Bialystok University of Technology
Faculty of Electrical Engineering

Field of study	**Industry Digitization**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**common subject**							Study profile	**general academic**
Course name	**Fundamentals of control**							Course code	**CP1S03001**
								Course type	**obligatory**
Forms and number of hours of educational ectivities	L	C	LC	P	SW	FW	S	Semester	**3**
	30		**30**		**30**			No. of ECTS credits	**7**
Entry requirements	Mathematics 1, Mathematics 2, Physics								
Course objectives	Acquainting with the theory of automation and the structure of automation systems. Acquiring the ability to model components of automatic control systems and determine their characteristics. Acquainting with the criteria for testing the stability of automatic control systems, the role of the controller and principles of tuning its parameters, evaluation of the control system operation. Introduction of the concept of nonlinearity and stability analysis of nonlinear control systems.								
Course content	Lecture: Introduction to automatic control: basic concepts, signals, automatic control system (ACS). Equations describing objects of automatic control. Stability of linear control systems. Stability test criteria. Static accuracy and dynamic performance of control systems. Performance indicators. Nonlinearities in automatic control. Stability of nonlinear automatic control systems. Linearization of nonlinear systems. The concept and determination of operator transfer function. Mathematical description of dynamical systems in the space of state variables. Operator transfer function and matrix equations of state. Basic linear objects: types, mathematical description, examples. Static, dynamic and frequency characteristics of control objects. Block diagrams and their transformations. Control objects: types, properties, examples, identification. Controllers: control laws, properties and dynamic characteristics, selection methods. Laboratory classes: Determining characteristics of control objects. Identification of the control object. Testing the PID controller (P, PI, I, PID). Tuning of PID controller parameters. Testing the automatic control system of rotational speed, liquid level, flow, temperature. Specialistic workshop: Calculating the transfer function of control objects. Analytical calculation of the characteristics of control objects. Calculation of substitute transfer function (transformations of block diagrams). Controller tuning. Stability of the control system. Determination of static accuracy and dynamic performance of the control system. Study of nonlinear systems. Simulation of control system in computer software.								
Teaching methods	Informative-problem lecture; Laboratory classes; Classes in computer methods and techniques with demonstration, instruction and discussion;								
	Lecture: exam								

Assessment method	Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop	
Symbol of learning outcome	Learning outcomes	Reference to the learning outcomes for the field of study
	Knowledge: the graduate knows and understands	
LO1	components and operation of the automatic control system	CP1_W03
LO2	methods of testing performance and stability of an automatic control system	CP1_W01
LO3	procedure for control parameters tuning in automatic control systems	CP1_W04
	Skills: the graduate is able to	
LO4	design a simple control system and tune the parameters of the PID controller	CP1_U07
LO5	use known methods and mathematical models to analyze and evaluate the operation of a simple automatic control system	CP1_U06
LO6	apply principles of occupational health and safety in laboratory classes	CP1_U13
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; Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop;	W Ps
LO3	Lecture: exam; 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; Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop;	L Ps
LO5	Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes; Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop;	L Ps
LO6	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
	Workshop attendance	30
	Preparation for the lecture exam; participation in the exam	23
	Preparation for laboratory classes	17
	Preparation for laboratory classes completion	6
	Preparation for specialistic workshop	26

	Preparation for workshop completion	8
	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	97	3,9
Student workload - practical activities	122	4,9

Basic references	1. Kowal J., Podstawy automatyki. T. 1, Uczelniane Wydawnictwa Naukowo-Dydaktyczne AGH, Kraków, 2006. 2. Kowal J., Podstawy automatyki. T. 2, Uczelniane Wydawnictwa Naukowo-Dydaktyczne AGH, Kraków, 2007. 3. Siemieniako F., Gosiewski Z., Automatyka. Tom. 1, Modelowanie i analiza układów. Wydawnictwo Politechniki Białostockiej, Białystok, 2006. 4. Prajs Z., Podstawy automatyki w zadaniach: układy liniowe ciągłe. Oficyna Wydawnicza Politechniki Białostockiej, Białystok, 2010. 5. Luft M., Łukasik Z., Podstawy teorii sterowania. Politechnika Radomska, Radom 2012.
Supplementary references	1. Gosiewski Z., Siemieniako F., Automatyka. Tom. 2, Synteza układów. Wydawnictwo Politechniki Białostockiej, Białystok, 2007. 2. Mazurek J., Vogt H., Żydanowicz W., Podstawy automatyki. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2002. 3. Dębowski A., Automatyka: podstawy teorii. WNT, Warszawa 2016. 4. Łysakowska B., Mzyk G., Komputerowa symulacja układów automatycznej regulacji w środowisku Matlab/Simulink, Oficyna Wyd. PW, Wrocław 2005. 5. Ogata K., Modern control engineering. Prentice-Hall, 2010.

