			Rial	vstok II	<i>App</i> niversity	endix No 1 t	o the Directive No 915/2	2019 of the Rector of BUT		
			Diai	yslok U	inversity	UI TECHIIC	Dogroe level and	full-time Bachelor's		
Field of study	Aut	omatic	Contro	and R	obotics		programme type	degree		
Specjalization / diploma path		CO	mmon s	ubject			Study profile	general academic		
Course name	Vieu	alization	ofindu	etrial n	nnassas	•	Course code	MYARS05001		
	¥150	anzation			0000300		Course type	obligatory		
Forms and	L C	LC	Р	SW	FW	S	Semester	5		
of tuition	15 0	0	30	0	0	0	No. of ECTS credits	4		
Entry requirements					Progra	imming of I	PLCs			
Course objectives	Acquainting w Wonderware.	Acquainting with visualization systems used in industrial applications on the example of SCADA - InTouch Wonderware.								
Course content	Lecture: vvays of presenting the course of the process and the state of the object, the structure of visualization systems, operator interface design, monitoring methods and process control. The concept of SCADA and HMI. Examples of programs for visualization of industrial processes and applications made in them. Wonderware package installation and installation of add-ons. Control algorithms for objects used in InTouch. Designation of task division between the PLC and the visualization software. Principles of developing programs for a PLC controller. Stages of process visualization system design. Ways of designing visualization applications. Configuration of communication between drivers from different companies, and InTouch (configuration of the controller and I / O server). Project: Project in the In Touch environment: graphic editor, creating windows, variables, animation links and scripts. Execution of subprograms and system configuration to: display alarms, reports, trends; communication with other Windows applications and with a PLC controller.									
Teaching	Informative-problem lecture; Project classes;									
Assessment method	Lecture: one test Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes									
Symbol of learning outcome		Learning outcomes Reference to the learning outcomes for the field of stud								
LO1	knows and u industrial proc	nderstan esses	ds the	basic c	oncepts	in the fiel	d of visualization o	f AR1_W04 AR1_W07		
LO2	knows the str between them	ucture o	f visuali	zation s	systems a	and metho	ds of communicatior	AR1_W04 AR1_W07		
LO3	has knowledg systems	e of the	type of	data ar	nd princip	oles of data	a use in visualizatior	AR1_W04 AR1_W05		
LO4	can use graph	ic elemer	its and p	orogram/	configure	them		AR1_U03		
LO5	can configure	scripts ar	id implei	ment the	em in visu	alization sy	vstems	AR1_U03		
LO6	can create ind	ividual an	d team	projects				AR1_U11		
Symbol of learning outcome		Ν	lethods of	assessing	g the learni	ng outcomes		Type of tuition during which the outcome is assessed		
LO1	Lecture: one te	est;						W		
LO2	Lecture: one te	est;						W		
LO3	Lecture: one te	est;						W		
LO4	Project: evaluation and	ation of p l activity (roject co during th	ompletio le classe	n, curren es;	t progress	in project completion	, P		
LO5	Project: evaluation discussion and	ation of p activity	roject co during th	ompletio le classe	n, curren es;	t progress	in project completion	' Р		
LO6	Project: evaluation discussion and	ation of p l activity (roject co during th	ompletio le classe	n, curren es;	t progress	in project completion	' P		
			Student wo	rkload (in h	ours)			No. of hours		
Calculation	Lecture attend	ance						15		
Guidalation	Project attenda	ance						30		

	Preparation for lecture test(s)	14								
	Preparation for project classes	18								
	Working on projects (including preparation of presentations)	12								
	Preparation for projects completion	6								
	Participation in teacher-student sessions related to the module subject	5								
	100									
	Quantitative indicators	Hours	ECTS							
	50	2								
	71	2,8								
	1. Podręczniki szkoleniowe. In Touch cz. 1. Tworzenie i serwisowanie aplikacji. Astor Kraków 2010.									
Basic references	2. Podręczniki szkoleniowe. In Touch cz. 2. Zagadnienia zaawansowane. Astor Kraków 2011.									
	3. Dzierżek K., Programowanie sterowników PLC GE-Fanuk. Wydawnictwo PB, Białystok 2007.									
	1. Tworzenie i zarządzanie symbolami ArchestrA - podręcznik użytkownika. Astor, Kraków 2009.									
	2. In Touch 9.5. Podręcznik użytkownika. Tłumaczenie z angielskiego. Astor Krakó	w 2006.								
Supplementary	3. In Touch – Opis funkcji, pól i zmiennych systemowych. Tłum. z angielskiego. As	tor Kraków 2006.								
1010101000	4. InTouch HMI Application Management and Extension Guide. Wonderware 2013	4. InTouch HMI Application Management and Extension Guide. Wonderware 2013.								
	5. InTouch HMI Visualization Guide. Wonderware 2013.									
Organisational	Katadra Automatuki i Dabatuki	Data of issuing the progr								
the course		Date of issuing the progr	amme							
Author of the programme	dr inż. Michał Ostaszewski	2019-09-23								

			Bialy	/stok Ur	niversitv	of Tech	noloav			
Field of study	Aut	omatic	Control	and Ro	obotics		Degree lev programme	el and e type	full-time Bacl degree	helor's
Specjalization / diploma path		CO	mmon s	ubject			Study pro	ofile	general acad	demic
Courso namo	r r)rogram	mable l	ala day	iooc		Course o	ode	MYARS05	002
Course name	r	Togram		Jyic dev	ICES		Course t	уре	obligato	ry
Forms and	L C	LC	Р	SW	FW	S	Semes	ter	5	
of tuition	15 0	0	30	0	0	0	No. of ECTS	credits	3	
Entry requirements			Progra	imming o	of microco	ontroller	s, Programmin	g of PLCs		
Course objectives	Familiarization program simple	with the control	specific systems	ity and a implement	structure: ented in p	s of prog program	grammable log mable logic de	jic devices vices.	. Acquiring the	ability to
Course content	Lecture: Structure and specifics of programmable PLD / FPGA logic devices. Basics of PLD / FPGA programming - VHDL language. Project: Programming combinatorial, sequential, synchronous systems, state machines in VHDL language.									
Teaching methods	Informative-pro	blem lec	ture; Pro	ject clas	ses;					
Assessment method	Lecture: or Project: ev activity dur	Lecture: one test Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes								
Symbol of learning outcome				Learning	outcomes				Reference to the outcomes for the f	e learning ield of study
LO1	knows and de devices	knows and describes the structure of selected PLD and FPGA programmable AR1_W04 AR1_U07								
LO2	knows and und	knows and understands methods of digital signal processing							AR1_W04 AR1_	W06
LO3	knows and explains main structures of VHDL programming language									
LO4	can apply VHDL language to programming simple control systems: combinatorial, AR1_U07 sequential, synchronous, state machines, microprocessors									
Symbol of learning outcome	Methods of assessing the learning outcomes Type of tuition during which the outcome is assessed									
LO1	Lecture: one te	st;							W	
LO2	Lecture: one te	st;							W	
LO3	Lecture: one te	st;							W	
	Lecture. One test, W									
1 04	Project: evaluation of project completion, current progress in project completion,									
LO4	discussion and	tion of p activity of	during th	e classe	s;	t progres	s in project co	Simpletion,		Р
LO4	discussion and	activity of p	during th Student wor	e classe kload (in ho	S; ours)	t progres	ss in project co	ompietion,	No. of ho	P urs
LO4	discussion and	activity of p	oroject co during th Student woo	e classe kload (in ho	S; burs)		ss in project co		No. of ho 15 30	P
L04	Lecture attenda Project attenda	activity of p activity of ance nce	troject co during th Student wor	e classe rkload (in ho	S; ours)		ss in project co		No. of ho 15 30 5	P
L04	Lecture attenda Project attenda Preparation for	activity of p activity of ance nce lecture t	roject co during th Student wor est(s)	e classe kload (in ho	s; purs)			Smpletion,	No. of ho 15 30 5 6	P
LO4 Calculation	Lecture attenda Project attenda Preparation for Preparation for Working on pro	ance nce lecture t project o iects (ind	roject co during th Student wor cest(s) classes cluding p	e classe kload (in ho	s; ^{uurs)}	sentatior			No. of ho 15 30 5 6 12	P
LO4 Calculation	Lecture attenda Project attenda Preparation for Preparation for Working on pro Preparation for	ance nce lecture t projects (inc projects)	roject co during th Student woo cest(s) classes cluding p complet	e classe kload (in ho reparatio ion	s; ^{uurs)}	sentatior	ns)		No. of ho 15 30 5 6 12 2	P
LO4	Arroject. evaluation discussion and Project attenda Preparation for Preparation for Working on pro Preparation for Participation in	ance nce lecture t projects (inc projects teacher-	roject co during th Student woo cest(s) classes cluding p complet student	e classe kload (in ho preparatio ion sessions	s; ours) on of pres	sentation	ns)		No. of ho 15 30 5 6 12 2 5	P urs
LO4	Lecture attenda Project attenda Project attenda Preparation for Preparation for Working on pro Preparation for Participation in	tion of p activity of ance nce lecture t project of jects (ind projects teacher-	roject co during th Student wor cest(s) classes cluding p complet student	e classe kload (in ho reparatio ion sessions	on of pres	sentation	ns)	TOTAL	No. of ho 15 30 5 6 12 2 5 75	P
LO4 Calculation	Project. evaluation discussion and Project attenda Preparation for Preparation for Working on pro Preparation for Participation in	tion of p activity of ance nce lecture t project of jects (ind projects teacher-	cluding p complet student work classes cluding p complet student	e classe kload (in ho preparatio ion sessions ive indicato	s; ours) on of pres related f	sentation	ns)	TOTAL	No. of ho 15 30 5 6 12 2 5 75 Hours	P urs ECTS
LO4 Calculation	Project. evaluation discussion and Lecture attenda Project attenda Preparation for Preparation for Preparation for Participation in Student	tion of p activity of ance nce lecture t project of jects (ind projects teacher-	est(s) classes cluding p complet student Quantitat	e classe kload (in ho reparatio ion sessions ive indicato it require dir	S; purs) pn of pres related the rs ect teacher	sentation	ns)	TOTAL	No. of ho 15 30 5 6 12 2 5 75 Hours 50	P urs ECTS 2
LO4 Calculation	Project. evalua discussion and Lecture attenda Project attenda Preparation for Preparation for Working on pro Preparation for Participation in Student	tion of p activity of ance nce lecture t project of jects (ind projects teacher-	complet student workload	e classe kload (in ho reparatio ion sessions ive indicato trequire dir d - practical	on of pres	sentation	ns)	TOTAL	No. of ho 15 30 5 6 12 2 5 75 Hours 50 55	P urs ECTS 2 2,2
LO4 Calculation Basic references	Project. evaluation discussion and Lecture attendation Project attendation Preparation for Preparation for Preparation for Participation in Student 1. Kulesza Z., Wydawnicza P 2. Zwolinski M.	tion of p activity of ance ince lecture t project of projects (ino projects teacher- workload - a Stude Prografi olitechnik , Projekto	complet student workload complet student complet student Quantitat activities tha ent workload mowanie ki Białost owanie u	e classe kload (in ho preparatio ion sessions ive indicato t require dir d - practical e sterow tockiej, E układów o	s; on of pres related f rs activities ników cz iałystok z cyfrowycł	sentation sentation to the me participation zasu rze 2015. h z wyko	ns) podule subject neczywistego w rzystaniem iez	TOTAL v układach	No. of ho 15 30 5 6 12 2 5 75 Hours 50 55 PLD i FPGA WKiŁ, Warsza	P urs ECTS 2 2,2 . Oficyna awa 2006.
LO4 Calculation Basic references	Project. evaluation discussion and Lecture attendation Project attendation Preparation for Preparation for Preparation for Preparation for Participation in Student 1. Kulesza Z., Wydawnicza P 2. Zwolinski M. 3. Skahill K., Je 4. Majewski L	tion of p activity of ance ince lecture t projects (ind projects (ind projects (ind projects action vorkload - a Stude Progration olitechnik , Projekte zyk VHE Zhysińel	Classes cluding p complet comp	e classe kload (in ho reparatio ion sessions ive indicato trequire dir d - practical e sterow tockiej, E kładów (, Warsza ady EPC	print of present of pr	sentation sentation to the me participation zasu rze 2015. h z wyko l.	ns) podule subject czywistego w rzystaniem jęz	TOTAL v układach zyka VHDL.	No. of ho 15 30 5 6 12 2 5 75 75 Hours 50 55 PLD i FPGA WKiŁ, Warsza	P urs ECTS 2 2,2 . Oficyna wwa 2006.

