1.2	1	Project/Report/Multimed	lia presentati	on				
				Forms of ass	essment					
F	or each learnin	g outcor	ne defined for th	e course in terms of knowled	lge, skills, and	l competencies, the grading criteria are as fol	llows:			
2,0	The student ob	tains less	than 51% of the n	naximum number of points	4,0	The student obtains between 71% and 80% of maximum number of points.	the			
3,0	<b>3,0</b> The student obtains between 51% and 60% of the maximum number of points.					<b>4,5</b> The student obtains between 81% and 90% of the maximum number of points.				
3,5	The student ob points.	tains betw	veen 61% and 70%	6 of the maximum number of	5,0	The student obtains more than 90% of the max number of points	imum			
				Grading criteria accor	ding to the so	cale:				
bar	dzo dobry		5	The student knows, understands practice at a very good level.	, and explains th	e expected learning outcomes and is able to apply the	nem in			

do	obry plu	s	4,5	The student knows, understands, and explains the expected learning of practice at an above-good level	outcomes and is	able to apply them in		
	dobry		4	The student knows, understands, and explains the expected learning of practice at a good level	outcomes and is	able to apply them in		
dosta	ateczny j	plus	3,5	The student knows, understands, and explains the expected learning of practice at a fairly good level	outcomes and is	able to apply them in		
do	stateczn	у	3	The student knows, understands, and explains the expected learning of practice at a sufficient level	outcomes and is able to apply them in			
nied	lostatecz	zny	2	The student does not know, understand, or explain the expected learn practice.	ing outcomes a	nd is unable to apply them in		
Z	aliczone	;	outcomes and is	comes and is able to apply them in				
nie	zaliczor	ne	ing outcomes and is unable to apply them in					
			Sel	lf-study hours	Average	e number of hours to		
				Form of activity	complete the activity			
		Class	hours (according to	the study plan) with the instructor	75			
ndy	1	Prepa	ration for classes		20			
elf-si	2	Readi	ng the assigned liter	ature	20			
š	3	Prepa	ration for the exam /	assessment	20			
	4	Prepa	ring reports on comp	leted 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									

Leve	l of educatio	n <b>first-</b>	cycle studies	5	Programme	profi	ile		prac	tice-orien	ted	
]	Field of stud	y <b>control engin</b>	eering and	robotics	Specia	lizati	on					
Educat	tional modul	e sp	ecialized		La	ingua	ge			English		
	Semeste	er	winter		Form of assessment				gı	raded test		
			Numł	per of teac	hing hours							
		Full-time studies					-					
Lecture		Exercises/Tutorials	Laboratory	Project								
15	1		30 2	30 2								
			Total nu	mber of t	eaching hou	rs						
				Full-time s	tudies							
		Lecture						1	5			
		Laboratory			30							
		Project						3	30			
	Т	otal contact hours						7	75			
		Self-study						7	75			
		Total			150							
		ECTS			6							
			(	Course ob	jective							
Familiarizing Developing an Developing an	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				Descri	ption							
				Knowle	dge							
W1	W1         W1.1         Student can draw a block diagram of a control system and create a corresponding mathematical description.											

W	2	W2.1	Student can describe PID algorithm					
			Skills					
U	1	U1.1	Student can design the controller and specify its control quality					
U	2	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.       Image: Control contr							
			Laboratory					
1	Basic Phase metho	concepts and plane method d, pole analys	definitions. Discussion of lecture structure. Simulating system behavior. I. Interconnecting systems. Stability and its analysis methods: Lyapunov sis.					
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 system the pro	concepts and n behavior. Pl oject scope.	definitions. Discussion of the project, assignment of topics. Simulating hase plane method. Reference to the project. Interconnecting systems within					

