

# Bialystok University of Technology



Study programme

## industry digitization

full-time Bachelor's degree in Engineering

sixth level of the Polish Qualifications Framework

Białystok 2023

## General characteristics of the studies

Name of the field of study: **industry digitization**.

Level of study: first-cycle studies (level 6 of the Polish Qualifications Framework).

Education profile: general academic profile.

Form of study: full-time studies.

ISCED code: 0714. Electronics and automation.

Assignment of the field of study to the discipline to which the learning outcomes apply: The learning outcomes for the field of industry digitization relate to the field of **engineering and technical sciences** and are assigned to the scientific discipline: *automatic control, electronics and electrical engineering*.

Professional title awarded to the graduate: After completing the first-cycle studies in the field of *industry digitization*, the graduate obtains the professional title of **engineer (Bachelor in Engineering)**.

The total number of semesters and the number of ECTS credits necessary to obtain qualifications corresponding to the level of study: 7 semesters and 210 ECTS credits.

## Graduate's profile

A graduate of the Bachelor studies in the field of industry digitization has knowledge and practical skills in the field of designing, assembling, operating and testing modern production lines connected via information networks with production management and planning systems. He/she can use artificial intelligence in vision systems of robots and production processes. He can program, operate and test autonomous mobile robots collaborating with intelligent components of a digital factory.

A graduate of the Bachelor studies in the field of industry digitization of industry acquires solid knowledge and practical skills in the field of analysis, modeling, design and completion, implementation, maintenance and testing of modern technical solutions for newly emerging flexible manufacturing systems and existing modernized production lines, which are managed and controlled via the network in accordance with the Industry 4.0 concept. The graduate is able to use artificial intelligence tools for the needs of robotic and cobot vision systems and to control robotic production processes; has practical skills related to programming, operating and testing autonomous mobile robots cooperating with intelligent components of a digital factory.

The graduate has knowledge, among others, in the field of:

- exact and technical sciences: mathematics, physics, metrology, analog technology and basic electronics - to the extent adapted to the issues of industry digitization;
- sensors and measurement systems, Internet of Things technology and cloud data processing;
- the use of artificial intelligence and image processing in the digital factory;
- programming of manipulators, industrial robots, collaborative cobots and autonomous mobile robots integrated with material handling systems;
- robotics, robotization, visualization and virtualization of industrial processes;
- theoretical foundations in the field of modern automation, robotics, digital signal processing;
- programming embedded controllers, PLC controllers and industrial communication networks.

The graduate is prepared to:

- use a foreign language at the proficiency level of at least B2 of the Common European Framework of Reference for Languages;
- use specialist language for terms and issues of the field of study;
- use information and communication techniques for digital factory management;
- select devices as well as maintenance and test production lines coupled via the Internet of Things with cloud data processing systems in order to improve the organization and increase production efficiency

and rational inventory management in terms of the archetypes of factories of the future, Industry 4.0 technology and Engineer 4.0 competences;

- operate, integrate and program mobile robots and industrial manipulators, cobots collaborating with automated flexible cells of production lines.

The graduate finds employment in engineering companies dealing with the design, implementation and operation of intelligent technological lines in digital factories; in enterprises designing and implementing industrial systems for automation and robotization of production processes; in companies dealing with the implementation and operation of autonomous collaborative robots: mobile and stationary. The graduate is prepared for the role of a member of teams developing projects to modernize factories, implement digitization strategies, knows the realities and specifics of the company's operation, knows how to implement technical solutions that increase flexibility and productivity, while maintaining cyber security and protection of identification and operational data, reducing the cost of production of goods. He can also be a team leader, technical expert and engineer independently performing technical tasks, such as: designing, managing teams, maintenance and servicing systems in the field of automation, robotization and digitization of industrial processes.