references	Willey, 2008.										
	2. Sacha K., Systemy czasu rzeczywistego. Warszawa, Oficyna Wydawnicza Po	litechniki Warszawskiej,									
	Warszawa 1999.										
	3. Zbysiński P., Pasierbiński J., Układy programowalne: pierwsze kroki. Wydawnictwo BTC, Warszawa										
	2004.										
	4. Pasierbiński J., Zbysiński P., Układy programowalne w praktyce. WKŁ, Warszwa	a 2002.									
Organisational											
unit conducting	Katedra Automatyki i Robotyki	Date of issuing the programme									
Author of the		0040.00.00									
programme	dr hab. inz. Zbigniew Kulesza, prof. PB	2019-09-23									

				Die	hvotok I	App Iniversit	endix No 1 t	to the Directive No 915/	2019 of the	Rector of E	<i>3UT</i>
				Dia	IIYSLOK L	Jniversi	y of recin		full tim	- Pachal	- " -
Field of study		Auto	omatic	Contro	l and R	obotics		Degree level and programme type	Tull-till	degree	ors
Specjalization / diploma path			CO	mmon s	subject			Study profile	gener	al academ	nic
Course name		Instr	umenta	tion of	control /	evetems	, ,	Course code	MY	ARS05003	3
		mən	umenta			393101110		Course type	ol	oligatory	
Forms and	L	С	LC	Р	SW	FW	S	Semester		5	
of tuition	30	0	30	0	0	0	0	No. of ECTS credits		5	
Entry requirements			Fundan	nentals of	of proces	ss contro	I, Electric d	lrive systems, Fluid d	rive syster	ns	
Course objectives	Acquair devices used ir robotics determi determi	devices for continuous processes: sensors and measuring transducers, actuators, controllers. Sensors used in industrial lines: RFID sensors and their cooperation with a PLC controller. Measurements in robotics: point measurements and array measurements. Acquiring the ability to study automation devices, determine their characteristics and their selection in the control system. Testing of PID and relay regulators, determination of characteristics using the WinCC environment.									
Course content	Lecture Static a flow me sensors Intellige control system convert properti mathem	Lecture: The role of sensors, measuring transducers, actuators, controllers in the automatic control system. Static and dynamic properties of sensors and actuators. Structure, principle of operation and parameters of: 'low meters, level gauges, valves, control throttles, microprocessor controllers, pressure transmitters, RFID sensors. Point measurements and array measurements. Cooperation between PLC and RFID heads. ntelligent materials: piezoelectric, magnetostrictive and shape memory alloys and their applications in the control system. The rules for the selection of automation devices. Classification and properties of real-time systems. A / D and D / A converters. Devices and methods for recovering energy from vibrations. Intelligent converters, HART protocol. Real-time dSpace processor. Laboratory: Determination of static and dynamic properties of sensors, testing of automatic control systems of various processes, determination of the mathematical model of the control plant.									
Teaching	Informa	Informative-problem lecture; Laboratory classes;									
Assessment	Leo	l ecture: exam									
method	Lab	oratory	: evalua	tion of ir	ntroducto	orv tests,	reports, dis	scussion and activity	durina the	classes	
Symbol of learning outcome					Learning) outcomes	<u></u>	<u> </u>	Refere	ence to the lea	rning of study
LO1	knows describ	the pri e their r	nciple of	of operatic	ation of on	selected	l automatio	on devices and car	AR1_W01	AR1_U01	
LO2	knows sketch:	the strublock d	ucture c iagrams	of select	ted auto ation sch	mation on the metric of the me	devices an	id on this basis car	AR1_W07	AR1_W08	AR1_U07
LO3	knows intellige	the bas ent meas	ic paran suring de	neters o <u>evices a</u>	of selecte and can r	ed autom name the	nation devic	ces including moderr	AR1_W01	AR1_U01	
LO4	knows selecte	the rul <u>d non-e</u>	es of s lectrical	ignal p quantitie	rocessin es	ig and o	can perfor	m measurements o	f AR1_W07	AR1_U04	
LO5	is able	to prope	rly proc	ess the	results o	of measur	rements		AR1_U04		
LO6	can, w determi	/hile ma ine stati	aintainin c and dy	g healt /namic c	h and haracte	safety r	egulations, selected au	conduct tests and utomation devices	AR1_U04	AR1_U12	
LO7	can wo	rk in a te	eam and	l is read	y to com	ply with	the binding	rules	AR1_U11	AR1_K02	
Symbol of learning outcome			N	lethods of	i assessinę	g the learni	ng outcomes		Type of tu outco	ition during v ome is asses	which the sed
LO1	Lecture and act	: exam; ivity dur	Labora	tory: ev classes;	aluation	of introd	uctory test	s, reports, discussior	W	L	
LO2	Lecture and act	: exam; ivity dur	Labora	tory: eva	aluation	of introd	uctory test	s, reports, discussior	W	L	
LO3	Lecture and act	: exam; ivity dur	Labora	tory: eva	aluation	of introd	uctory test	s, reports, discussior	W	L	
LO4	Lecture	: exam;	Labora	tory: ev	aluation	of introd	uctory test	s, reports, discussior	n W	L	