Organisational unit conducting the course	Department of Automatic Control and Robotics	Date of issuing the programme	
Author of the programme	dr hab. inż. Łukasz Sajewski, prof. PB	2022-06-07	

Bialystok University of Technology
Faculty of Electrical Engineering

Field of study	**Industry Digitization**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**common subject**							Study profile	**general academic**
Course name	**Fundamentals of robotics**							Course code	**CP1S03002**
								Course type	**obligatory**
Forms and number of hours of educational ectivities	L	C	LC	P	SW	FW	S	Semester	**3**
	30	**30**	**30**					No. of ECTS credits	**7**

Entry requirements	Mathematics 1, Mathematics 2, Physics
Course objectives	Acquainting with basic knowledge related to robotics as well as with the structure and application of robots and their components.
Course content	Lecture: Classification of robots, kinematic structures, concepts of the theory of machines and mechanisms. Sensors and actors used in robots. Description of coordinate system transformations. Modeling of kinematic chains. Working and configuration space. Simple and inverse kinematics task. Denavit-Hartenberg (D-H) notation, Jacobians and singularities of manipulators. Interpolation methods. Introduction to information technology tools used in robotics. Classes: Modeling the kinematics of a serial robot. Laboratory classes: Modeling the kinematics of a serial robot in a simulation environment. Programming of real industrial robots.
Teaching methods	Informative-problem lecture; Classes; Laboratory classes;
Assessment method	Lecture: exam Classes: two tests 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
	Knowledge: the graduate knows and understands	
LO1	basic robotics terms	CP1_W01 CP1_W02 CP1_W03
LO2	methods of solving computational tasks related to robotics	CP1_W01 CP1_W02
LO3	methods and tools for robot programming	CP1_W07
	Skills: the graduate is able to	
LO4	develop a model of robot kinematics, find solutions for simple and inverse tasks of manipulator kinematics	CP1_U02 CP1_U06 CP1_U07 CP1_U09

LO5	operate and program the selected industrial manipulator	CP1_U02 CP1_U03 CP1_U07 CP1_U09
LO6	apply principles of occupational health and safety in laboratory classes	CP1_U13
Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	Lecture: exam; Classes: two tests;	W C
LO2	Lecture: exam; Classes: two tests;	W C
LO3	Lecture: exam; Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes;	W L
LO4	Classes: two tests; Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes;	C L
LO5	Classes: two tests; Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes;	C L
LO6	Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes;	L

Student workload (in hours)		No. of hours
Calculation	Lecture attendance	30
	Classes attendance	30
	Laboratory classes attendance	30
	Preparation for the lecture exam; participation in the exam	28
	Preparation for classes	18
	Preparation for classes completion	6
	Preparation for laboratory classes	22
	Preparation for laboratory classes completion	6
	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	97	3,9
Student workload - practical activities	117	4,7

Basic references	1. Honczarenko J., Roboty przemysłowe: budowa i zastosowanie. WNT, Warszawa, 2010. 2. Zdanowicz R., Podstawy robotyki. WPŚ, Gliwice, 2011. 3. Szkodny T., Zbiór zadań z podstaw robotyki. WPŚ, Gliwice, 2013. 4. Craig J. J., Wprowadzenie do robotyki. Mechanika i sterowanie. WNT, Warszawa, 2003. 5. Spong M. W., Vidyasagar M., Dynamika i sterowanie robotów, WNT, Warszawa, 1997.
Supplementary references	1. Kozłowski K., Dutkiewicz P., Wróblewski W., Modelowanie i sterowanie robotów. PWN, Warszawa, 2003. 2. Buratowski T., Postawy robotyki. Uczelniane Wydawnictwa Naukowo-Techniczne AGH, Kraków 2006. 3. Wittbrodt E., Adamiec-Wójcik I., Wojciech S. Dynamics of flexible multibody systems: rigid finite element method. Springer Science & Business Media, 2007. 4. Adamiec-Wójcik I., Modelling dynamics of multibody systems using homogenous transformations. Wydawnictwo ATH, 2003. 5. Morecki A., Knapczyk J., Podstawy robotyki. WNT, Warszawa, 1999.

Organisational unit conducting the course	Department of Automatic Control and Robotics	Date of issuing the programme
Author of the programme	dr inż. Adam Wolniakowski	2022-06-07

Bialystok University of Technology
Faculty of Electrical Engineering

Field of study	**Industry Digitization**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**common subject**							Study profile	**general academic**
Course name	**Computer aided design 1**							Course code	**CP1S03003**
								Course type	**obligatory**
Forms and number of hours of educational ectivities	L	C	LC	P	SW	FW	S	Semester	**3**
	15				**30**			No. of ECTS credits	**3**
Entry requirements	Technical drawing, Electronic components and subsystems								
Course objectives	Acquainting with selected applications used in the work of an engineer. Acquiring knowledge in the field of creating diagrams and design documentation of power, control and signaling systems using the EPLAN Electric P8 design support program. Acquiring the ability to create technical documentation in an efficient and transparent manner.								
Course content	Lecture: Characteristics of commonly used programs for creating projects and technical documentation in the field of electrical installation and industrial automation. Possibility of supporting the design with the use of selected applications helpful in the work of an engineer, CAE programs (Computer Aided Engineering, eg EPLAN Electric P8). Overview of principles of operation of automation system components and the principles of creating control systems. EPLAN Electric P8 overview: installation process, customizing the user interface, project management, project structure, creating projects according to IEC 61346/61355, creating electrical schematics, terminals, cables, using PLC components, editing components from navigators, data processing components, automatic creation of assembly documentation, creation of graphic elements with dimensioning, working with macros, automatic part numbering, object-oriented planning and preparation of specifications, installation of the cabinet and the mounting plate. Specialistic workshop: Designing a power supply, control and signaling system of a simple electrical system. Selection of electric cables, power circuit protection and system components. Analysis of the performance of the designed control system. Design of electrical and control installations using the EPLAN Electric P8 program.								
Teaching methods	Informative-problem lecture; Classes in computer methods and techniques with demonstration, instruction and discussion;								
Assessment method	Lecture: one test Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop								

