Bialystok University of Technology									
Field of study	**Automatic Control and Robotics**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**common subject**							Study profile	**general academic**
Course name	**Visualization of industrial processes**							Course code	**MYARS05001**
								Course type	**obligatory**
Forms and number of hours of tuition	L	C	LC	P	SW	FW	S	Semester	**5**
	15	**0**	**0**	**30**	**0**	**0**	**0**	No. of ECTS credits	**4**
Entry requirements	Programming of PLCs								
Course objectives	Acquainting with visualization systems used in industrial applications on the example of SCADA - InTouch Wonderware.								
Course content	Lecture: Ways 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 methods	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 study
LO1	knows and understands the basic concepts in the field of visualization of industrial processes	AR1_W04 AR1_W07
LO2	knows the structure of visualization systems and methods of communication between them	AR1_W04 AR1_W07
LO3	has knowledge of the type of data and principles of data use in visualization systems	AR1_W04 AR1_W05
LO4	can use graphic elements and program/configure them	AR1_U03
LO5	can configure scripts and implement them in visualization systems	AR1_U03
LO6	can create individual and team projects	AR1_U11

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	Lecture: one test;	W
LO2	Lecture: one test;	W
LO3	Lecture: one test;	W
LO4	Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	P
LO5	Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	P
LO6	Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	P

Student workload (in hours)		No. of hours
Calculation	Lecture attendance	15
	Project attendance	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
	TOTAL	100

Quantitative indicators	Hours	ECTS
Student workload - activities that require direct teacher participation	50	2
Student workload - practical activities	71	2,8

Basic references	1. Podręczniki szkoleniowe. In Touch cz. 1. Tworzenie i serwisowanie aplikacji. Astor Kraków 2010. 2. Podręczniki szkoleniowe. In Touch cz. 2. Zagadnienia zaawansowane. Astor Kraków 2011. 3. Dzierżek K., Programowanie sterowników PLC GE-Fanuk. Wydawnictwo PB, Białystok 2007.
Supplementary references	1. Tworzenie i zarządzanie symbolami ArchestrA - podręcznik użytkownika. Astor, Kraków 2009. 2. In Touch 9.5. Podręcznik użytkownika. Tłumaczenie z angielskiego. Astor Kraków 2006. 3. In Touch – Opis funkcji, pól i zmiennych systemowych. Tłum. z angielskiego. Astor Kraków 2006. 4. InTouch HMI Application Management and Extension Guide. Wonderware 2013. 5. InTouch HMI Visualization Guide. Wonderware 2013.

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

Bialystok University of Technology									
Field of study	**Automatic Control and Robotics**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**common subject**							Study profile	**general academic**
Course name	**Programmable logic devices**							Course code	**MYARS05002**
								Course type	**obligatory**
Forms and number of hours of tuition	L	C	LC	P	SW	FW	S	Semester	**5**
	15	**0**	**0**	**30**	**0**	**0**	**0**	No. of ECTS credits	**3**
Entry requirements	Programming of microcontrollers, Programming of PLCs								
Course objectives	Familiarization with the specificity and structures of programmable logic devices. Acquiring the ability to program simple control systems implemented in programmable logic devices.								
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-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 study
LO1	knows and describes the structure of selected PLD and FPGA programmable devices	AR1_W04 AR1_U07
LO2	knows and understands methods of digital signal processing	AR1_W04 AR1_W06
LO3	knows and explains main structures of VHDL programming language	AR1_W04
LO4	can apply VHDL language to programming simple control systems: combinatorial, sequential, synchronous, state machines, microprocessors	AR1_U07

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	Lecture: one test;	W
LO2	Lecture: one test;	W
LO3	Lecture: one test;	W
LO4	Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	P

Student workload (in hours)		No. of hours
Calculation	Lecture attendance	15
	Project attendance	30
	Preparation for lecture test(s)	5
	Preparation for project classes	6
	Working on projects (including preparation of presentations)	12
	Preparation for projects completion	2
	Participation in teacher-student sessions related to the module subject	5
	TOTAL	75

Quantitative indicators	Hours	ECTS
Student workload - activities that require direct teacher participation	50	2
Student workload - practical activities	55	2,2