	and activity during the classes;									
1.05	Laboratory: evaluation of introductory tests, reports, discussion and activity	1								
200	during the classes;	L								
1.06	Laboratory: evaluation of introductory tests, reports, discussion and activity	1								
	during the classes;	_								
LO7	Laboratory: evaluation of introductory tests, reports, discussion and activity									
	during the classes;	_								
	Student workload (in hours)	No. of hours								
		30								
	Laboratory classes attendance	30								
	Preparation for the lecture exam; participation in the exam	31								
Calculation	Preparation for laboratory classes	23								
	Preparation for laboratory classes completion	6								
	Participation in teacher-student sessions related to the module subject	5								
	TOTAL	125								
	Quantitative indicators	Hours	ECTS							
	67	2,7								
	Student workload - practical activities	64	2,6							
	1. Turkowski M., Przemysłowe sensory i przetworniki pomiarowe, Oficyna Wydawnicza Politechniki									
	Warszawskiej, Warszawa 2002.									
	2. Pomiary: czujniki i metody pomiarowe wybranych wielkości fizycznych i składu chemicznego. Pod red. J.									
Basic references	Piotrowskiego. WNT, Warszawa 2009.									
	3. Kostro J., Elementy, urządzenia i układy automatyki, WSiP, Warszawa 2006.									
	4. Zawory regulacyjne. Energetyka i cieżkie warunki pracy. Fisher 2000.									
	5. Kuźnik J., Regulatory i układy regulacji. Wydawnictwo Politechniki Śląskiej, Gli	wice 2006.								
	1. Fraden J., Handbook of modern sensors-physics, design and applications. Spi	ringer-Verlag 2004								
Supplementary	2. Process industrial instruments and controls handbook. Edited by G. McMillan,	McGraw-Hill 1999.								
references	3 W Melvin: Principles of Modern Radar: Advanced Techniques, SciTech Publis	hia 2013								
	4. PN-EN 60534: Przemysłowe zawory regulacyjne.									
Organisational										
unit conducting the course	Katedra Automatyki i Robotyki	Date of issuing the progr	ramme							
Author of the programme	dr inż. Andrzej Koszewnik	2019-09-23								

				Bia	lystok l	App Iniversit	endix No T i	to the Directive No 915/ nology	2019 of the Rector of BUI			
							ly of reem	Degree level and	full-time Bachelor's			
Field of study		Auto	omatic	Contro	I and R	obotics	i	programme type	degree			
Specjalization / diploma path			CO	mmon s	subject			Study profile	general academic			
Course name		Cor	nnuter	neacur	amont s	vetome		Course code	MYARS05004			
		001		licasui		ystems		Course type	obligatory			
Forms and	L	С	LC	Р	SW	FW	S	Semester	5			
of tuition	15	0	30	0	0	0	0	No. of ECTS credits	4			
Entry requirements		Signal theory										
Course objectives	Familia procest the me	arization sing and asureme	with the d scaling ent syste	methoo methoo m. Ana	ls of mea ds of me lysis of e	asuring p asureme errors and	physical qua ent signals, d uncertain	antities using a compu , their acquisition and ty of measurement.	uter system. Presentation of graphical representation in			
Course content	Sensors - parameters, structure and operating principles. Basic measurement signals - types and characteristics. Measurement errors and uncertainty of measurement. The process of converting analogue signals into digital and digital to analogue signals. Parameters of transducers. Basic principles of creating a program in the LabView environment. Laboratory: Basic principles and methods of programming in the LabView environment. Analysis of signals in real time. Programming of the measurement and control system in a real-time processor. Data representation in graphical / numerical form via a graphical user interface. Measurement, acquisition and representation of real digital and analog signals coming from measurement sensors. Selection of the measurement methodology and determination of the measurement system operation algorithm. Implementation of dedicated applications for acquisition, processing and representation of measurement signals											
Teaching methods	Informa	Informative-problem lecture; Laboratory classes;										
Assessment method	Lecture: one test Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes											
Symbol of learning outcome	Learning outcomes Reference to the learning outcomes for the field of study											
LO1	knows and co	and und mponen	lerstand ts of the	s basic comput	concept erized m	s and is neasuren	able to list nent syster	and classify methods	AR1_W06			
LO2	knows charac	the pa terize th	arametei em	rs of A	. / D (converter	rs, selecte	d sensors and can	AR1_W05 AR1_W06			
LO3	can, w measu physica	/hile ma rement, al quanti	intaining carry ou ties) health ut meas	and sa urement	fety regi s and pro	ulations, cl esent resea	hoose the method of arch results of certain	AR1_U04 AR1_U12			
LO4	knows implem	acquisit ent ther	ion and n in the	process control s	sing algo system	orithms o	f measure	ment signals and can	AR1_W06 AR1_W08 AR1_U04			
Symbol of learning outcome			N	lethods of	assessing	g the learni	ng outcomes		Type of tuition during which the outcome is assessed			
LO1	Lecture	e: one te	st;						W			
LO2	Lecture discuse	e: one sion and	test; L activity	aborato. during t	ry: eva he class	luation es;	of introdu	ctory tests, reports,	W L			
LO3	Labora during	tory: ev	aluation ses;	of intr	oductory	v tests, I	reports, di	scussion and activity	L			
LO4	Lecture	e: one sion and	test; L activity	aborato	ry: eva he class	luation es;	of introdu	ctory tests, reports,	W L			
	Lecture	attand	anco	Student WO	i kioad (in h	ours)						
	Lebora	tory clas		ndanco					30			
	Drepar	ation for		toet(c)					2/			
Calculation	Proper	ation for	laborat	$\frac{100}{200}$	205				24			
	Drepar	ation for	laborat	ory class	505 00m	olotion			<u>ک</u> ل ۵			
	Particir	auon IOI nation in	topohor	studant		picilUII se relator	to the me	dula subject	5			
I	r aruur	σιιστι π	rearing	-ວເບປປ11	1 3533101				0			

	TOTAL	100								
	Quantitative indicators	Hours	ECTS							
	Student workload - activities that require direct teacher participation	50	2							
	Student workload - practical activities	61	2,4							
	1. Nawrocki W., Komputerowe systemy pomiarowe. Politechnika Poznańska, 2007.									
Basic references	2. Materiały szkoleniowe National Instuments. 2013.									
	3. Jakubiec J., Błędy i niepewności danych w systemie pomiarowo-sterującym. Politechnika Śląska, 2010.									
Supplementary	1. Chruściel M., LabView w praktyce, Wydawnictwo BTC, 2008.									
references	2. Halvorsen H. P., LabView Programming - Tutorial, Telemark University College, 2010.									
Organisational unit conducting the course	Katedra Automatyki i Robotyki Date of issuing the programme									
Author of the programme	dr inż. Michał Ostaszewski	2019-09-23								

						App	endix No 1 to	the Directive No 915/2	019 of the Rector of I	BUT
				В	alystok	Univers	ity of Lechr	nology	full flags Dash	
Field of study		Aut	omatic	Contro	ol and R	obotics	6	Degree level and programme type	full-time Bache degree	elor's
Specjalization / diploma path			co	mmon	subject			Study profile	general acade	emic
Course name			Phy	sical or	lucation	ı		Course code	MYARS050)5
			r ny.	Sical et	ucation			Course type	obligatory	1
Forms and	L	С	LC	Р	SW	FW	S	Semester	5	
of tuition	0	30	0	0	0	0	0	No. of ECTS credits	0	
Entry							-			
Course objectives	Interest in physical culture and sporting activity. Developing physical fitness, developing healthy hygiene and health habits that prepare for active leisure time and effective regeneration of the body. Teaching and improving technical and tactical elements in practiced sports disciplines. Getting to know the sports equipment located in the gyms and in the aerobics room and how to use it. Knowing the rules in force at the gyms, enabling safe exercise.									
Course content	Sports applica feature of build Prepara Practica compet	Sports disciplines: futsal, volleyball, basketball, table tennis, aerobics, strength training. Sports regulations applicable in the sports disciplines practiced. Performing a proper warm-up. Shaping the basic motor features. The technique of working on instruments in the gym. Exercises shaping the correct figure. Methods of building muscle mass, shaping strength, power, local strength endurance. Fat reduction methods. Preparation for self-training and arranging the training unit plan in the gym and in the aerobics room. Practical applications of tactics and techniques in practiced sports games. Participation in faculty competitions.								
Teaching methods	Classe	s;								
Assessment method	Classes: two tests									
Symbol of learning outcome	Learning outcomes								Reference to the I outcomes for the fiel	earning d of study
LO1	knows to the p	the rule practice	s of safe of variou	e use of us sport	sports fa s discipli	icilities, e nes	equipment a	nd instruments relate	d AR1_W1	
LO2	applies discipli	the bands the band	asic reg lemente	julation: d durino	s and ta g the cou	ictical a	nd technica e course of t	al elements of sport the physical educatior	S AR1_U01 AR1_U1 1	
LO3	can pra up	actically	apply te	chnical	skills du	ring the	game, carry	out the correct warm	_ AR1_U11 AR1_K03	
LO4	can ap system	ply exer and is	rcises sh ready to	aping ir develo	ndividual p his/her	muscle skills in	parts and fe this area	atures of the muscula	r AR1_W1 AR1_K01	
LO5	can wo activitie implem	ork in a es spor ientatior	team, pa ts game n of task	articipat es and s	es in spo is read	rts comp ly to ad	petition (grou ccept respo	up games) - applies to onsibility for the join	D AR1_U11 AR1_K02	
LO6	can dra knowle	aw up a dge in t	a simplif his area	ied trai	ning plar	n for hin	nself and is	ready to develop hi	S AR1_W1 AR1_U1 1 1	AR1_K0 1
Symbol of learning outcome				Vethods	of assessir	ig the lear	ning outcomes		Type of tuition duri the outcome is as	ng which ssessed
L01	Classe	s: two te	ests;						C	
LO2	Classe	s: two te	ests;						С	
LO3	Classe	s: two te	ests;						C	
LO4	Classe	s: two te	ests;						C	
LO5	Classe	s: two te	ests;						C	
LO6	Classe	s: two te	ests;						С	
				Student w	vorkload (in	hours)			No. of hour	S
	Classe	s attend	lance						30	
Calculation	Prepara	ation for	classes	comple	etion		1.4 .4		6	
	Particip	pation in	teacher	-studer	t sessior	is related	d to the mod	lule subject	5	
								TOTA	LI 41	