Symbol of learning outcome	Learning outcomes	Reference to the learning outcomes for the field of study
	Knowledge: the graduate knows and understands	
LO1	operating principles of automatic control systems	CP1_W02

LO1	operating principles of automatic control systems	
LO2	capabilities of the EPLAN Electric P8 design support program	CP1_W04
LO3	principles of electrical stroke protection in automatic control systems	CP1_W11
	Skills: the graduate is able to	
LO4	work individually and in a team, estimate the time needed to complete a task	CP1_U03
LO5	design and verify the correctness of the created project	CP1_U06
LO6	conduct a discussion on the completed project	CP1_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;	W
LO3	Lecture: one test;	W
LO4	Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop;	Ps
LO5	Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop;	Ps
LO6	Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop;	Ps

Student workload (in hours)		No. of hours
Calculation	Lecture attendance	15
	Workshop attendance	30
	Preparation for lecture test(s)	9
	Preparation for specialistic workshop	12
	Preparation for workshop completion	4
	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	51	2

Basic references	1. Dominik I., Tworzenie dokumentacji technicznej w programie EPLAN – przykłady praktyczne, Kraków 2012. 2. Gischel B., EPLAN Electric P8 Reference Handbook, Hanser, Carl GmbH+Co., 2016.
Supplementary references	1. Rengstorf J., EPLAN electric P8 - Version 2. Schülerband, Bildungsverlag Eins GmbH, 2017. 2. Meinert F., EPLAN Electric P8 für Dummies, Wiley VCH Verlag GmbH, 2019. 3. Dokumentacja techniczna programu EPLAN: www.eplan.pl, www.eplanusa.com 4. Internetowe materiały firmowe: www.automatykaonline.pl, www.forumsep.pl

Organisational unit conducting the course	Department of Electrical Engineering, Energoelectronics and Electroenergetics	Date of issuing the programme

Author of the programme	dr inż. Adam Kuźma	2022-06-07

Bialystok University of Technology
Faculty of Electrical Engineering

Field of study	**Industry Digitization**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**common subject**							Study profile	**general academic**
Course name	**Computer aided design 2**							Course code	**CP1S03004**
								Course type	**obligatory**
Forms and number of hours of educational ectivities	L	C	LC	P	SW	FW	S	Semester	**3**
	15				**30**			No. of ECTS credits	**3**
Entry requirements	Technical drawing, Mechanical components and subsystems								
Course objectives	Acquainting with the functionalities of selected CAx tools for the design, visualization, engineering analysis, production and quality control of mechanical assemblies of open and closed kinematic chains of industrial and service robots, as well as automated systems. Analysis of the possibility of using solid and surface CAD models to design single parts and assemblies of devices used in flexible manufacturing systems. Acquiring practical skills in operating programs for the design of technical objects and their analysis with the use of modern modeling methods and CAD/CAE computer simulation.								
Course content	Lecture: Introduction to the problems of computer aided design of mechanical elements. Analysis of environments supporting computer design of machines and devices. Solid and surface modeling - the essence of techniques, applications, advantages and disadvantages. CAx programs - areas of their application and functionality to be used in engineering practice. Creation of analysis of engineering projects using the method of finite elements in selected CAE tools. PLM, PDM and CIM systems. Generators, toolboxes, databases and other computer aided design process applications. Creating design documentation in the form of technical drawings based on the made 3D models. Specialistic workshop: Create and edit models of parts. Preparation of a project of a robotic assembly based on a review of existing solutions. Development of detailed drawings of parts and assembly drawings of the designed device. Performing mechanical analysis of a self-designed robotic assembly.								
Teaching methods	Informative-problem lecture; Classes in computer methods and techniques with demonstration, instruction and discussion;								
Assessment method	Lecture: one test Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop								

Symbol of learning outcome	Learning outcomes	Reference to the learning outcomes for the field of study
	Knowledge: the graduate knows and understands	
LO1	CAD of surface and solid modeling	CP1_W02 CP1_W05

LO2	purposes and principles of engineering analyzes in CAD/CAE packages	CP1_W12 CP1_W05
LO3	applications and basic functionalities of CAI tools	CP1_W12
	Skills: the graduate is able to	
LO4	model and edit solid models	CP1_U02
LO5	make assemblies from individual parts	CP1_U04
LO6	determine physical properties of a solid object and analyze the motion of a robotic assembly	CP1_U10 CP1_U04
	Social competences: the graduate is ready to	
LO7	critical assessment of knowledge, self-education and improvement of qualifications, use of own knowledge and experts opinions in order to solve various problems	CP1_K01
LO8	take responsibility for the consequences of using the designed robotic component	CP1_K03
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	Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop;	Ps
LO5	Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop;	Ps
LO6	Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop;	Ps
LO7	Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop;	Ps
LO8	Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop;	Ps
Student workload (in hours)		No. of hours
Calculation	Lecture attendance	15
	Workshop attendance	30
	Preparation for lecture test(s)	9
	Preparation for specialistic workshop	12
	Preparation for workshop completion	4
	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	51	2