2	Project observ	t – stability ar ability. State-	aalysis: Lyapur feedback contr	ov method, pole analysis. ol. Project – discussion of	Controllability (reachability) and the first stage of the project.					
3	State-f separat criteric prescri	eedback contr tion principle on. Presentation ibed content f	rol with specifi Predictive con on and discussi rom lectures ar	ed quality criteria. State-fo ntrol: accounting for const on of the project. Verifica nd laboratory.	eedback control: state observers, raints and minimizing a quality tion that the project includes the					
Verification of learning outcomes										
Co	de			Descrij	ption					
Knowledge Lecture										
W1     W1.1     1     graded test										
W	2	W2.1								
Skills Lecture										
U1 U1.1			1	graded test						
U	2	U2.1	1	graded test						
				Knowlege	Laboratory					
W	1	W1.1	1	Project/Report/Multimed	lia presentation					
W	2	W2.1	1	Project/Report/Multimed	lia presentation					
				Skills	Laboratory					
U	1	U1.1	1	Project/Report/Multimed	lia presentation					
U	2	U2.1	1	Project/Report/Multimed	lia presentation					
				Knowlege	Project					
W	1	W1.1	1	Project/Report/Multimed	lia presentation					
W2     W2.1     1     Project/Report/Multimedia presentation										
				Skills	Project					
U	1	U1.1	1	Project/Report/Multimed	lia presentation					
U	2	U2.1	1	Project/Report/Multimed	lia presentation					
				Forms of ass	essment					
F	For each learning outcome defined for the course in terms of knowledge, skills, and competencies, the grading criteria are as follows:									

2,0	The stu	ident obtains less than 51% of the	e maximum number of points	4,0	The student obtain maximum number	ins between 719 er of points.	71% and 80% of the		
3,0	The stu points.	ident obtains between 51% and 6	0% of the maximum number of	4,5	The student obtain maximum number	ins between 819 er of points.	% and 90% of the		
3,5	The stupoints.	ident obtains between 61% and 7	0% of the maximum number of	5,0	The student obtainumber of points	ins more than 9	0% of the maximum		
			Grading criteria accor	ding to the sc	ale:				
bar	dzo dob	у 5	The student knows, understands practice at a very good level.	, and explains the	e expected learning	outcomes and is	able to apply them in		
do	obry plus	4,5	The student knows, understands practice at an above-good level	, and explains the	e expected learning	outcomes and is	able to apply them in		
	dobry     4     The student knows, understands, and explains the expected learning practice at a good level						able to apply them in		
dosta	dostateczny plus3,5The student knows, understands, and explains the expected learn practice at a fairly good level						able to apply them in		
do	dostateczny     3     The student knows, understands, and explains the expected learn practice at a sufficient level					g outcomes and is able to apply them in			
nied	niedostateczny 2 The student does not know, understand, or explain the expected lear practice.						nd is unable to apply them in		
Z	aliczone	Zal	The student knows, understands practice.	, and explains the	e expected learning	outcomes and is	able to apply them in		
nie	zaliczon	e nzal	The student does not know, und practice.	erstand, or explai	in the expected learn	ning outcomes an	nd is unable to apply them in		
		Se	lf-study hours			Average	number of hours to		
			Form of activity			comp	plete the activity		
		Class hours (according to	the study plan) with the inst	tructor		75			
udy	1	Preparation for classes				20			
lf-st	2	Reading the assigned liter	ature			20			
Se	3	Preparation for the exam	assessment			20			
	4 Preparing reports on completed tasks								
				Total nur	mber of hours:	150			
					ECTS:	6			
			Literat	ure			·		
			Prima	ry					

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 1	name		System an	alysis	and	l modeling course code 20					20			
	org	anizational unit re	esponsible fo	or teach	ing	Institute of Engineering and Technology								
Level	of education	first-c	cycle studies Programme profile					practice-oriented						
F	ield of study	control engin	eering and	robotic	es.	Speci	alizati	on						
Educational module fundamental						L	angua	ige			E	Inglish		
Semester summer						ass	Form sessme	of		exam				
	Number of teaching hours													
	Full-time studies													
Lecture	Ex	ercises/Tutorials	Laboratory	Proje	ect									_
15	1		30 2	30	2									
			Total nu	ımber	of t	eaching ho	urs							
				Full-ti	me s	tudies								
		Lecture								15				
		Laboratory								30				
		Project								30				
	Total contact hours									75				
						75								
Total										15(	)			
		ECTS								6				
				Course	e obj	jective								