## Learning outcomes

Symbol	Description of learning outcomes  Field of study: digitization of industry Level of education: first-cycle studies Educational profile: general academic profile	Reference to qualifications obtained at level 6 in accordance with the characteristics of the first and second cycle of the Polish Qualifications Framework	Reference to engineering competences
<b>KNOWLEDGE: knows and understands</b>			
CP1_W01	at an advanced level, selected topics in the field of mathematics and physics necessary to describe, understand and analyze components and systems of electronics, automation, manipulators and robots	P6U_W, P6S_WG	P6S_WG
CP1_W02	at an advanced level, the principles and methods of mathematical and physical modeling of phenomena and processes in the field of electronics and automation systems, design and control of robots, and the integration of the above-mentioned techniques in the field of industry digitization methods	P6U_W, P6S_WG	P6S_WG
CP1_W03	at an advanced level, principles of operation of electronics and automation components and systems, as well as mechanical components that are the basis for the operation of automation systems	P6U_W, P6S_WG	P6S_WG
CP1_W04	at an advanced level, selected principles, methods and tools for the analysis and selection of electrical and electronic components and systems used in devices, facilities and systems designed for the needs of industry digitization	P6U_W, P6S_WG	P6S_WG
CP1_W05	at an advanced level, selected principles, methods and tools for the analysis and selection of mechanical components and systems used in devices designed and used for the needs of industry digitization	P6U_W, P6S_WG	P6S_WG

CP1_W06	at an advanced level, selected issues in the field of architecture of microprocessor systems, their functioning, programming and application in control systems	P6U_W, P6S_WG	P6S_WG
CP1_W07	at an advanced level, methods and techniques of programming and their application in electronic systems, automation and robotics, principles of software development	P6U_W, P6S_WG	P6S_WG
CP1_W08	at an advanced level, principles and methods of implementing solutions using databases and artificial intelligence algorithms	P6U_W, P6S_WG	P6S_WG
CP1_W09	at an advanced level, selected techniques of signal and image processing	P6U_W, P6S_WG	P6S_WG
CP1_W10	at an advanced level, principles of operation, design and application of technical solutions in the field of wired and wireless networks, industrial networks and data transmission protocols	P6U_W, P6S_WG	P6S_WG
CP1_W11	non-technical conditions of engineering activity, basic dilemmas of modern civilization, basic principles of occupational health and safety and principles of safe operation of electronic, automation and mechanical systems	P6U_W, P6S_WK	P6S_WK
CP1_W12	design and operation principles as well as selected processes occurring in the life cycle of electronic, mechanical and IT devices, facilities and systems	P6U_W, P6S_WG	P6S_WG
CP1_W13	basic economic, legal, ethical and other conditions of industry digitization, including intellectual property protection and patent law, as well as selected issues in the field of management and business and selected principles of creating and developing various forms of individual entrepreneurship	P6U_W, P6S_WK	P6S_WK
CP1_W14	principles, conditions and methods of implementing sustainable development processes	P6U_W, P6S_WG	P6S_WG
<b>SKILLS: can</b>			
CP1_U01	acquire knowledge from literature, databases and other sources, also in a foreign language; integrate the obtained information, perform its critical analysis and synthesis, draw conclusions and formulate and justify opinions	P6U_U, P6S_UW	P6S_UW
CP1_U02	use knowledge from various fields of science to analyze, formulate and solve complex technical problems; carry out an assessment and critical analysis of the functioning of existing technical solutions	P6U_U, P6S_UW	P6S_UW
CP1_U03	independently plan his/her own development; plan and organize individual and team work; collaborate in teamwork; estimate the time needed to complete the task; develop a work schedule and implement this schedule within the assumed deadlines	P6U_U, P6S_UO, P6S_UU	n/a
CP1_U04	develop technical documentation regarding the tasks performed; prepare a text and a presentation on the results of the work carried out, also in foreign language	P6U_U, P6S_UW	P6S_UW
CP1_U05	use a foreign language at least at level B2 of the Common European Framework of Reference for Languages, including communicating in an international engineering environment; participate in a debate, presenting, evaluating and discussing various opinions and positions; use technical documentation and instructions for applied tools and systems	P6U_U, P6S_UK	n/a