	Quantitative indicators	Hours	ECTS							
	Student workload - activities that require direct teacher participation	35	0							
	Student workload - practical activities	41	0							
	 Delavier.F, Gundill M., Modelowanie sylwetki metodą Delaviera: čwiczenia i programy treningu siłowego. PZWL, Warszawa, 2012. Grządziel G., Piłka siatkowa. Wydawnictwo Akademii Wychowania Fizycznego im. Jerzego Kukuczki, Katowice, 2012 									
Basic references	 Kuba L., Paruzel-Dyja M., Fitness: nowoczesne formy gimnastyki: podstawy te instruktorów, studentów i nauczycieli wychowania fizycznego. Wydawnictwo Fizycznego im. Jerzego Kukuczki, Katowice, 2013. Valdericeda F., Futsal: taktyka i ćwiczenia taktyczne. MH, Ruda Śląska, 2012. Wróblewski F. Koszykówka (bistoria, zasady, trening). Dragon Bielsko-Biała 20 	oretyczne: podręc Akademii Wycł	znik dla nowania							
Supplementary references	 Wioblewski F., Roszykowka (historia, zasady, iterining). Dragon, Bielsko-Biała, 2011. Clemenceau J-P., Delavier F., Stretching: ilustrowany przewodnik. PZWL, Warszawa, 2012. Delavier F., Atlas treningu siłowego. PZWL, Warszawa, 2011. Wołyniec J. (red.): Przepisy gier sportowych w zakresie podstawowym. BK, Wrocław, 2006. Wróblewski F., Siatkówka, Dragon, Bielsko-Biała, 2010. 									
Organisational unit conducting the course	Studium Wychowania Fizycznego i Sportu	Date of issuing the prog	ramme							
Author of the programme	dr Piotr Klimowicz	2019-09-23								

				Bialv	stok Uni	Appo iversity c	endix No 1 to f Technolo	the Directive No 915/201	9 of the Rector	of BUT	
				Dialys				9 y Degree level and	full-time Bac	helor's	
Field of study		Aut	omatic	Contro	l and R	obotics		programme type	degree))	
Specjalization / diploma path			cc	ommon s	subject			Study profile	general aca	demic	
Course name			Foreian	languag	e IV En	alish		Course code	MYARS05	006	
Former and			. e.e.g.		,	g	-	Course type	elective	e	
Forms and number of hours	L	C	LC	Р	SW	FW	S	Semester	5		
of tuition	0	30	0	0	0	0	0	No. of ECTS credits	2		
Entry requirements					F	oreign lar	iguage III Ei	nglish			
Course objectives	The use languag English literatur	e of the ge docur on a se re and th	vocabula ments re lected to <u>e Interne</u>	ary of En elated to pic from et regard	glish and the stuc the stud ing the s	d gramma died issue ied specia pecialty s	ar rules to p es. Preparat alty. The ab tudied.	repare complex texts a tion and presentation o ility to interpret informat	nd to interpret of the present ion obtained f	foreign ation in rom the	
Course content	Topics: equipm propert Creatin issues.	Topics: Disasters. Chances. Threats. Materials. Basic concepts of diagnostic techniques and modern equipment. Grammar: Present Simple Tense, form of gerund, infinitive - in description of material properties. The Future Perfect Tense in the active and passive speach. Ways of comparing items. Creating questions. Exam strategies - general repetition and consolidation of lexical and grammatical ssues.									
Teaching methods	Classes	S;									
Assessment method	Eva	aluation	of inter-s	emester	tests; m	ofular tes	ts, written a	nd oral statements, writ	ten and oral e	xam	
Symbol of learning outcome		Learning outcomes								e learning he field of	
LO1	knows stateme	nows and can apply grammatical rules of English to prepare various types of AR1_U10									
LO2	underst	understands and creates complex texts in English related to the field of studies									
LO3	has voo	cabulary	for free	communi	cation				AR1_U10		
LO4	prepare studies	es and p	resents a	a present	tation in	English c	n a selected	d topic from the fields o	f AR1_U10		
LO5	speaks Europe	English an Lang	in acco uage De	ordance scription	with the System	e require	ments set f	for the B2 level of the	AR1_U10		
Symbol of learning outcome				Methods of	of assessir	ng the learn	ing outcomes		Type of tuitio which the out assess	n during tcome is ed	
LO1	Evaluat and ora	tion of in al exam;	ter-seme	ester tes	ts; moful	lar tests,	written and	oral statements, writter	C		
LO2	Evaluat and ora	tion of in al exam;	ter-seme	ester tes	ts; moful	lar tests,	written and	oral statements, writter	C		
LO3	Evaluat and ora	tion of in al exam;	ter-seme	ester tes	ts; moful	lar tests,	written and	oral statements, writter	C C		
LO4	Evaluat and ora	tion of in al exam;	ter-seme	ester tes	ts; moful	lar tests,	written and	oral statements, writter	C		
LO5	Written	exam							С		
	Class			Student w	orkload (in l	hours)			No. of ho	ours	
	Classes	s attenda			noutiete	otion in th	0.010		30		
	Prepara	ation for	ine lectu	re exam	, particip	ation in th	ie exam		10		
Calculation	Prepara			oomalat!	~~				-1		
	Prepara	ation for		completio	n	naleta -l '			6		
	Particip	bation in t	leacher-	students	essions	related to	ine module		5		
				Quantit	ative indicat	tors		IUTAI	- JU Hours	FCTS	
		Studer	nt workload	- activities th	nat require of	direct teache	participation		37	1,5	
										•	

	Student workload - practical activities	40	1,6								
	1. Bonamy D., Technical English 3. Pearson Longman, 2011.										
Basic references	2. Jacques Ch., Technical English 3 Workbook. Pearson Longman, 2011.										
	3. Materiały własne lektora oraz materiały dodatkowe z Internetu.										
	1. Bonamy D., Technical English 2. Pearson Longman, 2008.										
	2. Bonamy D., Technical English 4. Pearson Longman, 2011.										
Supplementary	3. Ibbotson M., Professional English in Use - Engineering, Cambridge University Press, 2009.										
Telefenees	4. McCarthy M., O'Dell F., Academic Vocabulary in Use, Cambridge University Press, 2016.										
	5. Downes C., Cambridge English for Job Hunting, Cambridge University Press, 2008.										
Organisational	Oterliere her him Obrech	Date of issuir	na the								
unit conducting the course	Studium Językow Obcych	programme	5								
Author of the programme	mgr Wojciech Rogalski	2019-09-23									