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										
Co	de		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 o the learned concepts.								
Skills										
U1U1.1Student has the ability to search for information in available sources related to solving problems in mathematical analysis.										
Course content										
			Subject							
			Lecture							
1	Partia functi calcul	l derivative. D on of two vari ation methods	Pirectional derivative. Gradient. Higher-order derivatives. Extremum of a ables. Extremum of a function of multiple variables. Double integral, applications.							
2	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.									
	Laboratory									
1	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											
	1			Project								
1	Partia functi calcul	ll derivative. D on of two vari lation methods	virectional derivables. Extremut, applications.	vative. Gradient. Higher-o um of a function of multip	rder derivativ le variables. I	ves. Extremum of a Double integral,						
2	First- differ Powe	order ordinary ential equatior r series	differential eq ns. Numerical s	uations. Physical and tech eries. Comparison test, Ca	nical problem auchy's test, d	ns leading to l'Alembert's test.						
	Verification of learning outcomes											
Co	Code Description											
Knowledge Lecture												
W	W1         W1.1         1         exam											
				Skills	Lecture							
U	1	U1.1	1	exam								
		1		Knowlege	Laboratory	У						
W	'1	W1.1	1	Project/Report/Multimed	lia presentatio	on						
		1		Skills	Laboratory	У						
U	1	U1.1	1	Project/Report/Multimed	lia presentatio	on						
		1		Knowlege	Project							
w	1	W1.1	1	Project/Report/Multimed	lia presentatio	on						
		I	I	Skills	Project							
U	1	U1.1	1	Project/Report/Multimed	lia presentatio	on						
				Forms of ass	sessment							
For each learning outcome defined for the course in terms of knowledge, skills, and competencies, the grading criteria are as follows:												
2,0	The stu	ident obtains less	than 51% of the n	naximum number of points	4,0	The student obtains between 71% and 80% of maximum number of points.	the					
3,0	The student obtains between 51% and 60% of the maximum number of points. The student obtains between 81% and 90% of the maximum number of points.											

3,5	The stu points.	udent ob	tains between 61% and 709	% of the maximum number of	5,0	The student obtainumber of points	ns more than 9	0% of the maximum			
				Grading criteria accor	ding to the so	cale:					
bar	dzo dob	ry	5	The student knows, understands practice at a very good level.	, and explains th	e expected learning of	outcomes and is	able to apply them in			
do	obry plus	5	4,5	The student knows, understands practice at an above-good level	, and explains th	e expected learning of	outcomes and is	able to apply them in			
	dobry		4	The student knows, understands practice at a good level	, and explains th	e expected learning o	outcomes and is	able to apply them in			
dosta	ateczny p	olus	3,5	The student knows, understands practice at a fairly good level	, and explains th	e expected learning of	outcomes and is	able to apply them in			
do	stateczn	у	3	e expected learning o	outcomes and is	able to apply them in					
nied	niedostateczny 2 The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.										
zaliczoneZalThe student knows, understands, and explains the expected learning outcomes and is able to apply them in practice.											
nie	zaliczon	ne	Nzal	The student does not know, und practice.	erstand, or expla	in the expected learn	ing outcomes a	nd is unable to apply them in			
			Self	f-study hours			Average	e number of hours to			
				Form of activity			com	plete the activity			
		Class	hours (according to the	he study plan) with the inst	tructor		75				
tudy	1	Prepa	ration for classes				20				
elf-st	2	Read	ing the assigned litera	ture			20				
š	3	Prepa	ration for the exam / a	assessment			20				
	4	Prepa	ring reports on compl	eted tasks			15				
	•				Total nu	mber of hours:	150				
						ECTS:	6				
				Literat	ure						
				Prima	ry						
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	