Basic references	1. Kulesza Z., Programowanie sterowników czasu rzeczywistego w układach PLD i FPGA. Oficyna Wydawnicza Politechniki Białostockiej, Białystok 2015. 2. Zwolinski M., Projektowanie układów cyfrowych z wykorzystaniem języka VHDL. WKiŁ, Warszawa 2006. 3. Skahill K., Język VHDL. WNT, Warszawa 2001. 4. Majewski J., Zbysiński P., Układy FPGA w przykładach. Wydawnictwo BTC. Warszawa 2007.
Supplementary	1. Woods R., McAllister J., Lightbody G., Yi Y., FPGA-based implementation of signal processing systems.

references	Willey, 2008. 2. Sacha K., Systemy czasu rzeczywistego. Warszawa, Oficyna Wydawnicza Politechniki 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 2002.	
Organisational unit conducting the course	Katedra Automatyki i Robotyki	Date of issuing the programme
Author of the programme	dr hab. inż. Zbigniew Kulesza, prof. PB	2019-09-23

Bialystok University of Technology									
Field of study	**Automatic Control and Robotics**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**common subject**							Study profile	**general academic**
Course name	**Instrumentation of control systems**							Course code	**MYARS05003**
								Course type	**obligatory**
Forms and number of hours of tuition	L	C	LC	P	SW	FW	S	Semester	**5**
	30	**0**	**30**	**0**	**0**	**0**	**0**	No. of ECTS credits	**5**
Entry requirements	Fundamentals of process control, Electric drive systems, Fluid drive systems								
Course objectives	Acquainting with the structure, principle of operation, parameters and typical applications of automation 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: 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: flow meters, level gauges, valves, control throttles, microprocessor controllers, pressure transmitters, RFID sensors. Point measurements and array measurements. Cooperation between PLC and RFID heads. Intelligent 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 methods	Informative-problem lecture; Laboratory classes;								
Assessment method	Lecture: exam 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 the principle of operation of selected automation devices and can describe their mode of operation	AR1_W01 AR1_U01
LO2	knows the structure of selected automation devices and on this basis can sketch: block diagrams, automation schemes	AR1_W07 AR1_W08 AR1_U07
LO3	knows the basic parameters of selected automation devices including modern intelligent measuring devices and can name them	AR1_W01 AR1_U01
LO4	knows the rules of signal processing and can perform measurements of selected non-electrical quantities	AR1_W07 AR1_U04
LO5	is able to properly process the results of measurements	AR1_U04
LO6	can, while maintaining health and safety regulations, conduct tests and determine static and dynamic characteristics of selected automation devices	AR1_U04 AR1_U12
LO7	can work in a team and is ready to comply with the binding rules	AR1_U11 AR1_K02

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	Lecture: exam; Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes;	W L
LO2	Lecture: exam; Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes;	W L
LO3	Lecture: exam; Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes;	W L
LO4	Lecture: exam; Laboratory: evaluation of introductory tests, reports, discussion	W L

	and activity during the classes;	
LO5	Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes;	L
LO6	Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes;	L
LO7	Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes;	L
Student workload (in hours)		No. of hours
Calculation	Lecture attendance	30
	Laboratory classes attendance	30
	Preparation for the lecture exam; participation in the exam	31
	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
Student workload - activities that require direct teacher participation	67	2,7
Student workload - practical activities	64	2,6

Basic references	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. Piotrowskiego. WNT, Warszawa 2009. 3. Kostro J., Elementy, urządzenia i układy automatyki, WSiP, Warszawa 2006. 4. Zawory regulacyjne. Energetyka i ciężkie warunki pracy. Fisher 2000. 5. Kuźnik J., Regulatory i układy regulacji. Wydawnictwo Politechniki Śląskiej, Gliwice 2006.
Supplementary references	1. Fraden J., Handbook of modern sensors–physics, design and applications. Springer-Verlag 2004. 2. Process industrial instruments and controls handbook. Edited by G. McMillan. McGraw-Hill 1999. 3. W. Melvin: Principles of Modern Radar: Advanced Techniques, SciTech Publishig, 2013. 4. PN-EN 60534: Przemysłowe zawory regulacyjne.