				Bialy	stok Uni	Appo iversity c	endix No 1 to f Technolo	the Directive No 915/201	9 of the Rector of	of BUT	
				Dialy				Degree level and	full-time Bach	elor's	
Field of study		Aut	omatic	Contro	l and R	obotics		programme type	degree		
Specjalization / diploma path			cc	ommon s	subject			Study profile	general acad	emic	
Course name			Foreian	languag	ie IV Rus	ssian		Course code	MYARS050	07	
E and a			l e e e e e					Course type	elective		
number of hours	L	C	LC	Р	SW	FW	S	Semester	5		
of tuition	0	30	0	0	0	0	0	No. of ECTS credits	2		
Entry requirements					Fo	oreign lan	guage III Ru	ussian			
Course objectives	The use langua Russian the liter	The use of the vocabulary of Russian and grammar rules to prepare complex texts and to interpret foreign language documents related to the studied issues. Preparation and presentation of the presentation in Russian on a selected topic from the studied specialty. The ability to interpret information obtained from the literature and the Internet regarding the specialty studied.									
Course content	Topics: declara technol with no	Topics: Traveling. Use of urban, rail, air and water transport. Customs clearance - Russian customs declaration. Hotel offers and customer requirements. Specialist part: basic concepts from modern technologies. Grammatical issues: Irregular and immutable nouns. Verbs for movement. Numerals 2,3,4 with nouns and adjectives. Use of prepositions and adverbs.									
Teaching methods	Classes	s;									
Assessment method	Eva	aluation	of inter-s	emester	tests; m	ofular tes	ts, written a	nd oral statements, writ	ten and oral ex	am	
Symbol of learning outcome	Learning outcomes								Reference to the outcomes for the study	Reference to the learning outcomes for the field of study	
LO1	knows and can apply grammatical rules of the Russian language to prepare various types of statements								AR1_U10	AR1_U10	
LO2	understands and creates complex texts in Russian related to the fields of studies								AR1_U10		
LO3	has vocabulary for free communication							AR1_U10			
LO4	prepare studies	es and p	resents a	a presen	tation in	Russian	on a selecte	ed topic from the field o	f ^{AR1_U10}		
LO5	speaks Europe	Russia an Lang	n in acc uage De	ordance scription	with the System	e require	ments set	for the B2 level of the	AR1_U10		
Symbol of learning outcome				Methods	of assessi	ng the learn	ing outcomes		Type of tuition which the outo assesse	Type of tuition during which the outcome is assessed	
LO1	Evaluat and ora	tion of in al exam;	ter-seme	ester tes	ts; moful	lar tests,	written and	oral statements, writter	C		
LO2	Evaluat and ora	tion of in al exam;	ter-seme	ester tes	ts; moful	lar tests,	written and	oral statements, writter	C		
LO3	Evaluat and ora	tion of in al exam;	ter-seme	ester tes	ts; moful	lar tests,	written and	oral statements, writter	C		
LO4	Evaluat and ora	tion of in al exam;	ter-seme	ester tes	ts; moful	lar tests,	written and	oral statements, writter	C		
LO5	Written	exam							С		
				Student w	orkload (in	hours)			No. of hou	Irs	
	Classes	s attenda				-flam != 11			30		
	Prepara	ation for	the lectu	re exam	; particip	ation in th	ie exam		10		
Calculation	Prepara	ation for	classes	l - 4:					-1		
	Prepara	ation for		completi		rolotod	the medul	aubicat	<u>ь</u>		
	Panicip	auonin	leacher-	Singent	Sessions				5		
				Quantit	ative indica	tors		TOTAL	- DU Hours	ECTS	
		Studer	nt workload	- activities t	hat require of	direct teache	· participation		37	1,5	
			Stu	ident worklo	ad - practic	al activities			40	1,6	

	1. Cieplicka M., Torzewska W., Русский язык. Kompendium tematyczno-leksykalne 2007.	1. Wagros, Poznań,						
Basic references	2. Cieplicka M., Torzewska W., Русский язык. Kompendium tematyczno-leksykalne 2. Wagros, Poznań, 2008.							
	3. Chwatow S., Hajczuk R., Русский язык в бизнесе, WSiP, Warszawa, 2000.							
	4. Granatowska H., Danecka I., Как дела ? 2. Wydawnictwo Szkolne PWN, Warszawa, 2003.							
	5. Milczarek W., Język rosyjski od A do Z. Repetytorium. Kram, Warszawa, 2007.							
	1. Н.В.Баско, Изучаем русский, узнаём Россию. Издательство Флинта: Наука, Москва 2006.							
	2. Kowalska N., Samek D., Praktyczna gramatyka języka rosyjskiego. REA, Warszawa, 2004.							
Supplementary	Materiały z rosyjskojęzycznych portali internetowych, prasy i książek.							
references	4. Samek D., Rozmówki polsko-rosyjskie. REA, Warszawa, 2009.							
	5.Słownik naukowo-techniczny rosyjsko-polski. Wydawnictwa Naukowo-Techniczne, Warszawa, 1999;							
	Materiały z rosyjskojęzycznych portali internetowych, prasy i książek.							
Organisational unit conducting	Studium Jezyków Obcych	Date of issuing the						
the course		programme						
Author of the programme	mgr Irena Kamińska	2019-09-23						

				Bialv	stok Uni	Appo iversity c	endix No 1 to f Technolo	the Directive No 915/201	9 of the Rector	of BUT
								Degree level and	full-time Bacl	helor's
Field of study		Aut	omatic	Contro	I and R	obotics		programme type	degree	
Specjalization / diploma path			co	ommon s	subject			Study profile	general acad	demic
Course name			Foreian	languag	ie IV Gei	rman		Course code	MYARS05	008
Formo and				jj			0	Course type	elective	;
number of hours	L	C	LC	P	SW	FW	S	Semester	5	
of tuition	0	30	0	0	0	0	0	No. of ECTS credits	2	
requirements					Fo	oreign lan	guage III Ge	erman		
Course objectives	The use languag German the liter	The use of the vocabulary of German and grammar rules to prepare complex texts and to interpret foreign language documents related to the studied issues. Preparation and presentation of the presentation in German on a selected topic from the studied specialty. The ability to interpret information obtained from the literature and the Internet regarding the specialty studied.								
Course content	Topics: comput modern simple infinitive	Topics: Rights and obligations, expressing complaints (written and oral); modern electronic media, computer language; presentation of a selected technical problem. Specialist part: basic concepts from modern technologies. Grammar: participles I and II (function of the attribute); passive voice; building a simple and complex sentence (repetition); word formation (compound nouns, verbal and adjective nouns); infinitive constructions, occasional sentences of cause and purpose.								
Teaching methods	Classes	S;								
Assessment method	Eva	aluation	of inter-s	emester	tests; m	ofular tes	ts, written a	nd oral statements, writ	ten and oral e	xam
Symbol of learning outcome	Learning outcomes							Reference to the outcomes for the study	e learning te field of	
LO1	knows and can apply grammatical rules of the German language to prepare variou types of statements								AR1_U10	
LO2	understands and creates complex texts in German related to the fields of studies							AR1_U10		
LO3	has vocabulary for free communication							AR1_U10		
LO4	prepare studies	es and p	resents	a presen	tation in	German	on a selecte	ed topic from the field o	f ^{AR1_U10}	
LO5	speaks Europe	Germai an Lang	n in acc uage De	ordance scription	with the System	e require	ments set	for the B2 level of the	AR1_U10	
Symbol of learning outcome				Methods of	of assessir	ng the learn	ing outcomes		Type of tuition which the out assess	n during come is ed
LO1	Evaluat and ora	tion of in al exam;	ter-seme	ester tes	ts; moful	lar tests,	written and	oral statements, writter	C	
LO2	Evaluat and ora	tion of in al exam;	ter-seme	ester tes	ts; moful	lar tests,	written and	oral statements, writter	C	
LO3	Evaluat and ora	tion of in al exam;	ter-seme	ester tes	ts; moful	lar tests,	written and	oral statements, writter	C	
LO4	Evaluat and ora	tion of in al exam;	ter-seme	ester tes	ts; moful	lar tests,	written and	oral statements, writter	C	
LO5	Written	exam		<u>.</u>					C	
	Classes	oottood		Student w	orkload (in l	hours)			No. of ho	urs
	Droport	s allenda	the leafu		nartiain	ation in th			30	
	Prenar	ation for	uie ieclu classos		, particip	au011 111 [[ie exalli		1	
Calculation	Propara	ation for	classon	completi	n				 A	
	Particin	ation in	leachar-	student e	sessione	related to	the module	subject	5	
					0000010			TOTAI	50	
				Quantit	ative indicat	tors			Hours	ECTS
		Studer	nt workload	- activities the	nat require o	direct teache	r participation		37	1,5

	Student workload - practical activities	40	1,6							
	1. Perlmann-Balme, Schwalb M., Matussek S. M., Sicher! Deutsch als Fremdsp	orache: Niveau	J B2:							
Basic references	Kursbuch und Lektion 1-12, München, Hueber Verlag, 2014.									
	2. Steinmetz M., Heiner D., Deutsch für Ingenieure, Springer Vieweg 2014.									
	3. Ch. Kuhn, R.M. Niemann, B. Winzer-Kiontke: studio d - Die Mittelstufe B2, Cornelsen Verlag 2010.									
	4. Hagner V., Schlüter S., Im Beruf Kurs- und Arbeitsbuch, Hueber Verlag 2014.									
	1. Omelianiuk W., Ostapczuk H., Sach- und Fachtexte auf Deutsch, Teil 2, Polite	chnika Białost	ocka,							
	Białystok, 2010.									
Supplementary	2. Zespół red. Sokołowska M., Bender A., Żak K., Słownik naukowo-techniczny niemiecko-polski,									
references	Wydawnictwa Naukowo-Techniczne 2007.									
	3. Materiały własne prowadzącego (adaptowane i opracowane teksty z literatur	y fachowej o	raz z							
	Internetu).									
Organisational	Studium Jozyków Obovob	Date of issuin	g the							
the course		programme	-							
Author of the programme	mgr Wioletta Omelianiuk	2019-09-23								