				BAS	IC	INFO	DRM	IAT	<b>IC</b>	)N A	BOUT TH	<b>E</b> (	C <b>O</b>	URS	SE						
	course name artificial inte								tellig	course code 22						22					
	organizational unit responsible for teaching									hing	Institute of Engineering and Technology										
Level of education first-cycle studies							Programn	ne pi	rofi	le			pract	ice	e-oriented						
Field of studycontrol engineering and robotics							Spec	ializ	atic	n											
	Educat	tional n	nodule	f	unc	lamei	ntal				I	Lang	guag	ge			]	En	glish		
Semester summer							as	Foi sess	rm o mei	of nt			gr	ad	led test						
Number of teaching hours																					
			Fu	ll-time studies																	
	Lecture		Exe	ercises/Tutorials		Labor	ratory	1	Proj	ect											
15		1				30	2	30	)	2											
						Tot	al nu	umb	oer	of t	eaching ho	urs									
								Ful	ll-ti	ime s	tudies										
				Lecture												1	5				
				Laboratory												3	0				
Project													3	0							
Total contact hours													7	5							
Self-study												7	5								
	Total													15	50						
				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 int methods	elligence							
	W1.2	Student can list the types of artificial neurons and characterize their properties	es.							
W2	W2.1	Student can list and characterize the structures of fuzzy and neuro-fuzzy systems.								
	W2.2	2.2 Student can list and define simple and heuristic search algorithms.								
		Skills								
	U1.1	Student can implement models of fuzzy systems								
111	U1.2	Student can creatively apply learned artificial intelligence methods to solve r	new problems.							
U1	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 pr	rocess							
		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	Artific Simpl mode netwo mode	cial neural net le perceptron. I ls and their pro ork training. M ls. Dynamic ne v and neuro-fuz	works. Structu Perceptron lear operties. Adalin (ultilayer netwo eural networks zzy systems. Fu	re of a biological neuron. A rning rule. Limitations of t ne and Madaline structures ork training. Backpropagat . Examples of applications uzzy sets and fuzzy logic.	Mathematical model of a neuron. he simple perceptron. Neuron s. Multilayer networks. Single-layer ion algorithm. Dynamic neuron of artificial neural networks Operations on fuzzy sets. Fuzzy								
3	infere algori	nce. Fuzzy rul thms.	es. Examples o	of fuzzy systems. Neuro-fu	zzy structures and their learning								
				Verification of lear	ning outcomes								
Co	Code     Description												
				Knowledge	Lecture								
W	W1.1     1     graded test       W1     1     graded test												
		W1.2	<u>l</u>	graded test									
W	2	W2.1	l	graded test									
		W2.2		graded test	• ·		<u> </u>						
		T11 1	1	Skills	Lecture		[						
			1	graded test	raded test								
U	1	U1.2	1	graded test									
			1	graded test									
		01.4	1	gladed test	Laboratory								
		W/1 1	1	Rilowiege Project/Report/Multimed	Laboratory								
W	1	W1.1 W1.2	1	Project/Report/Multimed	lia presentation								
		W2 1	1	Project/Report/Multimed	lia presentation								
W	2	W2.1 W2.2	1	Project/Report/Multimed	lia presentation								
		** 2.2	1	Skille	Laboratory								
		U1.1	1	Activity during classes	Laboratory								
U	1	U1.1	1	Activity during classes									
		01.2			1								

			-									
		U1.3	1	Activity during classes								
		U1.4	1	Activity during classes								
				Knowlege	Project		•					
	14	W1.1	1	Project/Report/Multimed	lia presentati	on						
vv	1	W1.2	1	Project/Report/Multimed	lia presentati	on						
				Skills	Project		•					
		U1.1	1	Project/Report/Multimed	Project/Report/Multimedia presentation							
	1	U1.2	1	Project/Report/Multimed	Project/Report/Multimedia presentation							
U	T	U1.3	1	Project/Report/Multimed	lia presentati	on						
		U1.4	1	Project/Report/Multimed	lia presentati	on						
				Forms of ass	sessment							
F	For each	learning outcor	ne defined for th	e course in terms of knowled	lge, skills, and	competencies, the grading criteria are as fo	llows:					
<b>2,0</b> The student obtains less than 51% of the max				naximum number of points	4,0	The student obtains between 71% and 80% of maximum number of points.	the					
<b>3,0</b> The student obtains between 51% and 60% of th points.				% of the maximum number of	4,5	The student obtains between 81% and 90% of maximum number of points.	the					
3,5	The stupoints.	ident obtains betw	ween 61% and 70%	% of the maximum number of	5,0	The student obtains more than 90% of the max number of points	timum					
				Grading criteria accor	ding to the so	cale:						
baı	rdzo dobr	У	5	The student knows, understands practice at a very good level.	s, and explains th	e expected learning outcomes and is able to apply the	nem in					
d	obry plus		4,5	The student knows, understands practice at an above-good level	s, and explains th	e expected learning outcomes and is able to apply the	nem in					
	dobry		4	The student knows, understands practice at a good level	s, and explains th	e expected learning outcomes and is able to apply the	nem in					
dostateczny plus 3,5				The student knows, understands practice at a fairly good level	s, and explains th	e expected learning outcomes and is able to apply the	nem in					
dostateczny 3 T				The student knows, understands practice at a sufficient level	s, and explains th	e expected learning outcomes and is able to apply the	nem in					
niec	dostatecz	ny	2	The student does not know, und practice.	student does not know, understand, or explain the expected learning outcomes and is unable to apply them in ctice.							
zaliczone zal				The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice.								