Organisational unit conducting the course	Katedra Automatyki i Robotyki	Date of issuing the programme
Author of the programme	dr inż. Andrzej Koszewnik	2019-09-23

Bialystok University of Technology									
Field of study	**Automatic Control and Robotics**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**common subject**							Study profile	**general academic**
Course name	**Computer measurement systems**							Course code	**MYARS05004**
								Course type	**obligatory**
Forms and number of hours of tuition	L	C	LC	P	SW	FW	S	Semester	**5**
	15	**0**	**30**	**0**	**0**	**0**	**0**	No. of ECTS credits	**4**
Entry requirements	Signal theory								
Course objectives	Familiarization with the methods of measuring physical quantities using a computer system. Presentation of processing and scaling methods of measurement signals, their acquisition and graphical representation in the measurement system. Analysis of errors and uncertainty of measurement.								
Course content	Lecture: Measurement methods. Computer measuring systems - classification and their characteristics. 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	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 understands basic concepts and is able to list and classify methods and components of the computerized measurement system								AR1_W06
LO2	knows the parameters of A / D converters, selected sensors and can characterize them								AR1_W05 AR1_W06
LO3	can, while maintaining health and safety regulations, choose the method of measurement, carry out measurements and present research results of certain physical quantities								AR1_U04 AR1_U12
LO4	knows acquisition and processing algorithms of measurement signals and can implement them in the control system								AR1_W06 AR1_W08 AR1_U04
Symbol of learning outcome	Methods of assessing the learning outcomes								Type of tuition during which the outcome is assessed
LO1	Lecture: one test;								W
LO2	Lecture: one test; Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes;								W L
LO3	Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes;								L
LO4	Lecture: one test; Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes;								W L
Student workload (in hours)									No. of hours
Calculation	Lecture attendance								15
	Laboratory classes attendance								30
	Preparation for lecture test(s)								24
	Preparation for laboratory classes								20
	Preparation for laboratory classes completion								6
	Participation in teacher-student sessions related to the module subject								5

	TOTAL	100	
Quantitative indicators		Hours	ECTS
Student workload - activities that require direct teacher participation		50	2
Student workload - practical activities		61	2,4
Basic references	1. Nawrocki W., Komputerowe systemy pomiarowe. Politechnika Poznańska, 2007. 2. Materiały szkoleniowe National Instuments. 2013. 3. Jakubiec J., Błędy i niepewności danych w systemie pomiarowo-sterującym. Politechnika Śląska, 2010.		
Supplementary references	1. Chruściel M., LabView w praktyce, Wydawnictwo BTC, 2008. 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	

Bialystok University of Technology									
Field of study	**Automatic Control and Robotics**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**common subject**							Study profile	**general academic**
Course name	**Physical education I**							Course code	**MYARS05005**
								Course type	**obligatory**
Forms and number of hours of tuition	L	C	LC	P	SW	FW	S	Semester	**5**
	0	**30**	**0**	**0**	**0**	**0**	**0**	No. of ECTS credits	**0**
Entry requirements	-								
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 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	Classes;								
Assessment method	Classes: two tests								

Symbol of learning outcome	Learning outcomes	Reference to the learning outcomes for the field of study
LO1	knows the rules of safe use of sports facilities, equipment and instruments related to the practice of various sports disciplines	AR1_W10
LO2	applies the basic regulations and tactical and technical elements of sports disciplines implemented during the course in the course of the physical education	AR1_U01 AR1_U11
LO3	can practically apply technical skills during the game, carry out the correct warm-up	AR1_U11 AR1_K03
LO4	can apply exercises shaping individual muscle parts and features of the muscular system and is ready to develop his/her skills in this area	AR1_W11 AR1_K01
LO5	can work in a team, participates in sports competition (group games) - applies to activities sports games and is ready to accept responsibility for the joint implementation of tasks	AR1_U11 AR1_K02
LO6	can draw up a simplified training plan for himself and is ready to develop his knowledge in this area	AR1_W11 AR1_U11 AR1_K01

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	Classes: two tests;	C
LO2	Classes: two tests;	C
LO3	Classes: two tests;	C
LO4	Classes: two tests;	C
LO5	Classes: two tests;	C
LO6	Classes: two tests;	C