	Appo Bialystok University	ndix No 1 t	o the Directive No 915/2	019 of the Rector of BU	T							
			Degree level and	full-time Bachelor's								
Field of study	Automatic Control and Robotics		programme type	degree	,							
Specjalization / diploma path	mobile robots		Study profile	general academic								
Course name	Pohotics		Course code	MYARS15001								
	Kobolics		Course type	elective								
Forms and	L C LC P SW FW	S	Semester	5								
of tuition	30 0 0 30 0 0	0	No. of ECTS credits	5								
Entry requirements	Mathematics II, Kinematics and dynar	Mathematics II, Kinematics and dynamics of mechanisms, Fundamentals of robotics										
Course objectives	Gaining knowledge about the kinematics and dynamics of manipulators and learning about the tools and methods for determining the dynamics for a serial kinematic chain of a manipulator with rigid members. Introduction of numerical methods for determination of the forward and inverse kinematics of robots. Introduction of trajectory planning and generation methods. Introduction to the basics of robot modelling.											
Course content	Lecture: Denavit-Hartenberg parameters for any manipulator configuration; speed and acceleration of the manipulator links; Jacobian of the manipulator; open form of the Jacobian, singularities. Dynamics: Newton-Euler algorithm, Lagrange formalism; the inertia matrix, the general form of the manipulator motion equations; generating a trajectory. Kinematics and inverse dynamics of the manipulator Project: Calculation of inverse and forward dynamics of a specified robot configuration. Modelling and visualization of a robot in RobWork, Rviz and Gazebo. Implementing numerical methods of kinematics. Methods of planning and interpolation of trajectories. Time-optimal trajectories and collision avoidance. Effective methods of collision detection.											
Teaching methods	nformative-problem lecture; Project classes;											
Assessment method	Lecture: exam Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes											
Symbol of learning outcome	Learning outcomes Reference to the learning outcomes for the field of stu											
LO1	knows how to determine the Jacobian of the man	pulator an	d its singularities	AR1_W02 AR1_001								
LO2	understands the structure of the manipulator's dy	namics		AR1_W02 AR1_U01								
LO3	knows the methods of obtaining motion equations			AR1_W02 AR1_U01								
LO4	can implement trajectory planning methods			AR1_W02 AR1_U01								
LO5	can model and visualize a robot manipulator			AR1_U03 AR1_U11								
Symbol of learning outcome	Methods of assessing the learning	g outcomes		Type of tuition during wh the outcome is assessed	iich ed							
LO1	Lecture: exam;			W								
LO2	Lecture: exam;			W								
LO3	Lecture: exam; Project: evaluation of project of project completion, discussion and activity during	completion the classe	, current progress in s:	W P								
LO4	Lecture: exam; Project: evaluation of project project completion, discussion and activity during	completion the classe	, current progress in s;	W P								
LO5	Project: evaluation of project completion, current discussion and activity during the classes;	progress	in project completion,	P								
	Student workload (in hours)			No. of hours								
	Deciure allendance			30								
	Properties for the lecture events perticipation in the	00.020		30								
Coloulation	Preparation for the recture exam; participation in t	ie exam		19								
Calculation	Marking on project (including properties of any	ontotions		10								
	Propagation for projects (including preparation of pres	entations)		12								
	Preparation for projects completion	o the meat	ula aubicat	[E								
	ranicipation in teacher-student sessions related t			5								

	TOTAL	125					
	Quantitative indicators	Hours	ECTS				
	Student workload - activities that require direct teacher participation						
	Student workload - practical activities						
Basic references	 Craig J. J., Wprowadzenie do robotyki. Mechanika i sterowanie. WNT, Warszawa 2. Kozłowski K., Dutkiewicz P., Wróblewski W., Modelowanie i sterowanie robotów. Buratowski T., Podstawy robotyki. AGH Uczelniane Wydawnictwo Naukow 2006. Jezierski E., Dynamika robotów. WNT, Warszawa 2006. 	a 2003. . PWN, Warszawa o-Dydaktyczne, Ki	2003. raków				
Supplementary references	1. Leyko J., Mechanika ogólna, t. II, Dynamika. PWN, Warszawa 2006. 2. Spong M. W., Vidyasagar M., Dynamika i sterowanie robotów, WNT, Warszawa	1997.					
Organisational unit conducting the course	Katedra Automatyki i Robotyki	Date of issuing the prog	ramme				
Author of the programme	dr inż. Adam Wolniakowski	2019-09-23					

				Bial	vstok II	App niversity	endix No 1	to the Directive No 915/. Nany	2019 of the	Rector of I	BUT
		• •					of recim	Degree level and	full-time	Bachelo	or's
Field of study		Auto	omatic	Contro	l and R	obotics		programme type	d	egree	
diploma path			n	nobile ro	obots			Study profile	genera	l academ	nic
Course name		Signa	Inroces	sina sv	stems iı	n robotic	e.	Course code	MYA	RS15002	2
		oigila	i proces	Sing Sy				Course type	el	ective	
Forms and number of hours	L	C	LC	P	SW	FW	S	Semester		5	
of tuition	15	0	0	15	0	0	0	No. of ECTS credits		3	
Entry requirements				Si	gnal the	ory, Com	puter mea	surement systems			
Course objectives	Acquainting with selected techniques of analog and digital signal processing. Ability to implement selected algorithms of digital signal processing. Ability to design analog and digital filters for various applications.										
Course content	Lecture finite ir robotics Comple techniq comple	Lecture: Signal conversion. The structure of the analogue and digital signal processing system. Filters with finite impulse response (FIR) and infinite impulse response (IIR) - their properties and application in robotics. Matching filtration. Smoothing filters. Kalman filter. Estimation of traffic parameters. Complementary filter to measure orientation. Processing of random signals in linear systems. Advanced techniques for sampling complex signals. Project: Implementation of FIR, IIR filters, adaptive, complementary and Kalman filters as well as testing their properties.									
Teaching	Informa	ative-pro	blem lec	ture; Pro	oject clas	sses;	<u> </u>	1			
Assessment method	Leo Pro act	Lecture: exam Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes									
Symbol of learning outcome	Learning outcomes						Referer outcomes	ce to the lea for the field o	rning of study		
LO1	knows the basics of signal processing in robotics								AR1_W06		,
LO2	can characterize and apply learned methods, software and hardware tools f signal processing in robotics							AR1_W06			
LO3	can design and analyze simple analog signal processing circuits and numerical AR methods for design and analysis of digital circuits							AR1_U06	AR1_W06		
LO4	can inte	eract and	d work ir	n a group	taking	different	roles		AR1_K05		
Symbol of learning outcome			Ν	lethods of	assessin	g the learni	ng outcomes		Type of to the outc	uition during	g which essed
LO1	Lecture project	e: exam complet	; Projec ion, disc	t: evalua cussion a	ation of and activ	project ity during	completion the classe	n, current progress ir es;	^N W	Р	
LO2	Lecture project	e: exam complet	; Projec ion, disc	t: evalua	ation of and activ	project ity during	completior the classe	n, current progress ir es;	^N W	Р	
LO3	Lecture project	e: exam complet	; Projec ion, disc	t: evalua cussion a	ation of and activ	project ity during	completior the classe	n, current progress ir es;	¹ W	Р	
LO4	Project discuss	: evalua sion and	tion of p activity	project co during th	ompletio le classe	n, curren es;	t progress	in project completion	3	Р	
	1.4.1	- 44 ¹		Student wo	rkload (in h	ours)			N	o. of hours	
	Lecture	attenda								15	
	Project	attenda	nce				46.0			15	
	Prepara	ation for	the lectu	ure exan	i; partici	pation in	the exam			14	
Calculation	Prepara	ation for	project o			on -f		<u>۱</u>		15	
	VVORKIN	y on pro			heparati	on of pre	sentations)		0	
	Prepara	auon tor	projects	comple		o rolatad	to the mere	lula aubient	-	3 F	
	Particip	Dation in	leacher-	-student	session	s related	to the mod	UUE SUDJECI T∩T∆I	+	ວ 75	
				Quantita	tive indicate	ors		IUTAL	- Hr	ours	ECTS
		Student	workload - a	activities the	at require di	rect teacher	participation		3	57	1,5
			Stud	ent workloa	d - practica	l activities			4	-6	1,8
Basic references	1. Zielii	ński T., (Cyfrowe	przetwa	rzanie sy	ygnałów.	Od teorii c	lo zastosowań, WKŁ, V	Varszawa	2009.	