ni	ezaliczoi	ne	nzal	The student does not know, understand, or explain the expected learn practice.	ing outcomes a	nd is unable to apply them in				
			Sel	f-study hours	Average	number of hours to				
				Form of activity	com	plete the activity				
		Class	hours (according to t	he study plan) with the instructor	75					
ndy	1	Prepa	aration for classes		20					
ilf-st	2	Read	ing the assigned litera	20						
Š	3	Prepa	aration for the exam /	assessment	20					
r I	4	Prepa	aring reports on comp	15						
	•		150							
				ECTS:	6					
				Literature						
				Primary						
1	Purka artifi	ait, N. ( cial inte	2019). Hands-On Neu elligence principles. P	ural Networks with Keras: Design and create neural netw ackt Publishing Ltd.	vorks using	deep learning and				
2	2 Müller, A. C., & Guido, S. (2016). Introduction to machine learning with Python: a guide for data scientists. " O'Reilly Media, Inc.".									
	Supplementary									
Patan, K. Artificial neural networks for the modelling and fault diagnosis of technical system, Berlin 2008										

BASIC INFORMATION ABOUT THE COURSE										
course name	course code	33								
orga	anizational unit responsible for teaching	Institute of Engineer	ring and Technolo	ogy						
Level of education	first-cycle studies	Programme profile	practi	ce-oriented						
Field of study	control engineering and robotics	Specialization								
Educational module	specialized	Language	E	nglish						

		Sei	nester		sı	ımme	•				Fc	orm o ssme	of nt					exam			
						N	uml	be	r of t	eac	hing hours										
			Fu	ll-time studies																	
Leo	cture		Exe	ercises/Tutorials		Labor	atory		Proje	ct											
15		1				30	2	3	30	2											
						Tota	al nu	ım	ber (	of to	eaching hours	S									
								Fι	ull-tir	ne s	tudies										
				Lecture											15	5					
	Laboratory									30											
	Project													30	)						
			Tota	al contact hours											75	5					
				Self-study							75										
				Total											15	0					
				ECTS											6						
							(	Co	ourse	obj	ective										
The goal kinemation the conte	is to cs and ext of	familia 1 dynar industr	urize stu nics of ial appl	dents with basi manipulators a ications.	ic r s c	nethod ontrol	s for objec	• de cts,	escrib , moti	ing ion j	the position and planning, and c	d ori ontro	enta ol. T	tion The le	of rig ecture	id b s al	oodie so co	es, as we	ll as trol	the issue	s in
						Lear	ning	<b>5 O</b>	utco	mes	for the cours	se									
Code	e								De	scri	ption										
									Kno	wle	dge										
W1Student 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							
U	1	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 a risks associated with robot motion, equipment failures, and damages caused by the robot	5						
			Course content							
Subject										
Lecture										
1Basic concepts related to robotics. Manipulator workspaces. Grippers used in robotics. Homogeneous representations of basic transformations. Forward kinematics problem of manipulators.										
2	2Inverse 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.         1       Homogeneous representations of basic transformations. Forward kinematics problem of manipulators.										
2	Invers mode	se kinematics p ling. External	broblem of manipulators. Dynamic equations of manipulators. Robot systems used in robotics.							
			Project							
Basic concepts related to robotics. Manipulator workspaces. Grippers used in robotics.       Homogeneous representations of basic transformations. Forward kinematics problem of manipulators.										
2Inverse kinematics problem of manipulators. Dynamic equations of manipulators. Robot modeling. External systems used in robotics.Image: Comparison of manipulators and comparison										
Verification of learning outcomes										
Code Description										
Knowledge										