Student workload (in hours)		No. of hours
Calculation	Classes attendance	30
	Preparation for classes completion	6
	Participation in teacher-student sessions related to the module subject	5
	TOTAL	41

Quantitative indicators		Hours	ECTS
Student workload - activities that require direct teacher participation		35	0
Student workload - practical activities		41	0
Basic references	1. Delavier.F, Gundill M., Modelowanie sylwetki metodą Delaviera: ćwiczenia i programy treningu siłowego. PZWL, Warszawa, 2012. 2. Grządziel G., Piłka siatkowa. Wydawnictwo Akademii Wychowania Fizycznego im. Jerzego Kukuczki, Katowice, 2012. 3. Kuba L., Paruzel-Dyja M., Fitness: nowoczesne formy gimnastyki: podstawy teoretyczne: podręcznik dla instruktorów, studentów i nauczycieli wychowania fizycznego. Wydawnictwo Akademii Wychowania Fizycznego im. Jerzego Kukuczki, Katowice, 2013. 4. Valdericeda F., Futsal: taktyka i ćwiczenia taktyczne. MH, Ruda Śląska, 2012. 5. Wróblewski F., Koszykówka (historia, zasady, trening). Dragon, Bielsko-Biała, 2011.		
Supplementary references	1. Clemenceau J-P., Delavier F., Stretching: ilustrowany przewodnik. PZWL, Warszawa, 2012. 2. Delavier F., Atlas treningu siłowego. PZWL, Warszawa, 2011. 3. Wołyniec J. (red.): Przepisy gier sportowych w zakresie podstawowym. BK, Wrocław, 2006. 4. Wróblewski F., Siatkówka, Dragon, Bielsko-Biała, 2010.		
Organisational unit conducting the course	Studium Wychowania Fizycznego i Sportu	Date of issuing the programme	
Author of the programme	dr Piotr Klimowicz	2019-09-23	

Bialystok University of Technology									
Field of study	**Automatic Control and Robotics**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**common subject**							Study profile	**general academic**
Course name	**Foreign language IV English**							Course code	**MYARS05006**
								Course type	**elective**
Forms and number of hours of tuition	L	C	LC	P	SW	FW	S	Semester	**5**
	0	**30**	**0**	**0**	**0**	**0**	**0**	No. of ECTS credits	**2**
Entry requirements	Foreign language III English								
Course objectives	The use of the vocabulary of English 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 English 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: 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 issues.								
Teaching methods	Classes;								
Assessment method	Evaluation of inter-semester tests; mofular tests, written and oral statements, written and oral exam								

Symbol of learning outcome	Learning outcomes	Reference to the learning outcomes for the field of study
LO1	knows and can apply grammatical rules of English to prepare various types of statements	AR1_U10
LO2	understands and creates complex texts in English related to the field of studies	AR1_U10
LO3	has vocabulary for free communication	AR1_U10
LO4	prepares and presents a presentation in English on a selected topic from the fields of studies	AR1_U10
LO5	speaks English in accordance with the requirements set for the B2 level of the European Language Description System	AR1_U10

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	Evaluation of inter-semester tests; mofular tests, written and oral statements, written and oral exam;	C
LO2	Evaluation of inter-semester tests; mofular tests, written and oral statements, written and oral exam;	C
LO3	Evaluation of inter-semester tests; mofular tests, written and oral statements, written and oral exam;	C
LO4	Evaluation of inter-semester tests; mofular tests, written and oral statements, written and oral exam;	C
LO5	Written exam	C

Student workload (in hours)		No. of hours
Calculation	Classes attendance	30
	Preparation for the lecture exam; participation in the exam	10
	Preparation for classes	-1
	Preparation for classes completion	6
	Participation in teacher-student sessions related to the module subject	5
	TOTAL	50

Quantitative indicators	Hours	ECTS
Student workload - activities that require direct teacher participation	37	1,5