Basic references	1. Łodygowski T., Kąkol W., Metoda elementów skończonych w wybranych zagadnieniach mechaniki konstrukcji inżynierskich, Politechnika Poznańska 2003. 2. Keska P., SolidWorks 2013, Modelowanie części, złożenia, rysunki, Wydawnictwo CADvantage, 2013. 3. Kurmaz L., Kurmaz O., Podstawy konstruowania węzłów i części maszyn: podręcznik konstruowania, 2011. 4. Przybylski W., Deja M., Komputerowo wspomagane wytwarzanie maszyn: podstawy i zastosowanie, WNT, Warszawa 2007. 5. Chlebus E., Techniki komputerowe CAx w inżynierii produkcji, WNT, Warszawa, 2004.	
Supplementary references	1. Czasopisma branżowe (np., Design News Polska, Projektowanie i Konstrukcje Inżynierskie). 2. Lombard M., SolidWorks 2011 Parts Bible, Wiley Publishing, 2011. 3. Lombard M., SolidWorks 2011 Asemmblies Bible, Wiley Publishing, 2011. 4. SolidWorks Rysunki, Wydawnictwo CNS Solutions, 2012. 5. Portale internetowe (np., www.3dcad.pl, www.solidworks.com, www.cns.pl).	
Organisational unit conducting the course	Department of Automatic Control and Robotics	Date of issuing the programme
Author of the programme	dr inż. Roman Trochimczuk	2022-06-07

Bialystok University of Technology
Faculty of Electrical Engineering

Field of study	**Industry Digitization**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**common subject**							Study profile	**general academic**
Course name	**Python programming 2**							Course code	**CP1S03005**
								Course type	**obligatory**
Forms and number of hours of educational ectivities	L	C	LC	P	SW	FW	S	Semester	**3**
					30			No. of ECTS credits	**2**
Entry requirements	Python programming 1								
Course objectives	Acquisition of skills in the use of advanced language constructs, the use of libraries supporting the analysis and design of robots, programming of hardware support in Python.								
Course content	Specialistic workshop: The use of advanced structures of the Python language, including: iterators and generators, co-programs, concurrency. Application of libraries supporting the analysis and design of robots, e.g.: DART, PyDy, Pybotics. Hardware support programming in Python, e.g.: Raspberry PI, STM32.								
Teaching methods	Specialization workshop;								
Assessment method	Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop								

Symbol of learning outcome	Learning outcomes	Reference to the learning outcomes for the field of study
	Skills: the graduate is able to	
LO4	use advanced Python constructs	CP1_U07
LO5	use libraries supporting the analysis and design of robots in Python	CP1_U06 CP1_U07
LO6	program hardware support in Python	CP1_U07 CP1_U08
	Social competences: the graduate is ready to	
LO7	responsible planning of activities related to the preparation for classes	CP1_K03
LO8	conduct programming activities in a creative way	CP1_K04

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO4	Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop;	Ps
LO5	Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop;	Ps

LO6	Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop;	Ps	
LO7	Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop;	Ps	
LO8	Specialistic workshop: evaluation of reports, individual progress, discussion and activity at workshop;	Ps	
Student workload (in hours)		No. of hours	
Calculation	Workshop attendance	30	
	Preparation for specialistic workshop	11	
	Preparation for workshop completion	4	
	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		35	1,4
Student workload - practical activities		50	2
Basic references	1. Gorelick M., Ozsvald I., Wysokowydajny Python: efektywne programowanie w praktyce. Helion: O'Reilly, Gliwice 2021. 2. Ramalho L., Zaawansowany Python. Jasne, zwięzłe i efektywne programowanie. APN Promise: O'Reilly, Warszawa 2015. 3. Hillard D., Python: dobre praktyki profesjonalistów. Helion, Gliwice 2020. 4. Staple D., Jak zaprogramować robota: zastosowanie Raspberry PI i Pythona w tworzeniu autonomicznych robotów. Helion, Gliwice 2022.		
Supplementary references	1. Monk S., Raspberry PI: przewodnik dla programistów Pythona. Helion, Gliwice 2014. 2. https://dartsim.github.io/ 3. https://github.com/pydy/pydy 4. https://pypi.org/project/pybotics/		
Organisational unit conducting the course	Department of Automatic Control and Robotics	Date of issuing the programme	
Author of the programme	dr hab. inż. Zbigniew Kulesza, prof. PB	2022-06-07	

Bialystok University of Technology
Faculty of Electrical Engineering

Field of study	**Industry Digitization**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**common subject**							Study profile	**general academic**
Course name	**Digital signal processing**							Course code	**CP1S03006**
								Course type	**obligatory**
Forms and number of hours of educational ectivities	L	C	LC	P	SW	FW	S	Semester	**3**
	15		**30**					No. of ECTS credits	**4**
Entry requirements	Mathematics 1, Mathematics 2								
Course objectives	Acquainting with the methods of signal analysis and digital signal processing systems in time and frequency domains and obtaining practical skills in this field. Acquainting with the methods of synthesis and the possibilities of hardware and software implementation of basic methods of digital signal processing, along with acquiring the skills of their design and implementation.								
Course content	Lecture: Areas of application of digital signal processing methods. Signal classification. Finite and infinite impulse response filters. Realizability, causality, stability. Overview of analysis and synthesis methods of digital filters. The use of software for filter synthesis and practical aspects of hardware and software implementation of digital signal processing methods. Examples of applications and realizations in industrial systems. Sampling and quantization. Spectrum analysis of signals; use of Fourier transform. Discrete and fast Fourier transform. Aspects of the practical use of FFT. Basic methods of description of signals and systems in time and frequency domains: differential equations, application of the Z transform, impulse response, transfer function, frequency characteristics, state variables. Discrete linear and cyclic convolution. Basic structures of signal processing circuits and their features; Laboratory classes: Sampling and quantization of signals. Time and spectral analysis of signals. Practical aspects of using FFT. Time and frequency characteristics of basic types of digital filters. Synthesis of digital filters. Basic filters with finite and infinite impulse response - characteristics, properties, applications, implementation issues. Design and implementation of digital filters with the use of signal processors. Filtration and measurement of filter characteristics.								
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