W	/1	W	1.1	1	exam				
W	/2	W	2.1	1	exam				
					Skills	Lecture			
U	1	U	1.1	1	exam				
	Knowlege Laboratory								
W	/1	W	1.1	1	Project/Report/Multimed	lia presentati	on		
W	/2	W	2.1	1	Project/Report/Multimed	lia presentati	on		
					Skills	Skills Laboratory			
U	1	U	1.1	1	Project/Report/Multimed	lia presentati	on		
					Knowlege	Project			
W	/1	W	1.1	1	Project/Report/Multimed	lia presentati	on		
W	/2	W	2.1	1	Project/Report/Multimed	lia presentati	on		
	Skills Project								
U	U1     U1.1     1     Project/Report/Multimedia presentation								
	Forms of assessment								
I	For each	learning	g outcon	ne defined for th	e course in terms of knowled	lge, skills, and	competencies, the grading criteria are as fo	llows:	
2,0	The stu	ident obt	ains less	than 51% of the n	naximum number of points	4,0	The student obtains between 71% and 80% of maximum number of points.	the	
3,0	The stupoints.	ident obt	ains betv	veen 51% and 60%	6 of the maximum number of	4,5	The student obtains between 81% and 90% of maximum number of points.	the	
3,5	The stupoints.	ident obt	ains betv	veen 61% and 70%	6 of the maximum number of	5,0	The student obtains more than 90% of the max number of points	kimum	
					Grading criteria accor	ding to the so	cale:		
bai	rdzo dobr	У		5	The student knows, understands practice at a very good level.	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 the practice at an above-good level			hem in		
	dobry			4	The student knows, understands practice at a good level	, and explains th	e expected learning outcomes and is able to apply t	hem in	
dost	ateczny p	lus		3,5	The student knows, understands practice at a fairly good level	, and explains th	e expected learning outcomes and is able to apply t	hem in	
do	ostateczny	1		3	The student knows, understands practice at a sufficient level	ent knows, understands, and explains the expected learning outcomes and is able to apply the at a sufficient level			

niedostateczny		ny	2	The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.					
Z	zaliczone		zal	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice.					
nie	niezaliczone			The student does not know, understand, or explain the expected learning outcomes and is unable to apply them in practice.					
Self-study hours						e number of hours to			
				Form of activity	com	plete the activity			
		Class hours (	according to	75					
udy	1	Preparation f	or classes	20					
lf-st	2	Reading the a	assigned liter	20					
Š	3	Preparation f	for the exam /	20					
	4	Preparing rep	orts on comp	15					
	Total number of hours:				150				
				ECTS:	6				
		·		Literature					
				Primary					
1	West	cott, J. R. (202	3). 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					
1									

BASIC INFORMATION ABOUT THE COURSE								
course name	Sensor technology		course code	40				
orga	anizational unit responsible for teaching	Institute of Enginee	ring and Techno	ology				
Level of education	vel of education first-cycle studies Programme profile practice-orient			tice-oriented				

F	Field of study	control engin	eering and	robotics	Specializa	tion						
Educati	ional module	sp	ecialized		Langu	lage		English				
	Semester	S	ummer		Forrassessn	n of nent			gra	ided test		
			Numb	per of teac	hing hours							
	F	ull-time studies										
Lecture	E	xercises/Tutorials	Laboratory	Project								
15	1		30 2	30 2								
			Total nu	mber of t	eaching hours							
Full-time studies												
Lecture 15												
		Laboratory			30							
		Project			30							
	To	tal contact hours			75							
		Self-study			75							
		Total						150				
		ECTS						6				
			(	Course ob	jective							
Familiarizing s measurement p	students with paths for the	the construction a aforementioned set	nd operating nsors and de	g principles evices that c	of sensors used in collect data from s	n rob senso	otics a rs.	and auto	omatio	on. Unders	tandin	g
			Learning	outcomes	for the course							
Code				Descri	ption							
		1		Knowle	dge							
W1	W1.1	Student can ana	lyze the ope	ration of a s	simple electrical/e	electr	onic c	vircuit.				
W2	W2.1	Student can ana	lyze non-tec	hnical aspe	cts of engineering	g acti	vities	and dra	w cor	clusions.		