Student workload - practical activities		40	1,6
Basic references	1. Bonamy D., Technical English 3. Pearson Longman, 2011. 2. Jacques Ch., Technical English 3.- Workbook. Pearson Longman, 2011. 3. Materiały własne lektora oraz materiały dodatkowe z Internetu.		
Supplementary references	1. Bonamy D., Technical English 2. Pearson Longman, 2008. 2. Bonamy D., Technical English 4. Pearson Longman, 2011. 3. Ibbotson M., Professional English in Use - Engineering, Cambridge University Press, 2009. 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 unit conducting the course	Studium Języków Obcych	Date of issuing the programme	
Author of the programme	mgr Wojciech Rogalski	2019-09-23	

Bialystok University of Technology									
Field of study	**Automatic Control and Robotics**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**common subject**							Study profile	**general academic**
Course name	**Foreign language IV Russian**							Course code	**MYARS05007**
								Course type	**elective**
Forms and number of hours of tuition	L	C	LC	P	SW	FW	S	Semester	**5**
	0	**30**	**0**	**0**	**0**	**0**	**0**	No. of ECTS credits	**2**
Entry requirements	Foreign language III Russian								
Course objectives	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: 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;								
Assessment method	Evaluation of inter-semester tests; mofular tests, written and oral statements, written and oral exam								

Symbol of learning outcome	Learning outcomes	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
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	prepares and presents a presentation in Russian on a selected topic from the field of studies	AR1_U10
LO5	speaks Russian in accordance with the requirements set for the B2 level of the European Language Description System	AR1_U10

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	Evaluation of inter-semester tests; mofular tests, written and oral statements, written and oral exam;	C
LO2	Evaluation of inter-semester tests; mofular tests, written and oral statements, written and oral exam;	C
LO3	Evaluation of inter-semester tests; mofular tests, written and oral statements, written and oral exam;	C
LO4	Evaluation of inter-semester tests; mofular tests, written and oral statements, written and oral exam;	C
LO5	Written exam	C

Student workload (in hours)		No. of hours
Calculation	Classes attendance	30
	Preparation for the lecture exam; participation in the exam	10
	Preparation for classes	-1
	Preparation for classes completion	6
	Participation in teacher-student sessions related to the module subject	5
	TOTAL	50

Quantitative indicators	Hours	ECTS
Student workload - activities that require direct teacher participation	37	1,5
Student workload - practical activities	40	1,6

Basic references	1. Cieplicka M., Torzewska W., Русский язык. Kompendium tematyczno-leksykalne 1. Wagros, Poznań, 2007. 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.	
Supplementary references	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. 3.Materiały z rosyjskojęzycznych portali internetowych, prasy i książek. 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 the course	Studium Języków Obcych	Date of issuing the programme
Author of the programme	mgr Irena Kamińska	2019-09-23

Bialystok University of Technology									
Field of study	**Automatic Control and Robotics**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**common subject**							Study profile	**general academic**
Course name	**Foreign language IV German**							Course code	**MYARS05008**
								Course type	**elective**
Forms and number of hours of tuition	L	C	LC	P	SW	FW	S	Semester	**5**
	0	**30**	**0**	**0**	**0**	**0**	**0**	No. of ECTS credits	**2**
Entry requirements	Foreign language III German								
Course objectives	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: 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;								
Assessment method	Evaluation of inter-semester tests; mofular tests, written and oral statements, written and oral exam								
Symbol of learning outcome	Learning outcomes								Reference to the learning outcomes for the field of study
LO1	knows and can apply grammatical rules of the German language to prepare various 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	prepares and presents a presentation in German on a selected topic from the field of studies								AR1_U10
LO5	speaks German in accordance with the requirements set for the B2 level of the European Language Description System								AR1_U10
Symbol of learning outcome	Methods of assessing the learning outcomes								Type of tuition during which the outcome is assessed
LO1	Evaluation of inter-semester tests; mofular tests, written and oral statements, written and oral exam;								C
LO2	Evaluation of inter-semester tests; mofular tests, written and oral statements, written and oral exam;								C
LO3	Evaluation of inter-semester tests; mofular tests, written and oral statements, written and oral exam;								C
LO4	Evaluation of inter-semester tests; mofular tests, written and oral statements, written and oral exam;								C
LO5	Written exam								C
Student workload (in hours)									No. of hours
Calculation	Classes attendance								30
	Preparation for the lecture exam; participation in the exam								10
	Preparation for classes								-1
	Preparation for classes completion								6
	Participation in teacher-student sessions related to the module subject								5
	TOTAL								50
Quantitative indicators									Hours / ECTS
Student workload - activities that require direct teacher participation									37 / 1,5