	Knowledge: the graduate knows and understands	
LO1	methods of signal analysis in time and frequency domains	CP1_W09
LO2	principles of analog-to-digital conversion and selection of parameters of this process	CP1_W09
LO3	description, analysis, synthesis and implementation methods of digital signal processing systems	CP1_W04 CP1_W09
	Skills: the graduate is able to	
LO4	analyze signals in time and frequency domains, using appropriate hardware and software tools	CP1_U06 CP1_U11
LO5	formulate the specification of digital signal processing systems, perform their synthesis and verification using computer-aided design tools	CP1_U06
LO6	perform hardware implementation of simple digital signal processing systems and measure their characteristics	CP1_U06 CP1_U08 CP1_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;	W
LO4	Laboratory: evaluation of introductory tests, reports, discussion and activity during the classes;	L
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
Student workload (in hours)		No. of hours
Calculation	Lecture attendance	15
	Laboratory classes attendance	30
	Preparation for the lecture exam; participation in the exam	25
	Preparation for laboratory classes	19
	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	52	2,1
Student workload - practical activities	60	2,4

Basic references	1. Lyons R., Wprowadzenie do cyfrowego przetwarzania sygnałów. WKŁ, Warszawa, 2010. 2. Owen M., Przetwarzanie sygnałów w praktyce, WKŁ, Warszawa, 2009. 3. Zieliński T., Cyfrowe przetwarzanie sygnałów: od teorii do zastosowań. WKŁ, Warszawa, 2009. 4. Smith S. W., Cyfrowe przetwarzanie sygnałów: praktyczny poradnik dla inżynierów i naukowców, BTC, Warszawa, 2007.

	5. Osowski S., Cyfrowe przetwarzanie sygnałów z zastosowaniem MATLABA, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2016.	
Supplementary references	1. Szabatin J., Podstawy teorii sygnałów. WKŁ, Warszawa, 2007. 2. Zieliński T. (red.), Cyfrowe przetwarzanie sygnałów w telekomunikacji: podstawy, multimedia, transmisja, PWN, Warszawa, 2014. 3. Leśnicki A., Technika cyfrowego przetwarzania sygnałów, Wydawnictwo Politechniki Gdańskiej, Gdańsk, 2016. 4. Manolakis D. G., Ingle V. K., Applied digital signal processing: theory and practice, Cambridge University Press, Cambridge, 2011. 5. Rao K. D., Swamy M. N. S., Digital Signal Processing. Theory and Practice, Springer, 2018.	
Organisational unit conducting the course	Department of Photonics, Electronics and Light Technology	Date of issuing the programme
Author of the programme	dr hab. inż. Dariusz Jańczak	2022-06-07

Bialystok University of Technology
Faculty of Electrical Engineering

Field of study	**Industry Digitization**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**common subject**							Study profile	**general academic**
Course name	**Materials processing technologies**							Course code	**CP1S03007**
								Course type	**obligatory**
Forms and number of hours of educational ectivities	L	C	LC	P	SW	FW	S	Semester	**3**
	15							No. of ECTS credits	**1**
Entry requirements	3D prototyping and additive manufacturing								
Course objectives	Acquainting with basic issues of structure and properties of engineering materials. Overview of basic groups of engineering materials. Additive techniques. Methods of producing composite materials. Electrotechnologies used in materials processing. Overview of the applications of laser treatment. Presentation of basic tools in materials research. Provide an overview of the most important functional materials. Presentation of issues of economy and time-consuming methods of material processing. Life cycle of engineering materials. Materials recirculation processes. Technology for the production of thin layers. Acquainting with basic techniques of manufacturing and processing materials. Discussion of methods of production and modification of nanomaterials. Classification of polymers by application (construction, adhesive, coating, synthetic fibers, special). Overview of the classification of polymers (thermoplastic, duroplastic and elastomeric). Polymerization and processing methods of polymer materials (thermoforming, fillers, pigments, dyes, softeners, stabilizers, antistatic agents). Presentation of the methods of shaping ceramic and glass materials. Ceramic composites. Discussion of metal materials and their alloys (plastic, machining and thermal processing, founding, welding). Surface engineering.								
Course content	Lecture: Construction and properties of engineering materials. Basic group of engineering materials. Additive techniques. Basic tools in the study of materials. Methods of producing composite materials. Electrotechnologies used in materials processing. Laser processing. Overview of the most important functional materials and the basics of their production. Economical, ecological and time-consuming materials processing methods. Life cycle of engineering materials. Materials recirculation processes. Technology for the production of thin layers. Technologies for the production and processing of materials. Nanomaterials. Classification of polymers by application (construction, adhesive, coating, synthetic fibers, special). Types of polymers. Processing methods of polymer materials. Methods of shaping ceramic and glass materials. Ceramic composites. Metals and alloys (plastic, machining and heat working processes, founding, welding). Surface engineering.								
Teaching methods	Informative-problem lecture;								
Assessment method	Lecture: one test								