W	/3	W3.1	Student analyzes technical documentation and applies copyright protection principles.					
Skills								
U1         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 more them.			Student can select and apply engineering software applications, and model s them.	systems using				
U4 U4.1 Student builds measurement systems, analyzes measurement results, and processes them mathematically to calculate errors and trends.								
			Course content					
			Subject					
			Lecture					
1	1Measurement implementation, measurement methods, components of the measurement chain. Measurement inaccuracy, types of errors, processing of measurement results. Calibration of measuring instruments.Image: Calibratic content in the c							
2	2Temperature sensors. Position sensors. Vibration sensors. Force, torque, and pressure sensors. Optoelectronic sensors. Sensor management through network systems, HART protocol, Zigbee networks.							
			Laboratory					
1	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	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	Mana config	agement of sensors through network systems, HART protocol, Zigbee networks – module iguration.							
				Project					
1	Imple chain uncer	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	Mana config	anagement of sensors through network systems, HART protocol, Zigbee networks – module nfiguration.							
		1		Verification of lear	ning outcomes				
Co	de			Descri	ption				
		1	1	Knowledge	Lecture		1		
W	/1	W1.1	1	graded test					
W	2	W2.1	1	graded test			-		
W	3	W3.1	1	graded test					
		1		Skills	Lecture		1		
U	1	U1.1	1	graded test			-		
U	2	U2.1	1	graded test			-		
U3 U3.1 1 graded test		graded test			-				
U	4	U4.1	1	graded test					
				Knowlege	Laboratory				
W	/1	W1.1	1	Project/Report/Multimed	lia presentation				
W	W2         W2.1         1         Project/Report/Multimedia presentation								

W	/3	W3.1	1	Project/Report/Multimed	ct/Report/Multimedia presentation				
				Skills	Laborator	y			
U	1	U1.1	1	Project/Report/Multimed	dia presentati	on			
U	U2     U2.1     1     Project/Report/Multimedia presentation       U3     U3.1     1     Project/Report/Multimedia presentation					]			
U	3	U3.1         1         Project/Report/Multimedia presentation				]			
U	4	U4.1	1	Project/Report/Multimedia presentation					
	Knowlege Project								
W1         W1.1         1         Project/Report/Multimedia presentation				on					
W	2	W2.1	1	Project/Report/Multimed	dia presentati	on			
Skills Project									
U	1	U1.1	1	Project/Report/Multimed	dia presentati	on			
U	2	U2.1	1	Project/Report/Multimed	dia presentati	on			
U	3	U3.1	1	Project/Report/Multimed	ect/Report/Multimedia presentation				
U	U4         U4.1         1         Project/Report/Multimedia presentation								
	Forms of assessment								
I	For each	learning outcom	me defined for th	e course in terms of knowled	lge, skills, and	competencies, the grading criteria are as fo	llows:		
2,0	The stu	ident obtains less	than 51% of the n	naximum number of points	4,0	The student obtains between 71% and 80% of maximum number of points.	the		
3,0	The stupoints.	ident obtains bet	ween 51% and 60%	% of the maximum number of	4,5	The student obtains between 81% and 90% of maximum number of points.	the		
3,5	The stupoints.	ident obtains bet	ween 61% and 70%	% of the maximum number of	5,0	The student obtains more than 90% of the max number of points	timum		
				Grading criteria accor	ding to the so	cale:			
bai	rdzo dobr	У	5	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a very good level.					
d	obry 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 practice at a good level	s, and explains th	e expected learning outcomes and is able to apply the	nem in		
dost	ateczny p	lus	3,5	The student knows, understands practice at a fairly good level	s, and explains th	e expected learning outcomes and is able to apply the	nem in		
do	ostateczny	4	3	The student knows, understands practice at a sufficient level	The student knows, understands, and explains the expected learning outcomes and is able to apply them in practice at a sufficient level				

niedostateczny		ny	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 <b>nzal</b> The student does not know, understand, or explain practice.				The student does not know, understand, or explain the expected learning practice.	ing outcomes a	nd is unable to apply them in		
			Average number of hours to					
	Form of activity					plete the activity		
		Class he	ours (according to th	e study plan) with the instructor	75			
tudy	1	Prepara	ation for classes		20			
elf-st	2	Reading	g the assigned literat	20				
š	3	Prepara	ation for the exam / a	20				
	4 Preparing reports on completed tasks				15			
	•		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							
1								