	 Lyons R., Wprowadzenie do cyfrowego przetwarzania sygnałów. WKŁ, Warszaw Szabatin J., Podstawy teorii sygnałów. WKŁ, Warszawa 2003. Smith S. W., Cyfrowe przetwarzanie sygnałów. Praktyczny poradnik dla inżynie 2007. Stranneby D., Cyfrowe przetwarzanie sygnałów. BTC, 2004. 	va 2010. erów i naukowców, BTC,
Supplementary references	 Kwiatkowski W., Wstęp do cyfrowego przetwarzania sygnałów, Instytut Autor Warszawa, 2003. Wojciechowski J. M., Sygnały i systemy, Wydawnictwa Komunikacji i Łączności 3. Mallat S., A Wavelet Tour of Signal Processing. The Sparse Way, Elsevier, 2009 Schilling R.J., Harris S.L., Introduction to digital signal processing using MATL 2012. 	natyki i Robotyki, WAT, WKŁ, 2008.). .AB, Cengage Learning,
Organisational unit conducting the course	Katedra Automatyki i Robotyki	Date of issuing the programme
Author of the programme	dr hab. inż. Jolanta Pauk, prof. PB	2019-09-23

				Ria	alvetok I	<i>App</i> Inivorcif	endix No 1 t	o the Directive No 91.	5/2019 of the	Rector of	BUT	
				Did	IIYSLOK L	Jiiversi	ly of rechi		£	- Deebe	lor'o	
Field of study		Auto	matic	Contro	l and R	obotics	i	Degree level and programme type	tuii-tin	le Bache degree	IOPS	
Specjalization / diploma path			m	obile ro	obots			Study profile	gener	al acade	mic	
Course name			Progra	ammina	of robo	te		Course code	MY	ARS1500	3	
			Trogre			1.5		Course type	(elective		
Forms and	L	С	LC	Р	SW	FW	S	Semester		5		
of tuition	15	0	30	0	0	0	0	No. of ECTS credits		4		
Entry requirements	Programming in C, Fundamentals of robotics											
Course objectives	Introduction to the basic robot task types. Introduction to the robot programming methods and languages. Introducing the on-line and off-line robot programming tools and environments. Planning and programming tasks and trajectories for manipulators and mobile robots.											
Course content	 Wykrad: Planowanie zadan. Planowanie trajektorii w przestrzeni złącz i kartezjańskiej. Programowanie off- line i on-line. Wymagania stawiane językom programowania robotów. Języki programowania, m.in. Python, URScript, AS, MELFA-BASIC IV. Opis wybranych środowisk do programowania robotów off-line, m.in. RobWork i ROS. Podstawy programowania manipulatorów. Obsługa urządzeń peryferyjnych. Zagadnienia związane z programowaniem robotów mobilnych. Laboratorium: Praktyczne programowanie robotów o różnych konfiguracjach. Lecture: Task planning. Trajectory planning in the joint and cartesian space. Off- line and on-line programming. Requirements for programming languages of robots. Programming languages, e.g. Python, Mikro V+, AS, MELFA-BASIC IV. Description of selected environments for programming off-line robots, e.g. RobWork and ROS. Basics of programming the manipulators. Support for peripheral devices. Issues related to programming of mobile robots. Laboratory: Practical programming of robots of various configurations. 											
Teaching	Informa	Informative-problem lecture: Laboratory classes:										
methods		turo: on	o tost	,			,					
method		oratory	e test . ovalua	tion of in	stroducto	ny toete	ronorte dia	scussion and activity	during the	classos		
Symbol of	Lau	oratory	evalua			i y 16313,	Tepono, un	scussion and activity	Refere	ence to the le	arning	
learning outcome					Learning	outcomes			outcome	outcomes for the field of study		
LO1	knows a	and des	cribes m	nethods	of motio	n trajecto	ory planning	9	AR1_W02			
LO2	knows a	and und	erstand	s robot p	orogramr	ning met	thods		AR1_W02	AR1_W06		
LO3	charact progran	erizes nming, o	key p can use	barameto them in	ers of practice	selecte	ed enviror	nments for off-lir	e ^{AR1_W05}	AR1_U04		
LO4	can, pre	eserving) health	and safe	ety regula	ations, p	rogram a ro	bot movement	AR1_W08	AR1_U04	AR1_U12	
Symbol of learning outcome			Μ	lethods of	fassessing	the learni	ng outcomes		Type of tu outco	ition during	which the essed	
LO1	Lecture	: one te	st;						W			
LO2	Lecture	: one te	st;						W			
LO3	Lecture discuss	: one ion and	test; L activity	aborato. during t	ry: eval	luation es;	of introdu	ctory tests, report	s, W	L		
LO4	Laborat	tory: ev	aluation	of intr	oductory	tests, i	reports, dis	scussion and activi	ty	L		
	during t	ne class	<u>ses,</u>	Student wo	orkload (in h	ours)				No. of hours		
	Lecture	attenda	ance			0013)				15		
	Laborat	tory clas	ses atte	ndance						30		
	Prenara	ation for	lecture	test(s)						24		
Calculation	Prenara	ation for	lahorate	nry class	Ses					27		
Carculation	Prenara	ation for	laborate	ny class	ses com	letion				6		
	Particin	ation in	teacher	-studant	t speeinn	s relater	to the mov	tule subject		5		
			Gaund	−งเนนธ∏	1 30331011				J	100		
				Quantita	tive indicato	ors		1017	м ш На	urs	ECTS	
		Student v	vorkload - a	activities the	at require di	rect teacher	r participation		5	0	2	

	Student workload - practical activities									
	1. Kaczmarek W., Panasiuk J., Programowanie robotów przemysłowych. PWN, Warszawa, 2017.									
Basic references	2. Kaczmarek W., Panasiuk J., Borys S., Środowiska programowanie robotów. PWN, Warszawa, 2017.									
	3. Hughes C., Hughes T., Programowanie robotów: sterowanie praca robotów autonomicznych. Helion,									
	Gliwice, 2017.									
	1. Honczarenko J., Roboty przemysłowe: budowa i zastosowanie. WNT, Warszawa, 2011.									
Supplementary	2. Murphy R.R., Disaster robotics. The MIT Press, London, 2014.									
references	3. Stone P., Intelligent autonomous robotics: a robot soccer case study. Morgan a Claypool Publishers,									
	Warszawa, 2007.									
Organisational										
the course	Katedra Automatyki i Robotyki	Date of issuing the prog	ramme							
Author of the programme	dr inż. Adam Wolniakowski	2019-09-23								

Appendix No 1 to the Directive No 915/2019 of the Rector of BUT Bialvstok University of Technology											
Field of study		Auto	omatic (Control	and R	obotics		Degree level and programme type	full-time Bachelor's degree		
Specjalization / diploma path	au	ıtomatio	on and co	ompute	rization	of proce	sses	Study profile	general academic		
Course name				Pohoti	00			Course code	MYARS25001		
		1		RUDUI	65	1	r	Course type	elective		
Forms and number of hours	L	С	LC	Р	SW	FW	S	Semester	5		
of tuition	30	0	15	30	0	0	0	No. of ECTS credits	7		
requirements		Mat	hematics	s II, Kine	matics a	nd dynar	nics of me	chanisms, Fundamen	tals of robotics		
Course objectives	Gaining knowledge about the kinematics and dynamics of manipulators and learning about the tools and methods for determining the dynamics for a serial kinematic chain of a manipulator with rigid members. Introduction of numerical methods for determination of the forward and inverse kinematics of robots. Introduction of trajectory planning and generation methods. Introduction to the basics of robot modelling.										
Course content	Lecture: Denavit-Hartenberg parameters for any manipulator configuration; speed and acceleration of the manipulator links; Jacobian of the manipulator; open form of the Jacobian, singularities. Dynamics: Newton-Euler algorithm, Lagrange formalism; the inertia matrix, the general form of the manipulator motion equations; generating a trajectory. Kinematics and inverse dynamics of the manipulator Project: Calculation of inverse and forward dynamics of a specified robot configuration. Modelling and visualization of a robot in RobWork, Rviz and Gazebo. Implementing numerical methods of kinematics. Methods of planning and interpolation of trajectories. Time-optimal trajectories and collision avoidance. Effective methods of collision detection. Laboratory: Programming of industrial manipulators.										
Teaching methods	Informa	nformative-problem lecture; Laboratory classes; Project classes;									
Assessment method	Lecture: exam Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes										
Symbol of learning outcome					Learning	outcomes			Reference to the learning outcomes for the field of study		
LO1	knows	how to d	etermine	e the Jac	obian of	f the man	ipulator a	nd its singularities	AR1_W02 AR1_U01		
LO2	underst	tands the	e structur	re of the	manipu	lator's dy	namics		AR1_W02 AR1_U01		
LO3	knows	the meth	ods of o	btaining	motion	equations	6		AR1_W02 AR1_U01		
LO4	determ	ines mot	ion equa	tions of	a manip	ulator			AR1_W02 AR1_U01		
LO5	can, w movem	/hile ma ients	intaining	health	and s	afety reo	gulations,	program manipulato	r AR1_U03 AR1_U11		
LO6	can det	termine t	he Jacol	bian and	singula	rities of th	ne manipu	lator	AR1_W02 AR1_U01		
Symbol of learning outcome			М	lethods of	assessing	the learnir	ng outcomes	3	Type of tuition during which the outcome is assessed		
L01	Lecture	e: exam;							W		
LO2	Lecture	e: exam;	<u> </u>						W		
LO3	Lecture project	e: exam; completi	Project ion, disc	: evalua ussion a	nd activi	project of the sector of the s	the class	n, current progress ir es;	W P		
LO4	Lecture project	e: exam; completi	Project ion, disc	: evalua ussion a	ation of nd activi	project (ity during	completion the class	n, current progress ir es;	¹ WP		
LO5	Project discuss	: evaluat sion and	tion of pr activity c	roject co luring th	ompletion e classe	n, curren [:] s;	t progress	in project completion	' P		
LO6	Labora the clas	tory: eva sses;	luation o	of introdu	ictory te	sts, repor	ts, discus	sion and activity during	L		
LO7	Laboration the class	tory: eva sses;	luation o	of introdu	ictory te	sts, repor	ts, discus	sion and activity during) L		
			ę	Student wor	kload (in ho	ours)			No. of hours		