Symbol of learning outcome	Learning outcomes	Reference to the learning outcomes for the field of study
	Knowledge: the graduate knows and understands	
LO1	basic materials processing	CP1_W12
LO2	principles of selection and application of engineering materials	CP1_W12
LO3	processes of using and designing the flow of materials in industrial processes	CP1_W13

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

Student workload (in hours)		No. of hours
Calculation	Lecture attendance	15
	Preparation for lecture test(s)	5
	Participation in teacher-student sessions related to the module subject	5
	TOTAL	25

Quantitative indicators	Hours	ECTS
Student workload - activities that require direct teacher participation	20	0,8
Student workload - practical activities	0	0

Basic references	1. Dobrzański L., Metalowe materiały inżynierskie. Wydawnictwa Naukowo-Techniczne WNT, 2004. 2. Blicharski M., Wstęp do inżynierii materiałowej. Wydawnictwo WNT, 2003. 3. Ashby M., Shercliff H., Cebon D., Inżynieria materiałowa T1, T2. Galaktyka, 2011. 4. Dobrzański L. A., Zasady doboru materiałów inżynierskich z kartami charakterystyk. Politechnika Śląska, Gliwice 2001. 5. Szlezyngier W., Brzozowski Z. K., Tworzywa sztuczne: chemia, technologia wytwarzania, właściwości, przetwórstwo, zastosowanie. T. 2, Polimery specjalne i inżynieryjne. Wydawnictwo Oświatowe FOSZE, Rzeszów 2012.
Supplementary references	1. Kula P., Inżynieria Warstwy Wierzchniej. Wydawnictwo Politechniki Łódzkiej. Łódź 2000. 2. Grabski M. W., Kozubowski J. A., Inżynieria materiałowa. Geneza, istota, perspektywy, Oficyna Wydawnicza Politechniki Warszawskiej, 2003. 3. Rabek J. F., Współczesna wiedza o polimerach. 2, Polimery naturalne i syntetyczne, otrzymywanie i zastosowania. Wydawnictwo Naukowe PWN, Warszawa 2017. 4. Zimny J., Laserowa obróbka stali. Wydawnictwo Politechniki Częstochowskiej, Częstochowa 1999. 5. Jurczyk M., Nanomateriały: wybrane zagadnienia. Politechnika Poznańska, Poznań 2001.

Organisational unit conducting the course	Department of Photonics, Electronics and Light Technology	Date of issuing the programme
Author of the programme	dr hab. inż. Piotr Miluski, prof. PB	2022-06-07

Bialystok University of Technology
Faculty of Electrical Engineering

Field of study	**Industry Digitization**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**common subject**							Study profile	**general academic**
Course name	**Foreign language 2**							Course code	**CP1S03008**
								Course type	**elective**
Forms and number of hours of educational ectivities	L	C	LC	P	SW	FW	S	Semester	**3**
		30						No. of ECTS credits	**2**

Entry requirements	Foreign language 1
Course objectives	Continue to improve language proficiency (listening, reading, interacting, production, writing) at level B2 or above in line with the Common European Framework of Reference for Languages. Stimulating curiosity about fundamental dilemmas of modern civilization and issues of the field of study. Getting to know the basic vocabulary of the field of study. Familiarization with the selected type of specialist text.
Course content	Classes: Topics related to academic life, current problems of social life and dilemmas of modern civilization and problems of the studied field. Language and grammar issues in the discussed texts. Basic vocabulary related to the field of study. Work with a selected type of specialist text (e.g. technical specification, catalog card, project documentation).
Teaching methods	Classes;
Assessment method	Evaluation of inter-semester tests; modular tests, written and oral statements

Symbol of learning outcome	Learning outcomes	Reference to the learning outcomes for the field of study
	Skills: the graduate is able to	
LO4	understand and formulate oral statements to a greater extent, provided that they relate to a well-known subject, also those containing basic terminology in the field of the studied field	CP1_U01 CP1_U04 CP1_U05
LO5	understand and formulate to a greater extent texts on various issues of the modern world, including those containing the basic terminology of the field of study	CP1_U01 CP1_U05
LO6	understand and interpret the selected type of specialist text	CP1_U01 CP1_U05
	Social competences: the graduate is ready to	
LO7	take an active part in the discussion respecting the diversity of expressed opinions, views, cultural references	CP1_K02

Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO4	Evaluation of inter-semester tests; modular tests, written and oral statements;	C
LO5	Evaluation of inter-semester tests; modular tests, written and oral statements;	C
LO6	Evaluation of inter-semester tests; modular tests, written and oral statements;	C
LO7	Evaluation of inter-semester tests; modular tests, written and oral statements;	C

Student workload (in hours)		No. of hours
Calculation	Classes attendance	30
	Preparation for classes	9
	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	35	1,4
Student workload - practical activities	50	2