Student workload - practical activities		40	1,6
Basic references	1. Perlmann-Balme, Schwalb M., Matussek S. M., Sicher! Deutsch als Fremdsprache: Niveau B2: 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.		
Supplementary references	1. Omelianiuk W., Ostapczuk H., Sach- und Fachtexte auf Deutsch, Teil 2, Politechnika Białostocka, Białystok, 2010. 2. Zespół red. Sokołowska M., Bender A., Żak K., Słownik naukowo-techniczny niemiecko-polski, Wydawnictwa Naukowo-Techniczne 2007. 3. Materiały własne prowadzącego (adaptowane i opracowane teksty z literatury fachowej oraz z Internetu).		
Organisational unit conducting the course	Studium Języków Obcych	Date of issuing the programme	
Author of the programme	mgr Wioletta Omelianiuk	2019-09-23	

Bialystok University of Technology									
Field of study	**Automatic Control and Robotics**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**mobile robots**							Study profile	**general academic**
Course name	**Robotics**							Course code	**MYARS15001**
								Course type	**elective**
Forms and number of hours of tuition	L	C	LC	P	SW	FW	S	Semester	**5**
	30	**0**	**0**	**30**	**0**	**0**	**0**	No. of ECTS credits	**5**
Entry requirements	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	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 learning outcome	Learning outcomes	Reference to the learning outcomes for the field of study
LO1	knows how to determine the Jacobian of the manipulator and its singularities	AR1_W02 AR1_U01
LO2	understands the structure of the manipulator's dynamics	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 outcomes	Type of tuition during which the outcome is assessed
LO1	Lecture: exam;	W
LO2	Lecture: exam;	W
LO3	Lecture: exam; Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	W P
LO4	Lecture: exam; Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	W P
LO5	Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	P

Student workload (in hours)		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	
Quantitative indicators		Hours	ECTS
Student workload - activities that require direct teacher participation		67	2,7
Student workload - practical activities		76	3
Basic references	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. 3. Buratowski T., Podstawy robotyki. AGH Uczelniane Wydawnictwo Naukowo-Dydaktyczne, Kraków 2006. 4. Jezierski E., Dynamika robotów. WNT, Warszawa 2006.		
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 programme	
Author of the programme	dr inż. Adam Wolniakowski	2019-09-23	

Bialystok University of Technology									
Field of study	**Automatic Control and Robotics**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**mobile robots**							Study profile	**general academic**
Course name	**Signal processing systems in robotics**							Course code	**MYARS15002**
								Course type	**elective**
Forms and number of hours of tuition	L	C	LC	P	SW	FW	S	Semester	**5**
	15	**0**	**0**	**15**	**0**	**0**	**0**	No. of ECTS credits	**3**
Entry requirements	Signal theory, Computer measurement 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: 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 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 learning outcome	Learning outcomes	Reference to the learning outcomes for the field of study
LO1	knows the basics of signal processing in robotics	AR1_W06
LO2	can characterize and apply learned methods, software and hardware tools for signal processing in robotics	AR1_W06
LO3	can design and analyze simple analog signal processing circuits and numerical methods for design and analysis of digital circuits	AR1_U06 AR1_W06
LO4	can interact and work in a group taking different roles	AR1_K05

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	Lecture: exam; Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	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;	P

Student workload (in hours)		No. of hours
Calculation	Lecture attendance	15
	Project attendance	15
	Preparation for the lecture exam; participation in the exam	14
	Preparation for project classes	15
	Working on projects (including preparation of presentations)	6
	Preparation for projects completion	5
	Participation in teacher-student sessions related to the module subject	5
	TOTAL	75

Quantitative indicators	Hours	ECTS
Student workload - activities that require direct teacher participation	37	1,5
Student workload - practical activities	46	1,8

Basic references	1. Zieliński T., Cyfrowe przetwarzanie sygnałów. Od teorii do zastosowań, WKŁ, Warszawa 2009.