	Lecture attendance	30								
	Laboratory classes attendance	15								
	Project attendance	30								
	Preparation for the lecture exam; participation in the exam	24								
Calculation	Preparation for laboratory classes	19								
	Preparation for laboratory classes completion	3								
	Preparation for project classes	28								
	Working on projects (including preparation of presentations)	12								
	Preparation for projects completion	9								
	Participation in teacher-student sessions related to the module subject	5								
	175									
	Hours	ECTS								
	Student workload - activities that require direct teacher participation	82	3,3							
	Student workload - practical activities	121	4,8							
	1. Craig J. J., Wprowadzenie do robotyki. Mechanika i sterowanie. WNT, Warszawa 2003.									
	2. Kozłowski K., Dutkiewicz P., Wróblewski W., Modelowanie i sterowanie robotów. PWN Warszawa 2003.									
Pasia references	3. Morecki A., Podstawy robotyki. Teoria manipulatorów i robotów, WNT, Wydawnictwo poprawione,									
Dasic references	Warszawa, 2002.									
	4. Spong M. W., Vidyasagar M., Dynamika i sterowanie robotów. WNT, Warszawa, 2000.									
	5. Jezierski E., Dynamika robotów. WNT, Warszawa 2006.									
Supplementary	1. Leyko J., Mechanika ogólna, t. II, Dynamika. PWN, Warszawa 2006.									
references	2. Cannon R.H., Dynamika układów fizycznych. WNT, Warszawa, 1973.									
Organisational	Katada Automatuki Dabatuki	Data affinition the								
the course	Kaleora Automatyki i Robolyki	Date of issuing the prog	ramme							
Author of the	dr inż. Adam Wolniakowski	2019-09-23								
programme										

			Bialveto	<u>Ap</u>	<u>pendix No 1 t</u>	to the Directive No 915	5/2019 of the Rector of BUT		
Field of study	Automatic Control and Robotics					Degree level and programme type	full-time Bachelor's degree		
Specjalization / diploma path	automation and computerization of processes					Study profile	general academic		
						Course code	MYARS25002		
Course name	Mod	eling and si	mulation of c	ontrol sys	Course type	elective			
Forms and	L	C LC	P SW	FW	S	Semester	5		
number of nours of tuition	30	0 0	30 0	0	0	No. of ECTS credits	5		
Entry requirements		i	Fundame	entals of p	process contr	ol, Programming in (2		
Course objectives	Familiarizing with general characteristics of computer programs used in automation. Familiarizing with the use of MATLAB / Simulink software for performing numerical calculations, writing functions and m-files, modeling differential equations, linear and nonlinear control plants, designing linear and linear-quadratic algorithms, simulation analysis of control plants and systems, displaying and representing results of calculations and simulations.								
Course content	Lecture: Characteristics and functions of computer programs used in robotics and process automation. Computer tools and methods for designing control systems in MBD technology. Application of MATLAB / Simulink tools in Internet of Things solutions. Basics of calculations and simulations in the MATLAB / Simulink environment, s-functions, m-files, graphics. Writing the motion equations of objects to the transfer function model, state space model and zero-pole-gain model. Designing of PID controllers, lead-lag compensators, LQR controllers and controllers determined by the pole placement method in the MATLAB / Simulink environment. Methods of automatic generation of C codes and implementation in embedded systems from MATLAB / Simulink level (including support for libraries, PLC, Arduino, Raspberry PI, LEGO, NI-DAQmx and FPGA chips). Conducting HIL simulations. Methods of rapid prototyping of control algorithms in the field of robotics and automation from the MATLAB / Simulink level. Functions for analysis of control systems in time and frequency domain, including square root lines. Functions for identifying control objects and for processing data measured from the MATLAB / Simulink level. Project: Modeling and testing of automation systems and components using MATLAB Control Toolbox. Modeling of LTI systems. Programming test signals. Analysis of systems in the field of time and frequency. Design and simulation of automation systems in the Simulink environment. Conducting simulation. Designing a linear control system with a structurally unstable plant. Designing PID controllers. Designing lead-lag compensator. Designing								
Teaching methods	Informative-problem lecture; Project classes;								
Assessment method	Lecture: exam Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes								
Symbol of			Learr	ning outcome	s		Reference to the learning		
LO1	knows the technology	tools, meth	ods and funct	ions for d	lesigning cor	ntrol systems in MBI	AR1_W04 AR1_W05 AR1_U07		
LO2	knows an equations	d can use given with d	computer me ifferential or di	ethods fo	or modeling linear / nonlir	and solving motio near equations	n AR1_W05 AR1_W07 AR1_U04		
LO3	knows a representa	nd can ap ations in the	oply methods form of linear i	to des nodels in	sign control the MATLAE	I plants and the 3 / Simulink program	ir AR1_W04 AR1_W07 AR1_U03		
LO4	can mode Simulink e	I automatior	1 and robotics	plants a	nd systems	using the MATLAB	/ AR1_U01		
LO5	can use i program	nethods for	designing co	ntrol syst	tems in the	MATLAB / Simulin	k AR1_U04 AR1_U03		
LO6	is ready engineerir	to critically g problems	evaluate his/h	ner know	ledge of co	omputer methods fo	r AR1_K01		
Symbol of learning outcome		Ν	lethods of assess	ing the lear	ning outcomes		Type of tuition during which the outcome is assessed		
LO1	Lecture: e project co	xam; Projec	t: evaluation	of project	t completion ing the class	, current progress i es;	ⁿ W P		

LO2	Lecture: exam; Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	W P					
LO3	Lecture: exam; Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	W P					
LO4	Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	Р					
LO5	Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	Р					
LO6	Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	Р					
	No. of hours						
Calculation	Lecture attendance	30					
	Project attendance	30					
	Preparation for the lecture exam; participation in the exam	19					
	Preparation for project classes	22					
	Working on projects (including preparation of presentations)	12					
	Preparation for projects completion	7					
	Participation in teacher-student sessions related to the module subject	5					
	TOTAL	125					
	Hours	ECTS					
	67	2,7					
	76	3					
Basic references	 Mrozek B., Mrozek Z., MATLAB i Simulink: poradnik użytkownika, Wydawnictwo Helion, Gliwice, 2004. Łysakowska B., Mzyk G., Komputerowa symulacja układów automatycznej regulacji w środowisku MATLAB/Simulink, Oficyna Wydawnictwo Politechniki Wrocławskiej, 2005. Ogata K., Modern Control Engineering, 4th ed., Pearson Education International, 2002. Webminaria, tutoriale na serwerach: www.ont.com.pl, www.mathworks.com Łysakowska B., Mzyk G., Komputerowa symulacja układów automatycznej regulacji w środowisku MATLAB/Simulink, Oficyna Wydawnicza Politechniki Wrocławskiei. 2005. 						
Supplementary references	 Tewari A., Modern Control Design: With MATLAB and Simulink, Wiley-IEEE Press, 2001. Hahn B., Valentine D. T., Essential MATLAB for Engineers and Scientists, 3rd ed., Elsevier Science & Technology Books, 2007. Bequette B.W., Process Control, Modeling, Design and Simulation, Prentice Hall, 2003. 						
Organisational		Date of issuing the programme					
the course	Katedra Automatyki i Robotyki	Date of issuing the progr	ramme				