Basic references	1. Murphy R., English Grammar in Use, Cambridge: Cambridge University Press 2010. 2. Cieplicka M., Torzewska W., Русский язык. Kompendium tematyczno-leksykalne 2, Wagros 2008. 3. Długokęcka J., Chadaj S., Język niemiecki zawodowy w branży elektronicznej, informatycznej i elektrycznej, WSIP 2013. 4. McCarthy M., Academic Vocabulary in Use, Cambridge: Cambridge University Press 2010. 5. Chwatow S., Hajczuk R., Русский язык в бизнесе, WSiP 2000. 6. Kuhn Ch., Niemann R. M., Winzer-Kiontke B., Studio d - Die Mittelstufe B2, Cornelsen Verlag 2010. 7. Foley M., My Grammar Lab, Pearson 2012. 8. Granatowska H., Danecka I., Как дела? 2. Wyd. Szkolne PWN 2003. 9. Koithan U., Schmitz H., Sieber T., Sonntag R., Aspekte Mittelstufe Deutsch, Langenscheidt 2007. 10. Milczarek W., Język rosyjski od A do Z. Repetytorium, Kram. 2007.
Supplementary references	1. Longman Dictionary of Contemporary English. Harlow: Pearson Education 2011. 2. Kowalska N., Samek D., Praktyczna gramatyka języka rosyjskiego, REA 2004. 3. Nietrzebka M., Ostalak S., Alles klar Grammatik, WSIP 2004. 4. Kuca Z., Język rosyjski w biznesie dla średniozaawansowanych, WSiP 2007. 5. Kostka G., Elektroniker fuer Energie- und Gebaeudetechnik, Fundacja VCC. 6. Samek D., Rozmówki polsko-rosyjskie, REA 2009. 7. Słownik naukowo-techniczny polsko-niemiecki, niemiecko-polski. WNT 2006, 2007. 8. Słownik naukowo-techniczny rosyjsko-polski. WNT 2009. 9. Corbeil J-C., Archambault A., Wielojęzyczny słownik wizualny, leksykon tematyczny, Wydawnictwo Wilga 1996.

Organisational unit conducting the course	School of Foreign Languages	Date of issuing the programme
Author of the programme	mgr Dorota Ostrowska	2022-06-07

Bialystok University of Technology
Faculty of Electrical Engineering

Field of study	**Industry Digitization**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**common subject**							Study profile	**general academic**
Course name	**Intelectual property protection**							Course code	**CP1S03009**
								Course type	**elective**
Forms and number of hours of educational ectivities	L	C	LC	P	SW	FW	S	Semester	**3**
	15							No. of ECTS credits	**1**
Entry requirements	-								
Course objectives	Discussion of the legal bases of copyright as well as intellectual property and patent protection regulations at the national, community and international level. Legal and patent protection of material goods, configuration of integrated circuits and protection of software and databases. Acquainting with the strategies of patent protection and the procedure of obtaining patents. Explanation of the rules of using tangible and intangible goods protected by law. Obtaining information on patents.								
Course content	Lecture: Basic concepts of intellectual property protection: the concept of creator, intellectual property, property of things, concept of innovation, work, patents, utility models, industry designs owe, trademarks. Co-authorship and employee works. Protection of intellectual property in the light of university law. The Act on Combating Unfair Competition. Agreements used in the trade of intellectual property rights. Patent application procedures (national, international). Patent databases: national, international. Patent Claims. Exclusive rights. Managing industrial and intellectual property. Premises of protection of innovative solutions. Sources of intellectual property law in Poland, European and international law. Copyright and related rights. Property rights and personal rights. Industrial property law. Industrial property law and copyright protection. Legal protection of software and databases. Prerequisites for protection resulting from copyright.								
Teaching methods	Informative-problem lecture;								
Assessment method	Lecture: one test								

Symbol of learning outcome	Learning outcomes	Reference to the learning outcomes for the field of study
	Knowledge: the graduate knows and understands	
LO1	basic concepts of the intellectual property protection	CP1_W13
LO2	basic principles of industrial property law and copyright law	CP1_W13
LO3	rules of using tangible and intangible goods protected by law	CP1_W13

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	
Student workload (in hours)		No. of hours	
Calculation	Lecture attendance	15	
	Preparation for lecture test(s)	5	
	Participation in teacher-student sessions related to the module subject	5	
	TOTAL	25	
Quantitative indicators		Hours	ECTS
Student workload - activities that require direct teacher participation		20	0,8
Student workload - practical activities		0	0
Basic references	1. Pyrża A., Poradnik wynalazcy. Urząd Patentowy RP, Warszawa, 2017. 2. Rzężelewska D., Własność intelektualna dla przedsiębiorcy. Urząd Patentowy RP, Warszawa, 2020. 3. Markiewicz R., Ilustrowane prawo autorskie. Wolters Kluwer Polska, Warszawa, 2018. 4. Przewodnik dla eksperta ochrony własności intelektualnej, NCBR, Warszawa, 2017. 5. Nowak–Gruca A., Własność intelektualna w przedsiębiorstwie, Gdańsk: ODDK Sp. o.o. Sp.k, 2018.		
Supplementary references	1. Ustawa z dnia 4 lutego 1994 r. o prawie autorskim i prawach pokrewnych (Dz. U. 2021. poz. 1062 z późn. zm.). 2. Ustawa z dnia 30 czerwca 2000 r. Prawo własności przemysłowej (Dz.U.2001 nr 49 poz. 508 z późn. zm.). 3. Ustawa z dnia 16 kwietnia 1993 r. o zwalczaniu nieuczciwej konkurencji, (Dz.U. 2021 poz. 1655 z późn. zm.). 4. du Vall M., du Vall P., Kostański P., Ożegalska-Trybalska J., Podrecki P., Traple E., Uchańska Joanna, Prawo patentowe. Wolters Kluwer Polska, 2017. 5. Michniewicz G., Ochrona własności intelektualnej, C.H.BECK, 2016.		
Organisational unit conducting the course	Department of Electrical Engineering, Energoelectronics and Electroenergetics	Date of issuing the programme	
Author of the programme	dr hab. inż. Bogusław Butryło, prof. PB	2022-06-07	