	2. Lyons R., Wprowadzenie do cyfrowego przetwarzania sygnałów. WKŁ, Warszawa 2010. 3. Szabatin J., Podstawy teorii sygnałów. WKŁ, Warszawa 2003. 4. Smith S. W., Cyfrowe przetwarzanie sygnałów. Praktyczny poradnik dla inżynierów i naukowców, BTC, 2007. 5. Stranneby D., Cyfrowe przetwarzanie sygnałów, BTC, 2004.	
Supplementary references	1. Kwiatkowski W., Wstęp do cyfrowego przetwarzania sygnałów, Instytut Automatyki i Robotyki, WAT, Warszawa, 2003. 2. Wojciechowski J. M., Sygnały i systemy, Wydawnictwa Komunikacji i Łączności WKŁ, 2008. 3. Mallat S., A Wavelet Tour of Signal Processing. The Sparse Way, Elsevier, 2009. 4. Schilling R.J., Harris S.L., Introduction to digital signal processing using MATLAB, Cengage Learning, 2012.	
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

Bialystok University of Technology									
Field of study	**Automatic Control and Robotics**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**mobile robots**							Study profile	**general academic**
Course name	**Programming of robots**							Course code	**MYARS15003**
								Course type	**elective**
Forms and number of hours of tuition	L	C	LC	P	SW	FW	S	Semester	**5**
	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 programing tasks and trajectories for manipulators and mobile robots.								
Course content	Wykład: Planowanie zadań. 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 methods	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 describes methods of motion trajectory planning	AR1_W02
LO2	knows and understands robot programming methods	AR1_W02 AR1_W06
LO3	characterizes key parameters of selected environments for off-line programming, can use them in practice	AR1_W05 AR1_U04
LO4	can, preserving health and safety regulations, program a robot movement	AR1_W08 AR1_U04 AR1_U12

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	Lecture: one test;	W
LO2	Lecture: one test;	W
LO3	Lecture: one test; Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes;	W L
LO4	Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes;	L

Student workload (in hours)		No. of hours
Calculation	Lecture attendance	15
	Laboratory classes attendance	30
	Preparation for lecture test(s)	24
	Preparation for laboratory classes	20
	Preparation for laboratory classes completion	6
	Participation in teacher-student sessions related to the module subject	5
	TOTAL	100

Quantitative indicators	Hours	ECTS
Student workload - activities that require direct teacher participation	50	2

Student workload - practical activities		61	2,4
Basic references	1. Kaczmarek W., Panasiuk J., Programowanie robotów przemysłowych. PWN, Warszawa, 2017. 2. Kaczmarek W., Panasiuk J., Borys S., Środowiska programowanie robotów. PWN, Warszawa, 2017. 3. Hughes C., Hughes T., Programowanie robotów: sterowanie pracą robotów autonomicznych. Helion, Gliwice, 2017.		
Supplementary references	1. Honczarenko J., Roboty przemysłowe: budowa i zastosowanie. WNT, Warszawa, 2011. 2. Murphy R.R., Disaster robotics. The MIT Press, London, 2014. 3. Stone P., Intelligent autonomous robotics: a robot soccer case study. Morgan a.Claypool Publishers, Warszawa, 2007.		
Organisational unit conducting the course	Katedra Automatyki i Robotyki	Date of issuing the programme	
Author of the programme	dr inż. Adam Wolniakowski	2019-09-23	

Bialystok University of Technology									
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 name	**Robotics**							Course code	**MYARS25001**
								Course type	**elective**
Forms and number of hours of tuition	L	C	LC	P	SW	FW	S	Semester	**5**
	30	**0**	**15**	**30**	**0**	**0**	**0**	No. of ECTS credits	**7**
Entry requirements	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. Laboratory: Programming of industrial manipulators.								
Teaching methods	Informative-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 determine the Jacobian of the manipulator and its singularities	AR1_W02 AR1_U01
LO2	understands the structure of the manipulator's dynamics	AR1_W02 AR1_U01
LO3	knows the methods of obtaining motion equations	AR1_W02 AR1_U01
LO4	determines motion equations of a manipulator	AR1_W02 AR1_U01
LO5	can, while maintaining health and safety regulations, program manipulator movements	AR1_U03 AR1_U11
LO6	can determine the Jacobian and singularities of the manipulator	AR1_W02 AR1_U01