Bialystok University of Technology
Faculty of Electrical Engineering

Field of study	**Industry Digitization**							Degree level and programme type	**full-time Bachelor's degree**
Specjalization / diploma path	**common subject**							Study profile	**general academic**
Course name	**Legal aspects of industry digitization**							Course code	**CP1S03010**
								Course type	**elective**
Forms and number of hours of educational ectivities	L	C	LC	P	SW	FW	S	Semester	**3**
	15							No. of ECTS credits	**1**
Entry requirements	-								
Course objectives	Overview of copyright law and patent protection. Acquainting with the strategies of patent protection and the procedure of obtaining patents. Explanation of the rules of using tangible and intangible goods protected by law. Presentation of issues related to software licensing, legal restrictions applied by manufacturers of digital devices. Discussion of the security issues of data storage, securing data sets, the use of cloud technology. Principles of assembly and arrangement of electrical devices. Overview of the principles of universal design in the field of technical solutions in the field of industry digitization. Implementation of the principles of sustainable development as part of solutions in the field of industry digitization.								
Course content	Lecture: Premises of protection of technical and IT solutions. Basic terms in the field of intellectual property protection: creator, intellectual property, property of things, innovation, work, patent. Security, data consistency in cloud technologies. Legal restrictions by device manufacturers. Ergonomics and principles of device construction: principles of the arrangement of electrical devices, principles of the arrangement of control and monitoring devices. Influence of digital technologies on ergonomics of workplaces. Ergonomics in cyber-physical systems. Ergonomic workstations in a human-machine cooperation system. Principles of universal design in the field of industry digitization technology. Sustainable development: goals and principles, examples of implementing the principles. Intellectual property law. Copyright, property law, industrial property. Protection of intellectual property in the light of university law. Agreements used in the trade of intellectual property rights. Patent application procedures. Patent databases: national, international. Managing industrial and intellectual property. Legal protection of software and databases.								
Teaching methods	Informative-problem lecture;								
Assessment method	Lecture: one test								

Symbol of learning outcome	Learning outcomes	Reference to the learning outcomes for the field of study

	Knowledge: the graduate knows and understands	
LO1	basic concepts for the protection of intellectual property	CP1_W13
LO2	basic principles of industrial property law and copyright, principles of using goods protected by law	CP1_W13
LO3	basic data security principles	CP1_W13
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
Student workload (in hours)		No. of hours
Calculation	Lecture attendance	15
	Preparation for lecture test(s)	5
	Participation in teacher-student sessions related to the module subject	5
	TOTAL	25
Quantitative indicators		Hours / ECTS
Student workload - activities that require direct teacher participation		20 / 0,8
Student workload - practical activities		0 / 0
Basic references	1. Pyrża A., Poradnik wynalazcy. Urząd Patentowy RP, Warszawa, 2017. 2. Rzężelewska D., Własność intelektualna dla przedsiębiorcy. Urząd Patentowy RP, Warszawa, 2020. 3. Markiewicz R., Ilustrowane prawo autorskie. Wolters Kluwer Polska, Warszawa, 2018. 4. Dotson C., Bezpieczeństwo w chmurze. Przewodnik po projektowaniu i wdrażaniu zabezpieczeń. PWN, 2020. 5. Ignac-Nowicka J., Ergonomia i higiena przemysłowa. Wykłady. Wydawnictwa Politechniki Śląskiej, 2017.	
Supplementary references	1. Ustawa z dnia 4 lutego 1994 r. o prawie autorskim i prawach pokrewnych (Dz. U. 2021. poz. 1062 z późn. zm.). 2. Ustawa z dnia 30 czerwca 2000 r. Prawo własności przemysłowej (Dz.U.2001 nr 49 poz. 508 z późn. zm.). 3. du Vall M., du Vall P., Kostański P., Ożegalska-Trybalska J., Podrecki P., Traple E., Uchańska Joanna, Prawo patentowe. Wolters Kluwer Polska, 2017. 4. Bąk I., Cheba K., Zielona gospodarka jako narzędzie zrównoważonego rozwoju. CeDeWu Sp. z o.o., 2020. 5. Rogall H., Ekonomia Zrównoważonego Rozwoju, Wydawnictwo Zysk i S-ka, 2010.	
Organisational unit conducting the course	Department of Electrical Engineering, Energoelectronics and Electroenergetics	Date of issuing the programme
Author of the programme	dr hab. inż. Bogusław Butryło, prof. PB	2022-06-07