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	Lecture: exam;	W
LO2	Lecture: exam;	W
LO3	Lecture: exam; Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	W P
LO4	Lecture: exam; Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	W P
LO5	Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	P
LO6	Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes;	L
LO7	Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes;	L

Student workload (in hours)	No. of hours

Calculation	Lecture attendance	30
	Laboratory classes attendance	15
	Project attendance	30
	Preparation for the lecture exam; participation in the exam	24
	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
	TOTAL	175

Quantitative indicators	Hours	ECTS
Student workload - activities that require direct teacher participation	82	3,3
Student workload - practical activities	121	4,8

Basic references	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. 3. Morecki A., Podstawy robotyki. Teoria manipulatorów i robotów, WNT, Wydawnictwo poprawione, Warszawa, 2002. 4. Spong M. W., Vidyasagar M., Dynamika i sterowanie robotów. WNT, Warszawa, 2000. 5. Jezierski E., Dynamika robotów. WNT, Warszawa 2006.	
Supplementary references	1. Leyko J., Mechanika ogólna, t. II, Dynamika. PWN, Warszawa 2006. 2. Cannon R.H., Dynamika układów fizycznych. WNT, Warszawa, 1973.	
Organisational unit conducting the course	Katedra Automatyki i Robotyki	Date of issuing the programme
Author of the programme	dr inż. Adam Wolniakowski	2019-09-23

Bialystok University of Technology									
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 name	**Modeling and simulation of control systems**							Course code	**MYARS25002**
								Course type	**elective**
Forms and number of hours of tuition	L	C	LC	P	SW	FW	S	Semester	**5**
	30	**0**	**0**	**30**	**0**	**0**	**0**	No. of ECTS credits	**5**
Entry requirements	Fundamentals of process control, Programming in C								
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 LQR controller. Development, comparison and analysis of the properties of closed control systems.								
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 learning outcome	Learning outcomes	Reference to the learning outcomes for the field of study
LO1	knows the tools, methods and functions for designing control systems in MBD technology	AR1_W04 AR1_W05 AR1_U07
LO2	knows and can use computer methods for modeling and solving motion equations given with differential or differential linear / nonlinear equations	AR1_W05 AR1_W07 AR1_U04
LO3	knows and can apply methods to design control plants and their representations in the form of linear models in the MATLAB / Simulink program	AR1_W04 AR1_W07 AR1_U03
LO4	can model automation and robotics plants and systems using the MATLAB / Simulink environment	AR1_U01
LO5	can use methods for designing control systems in the MATLAB / Simulink program	AR1_U04 AR1_U03
LO6	is ready to critically evaluate his/her knowledge of computer methods for engineering problems	AR1_K01

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	Lecture: exam; Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;	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;		P
LO5	Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;		P
LO6	Project: evaluation of project completion, current progress in project completion, discussion and activity during the classes;		P
Student workload (in hours)		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	
Quantitative indicators		Hours	ECTS
Student workload - activities that require direct teacher participation		67	2,7
Student workload - practical activities		76	3
Basic references	1. Mrozek B., Mrozek Z., MATLAB i Simulink: poradnik użytkownika, Wydawnictwo Helion, Gliwice, 2004. 2. Łysakowska B., Mzyk G., Komputerowa symulacja układów automatycznej regulacji w środowisku MATLAB/Simulink, Oficyna Wydawnictwo Politechniki Wrocławskiej, 2005. 3. Ogata K., Modern Control Engineering, 4th ed., Pearson Education International, 2002. 4. Webminaria, tutoriale na serwerach: www.ont.com.pl, www.mathworks.com 5. Łysakowska B., Mzyk G., Komputerowa symulacja układów automatycznej regulacji w środowisku MATLAB/Simulink, Oficyna Wydawnicza Politechniki Wrocławskiej, 2005.		
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Organisational unit conducting the course	Katedra Automatyki i Robotyki	Date of issuing the programme	
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