CP1_U06	define and solve complex, unusual problems and operate in conditions that are not fully predictable, using known methods, mathematical models, numerical techniques and engineering tools to analyze basic issues, synthesize and evaluate the operation of industry digitization systems	P6U_U, P6S_UW	P6S_UW
CP1_U07	using appropriate IT tools, develop a computer algorithm, software for drivers and embedded systems	P6U_U, P6S_UW	P6S_UW
CP1_U08	design, implement and operate a selected system in which electronic and IT solutions have been integrated, including data, signal and image transmission and processing	P6U_U, P6S_UW	P6S_UW
CP1_U09	use IT tools, including advanced information and communication techniques, to visualize and virtualize technical processes	P6U_U, P6S_UW	P6S_UW
CP1_U10	use industry digitization techniques, including electronics, automation, robotics techniques	P6U_U, P6S_UW	P6S_UW
CP1_U11	plan and conduct experiments, including measurements and computer simulations, interpret the obtained results, draw conclusions, formulate opinions	P6U_U, P6S_UW,	P6S_UW
CP1_U12	when formulating and solving engineering tasks, perceive non-technical aspects, including environmental, economic, legal and those resulting from the principles of sustainable development and universal design; evaluate the proposed solutions and activities in economic terms	P6U_U, P6S_UW	P6S_UW
CP1_U13	apply the rules of occupational health and safety	P6U_U, P6S_UW	P6S_UW
<b>SOCIAL COMPETENCES: is ready to</b>			
CP1_K01	critical assessment of knowledge, use of own knowledge and expert opinions to solve various problems	P6U_K, P6S_KK	n/a
CP1_K02	behave in a professional manner, comply with ethical standards and rules of professional ethics and require others to do so, care for the achievements, traditions, rank and ethos of the engineering profession, respect the diversity of views and cultures	P6U_K, P6S_KR	n/a
CP1_K03	taking actions in a planned manner, taking responsibility for the tasks performed, responsibly fulfilling professional duties	P6U_K, P6S_KO	n/a
CP1_K04	thinking and acting in a creative and entrepreneurial way	P6U_K, P6S_KO	n/a
CP1_K05	taking initiatives for the benefit of the social environment and the public interest, and broadly implementing the principles of sustainable development	P6U_K, P6S_KO	n/a

Legend:

- AR1 – learning outcomes for Bachelor's degree studies in *industry digitization*
- W – category of knowledge
- U – category of skills
- K – category of social competences
- 01, 02, 03... - the number of a learning outcome
- Symbols according to the Polish Qualifications Framework (PQF)
- P - level of the Polish Qualifications Framework
- U - universal characteristics

K - social competences

P6U\_W – level 6 of PQF, universal characteristics, knowledge

P6U\_U – level 6 of PQF, universal characteristics, skills

P6U\_K – level 6 of PQF, universal characteristics, social competences

P6S – learning outcomes for Bachelor's level according to the Polish Qualifications Framework;

W – knowledge (the graduate knows and understands): P6S\_WG – scope and depth / completeness of learning perspective and relations, P6S\_WK – context / determinants, results;

U – skills (the graduate can): P6S\_UW – knowledge application / solved problems and conducted tasks; P6S\_UK – communications / receiving and creating statements, dissemination of knowledge in the scientific community and using a foreign language; P6S\_UO – work organization / planning and teamwork; P6S\_UU – learning / planning your own development and development of other people;

K – social competences (the graduate is ready to): P6S\_KK – rating / critical approach, P6S\_KO – responsibility / filling social liabilities and taking actions for public interest, P6S\_KR – professional role / independence and ethos development..

## Study programme

### SEMESTER 1

No	Course name	Course code	Hours per week							Hours per semester	ECTS credits
			L	C	LC	P	SW	FW	S		
1	Mathematics 1 (E)	CP1S01001	30	60	-	-	-	-	-	90	7
2	Technical drawing (E)	CP1S01002	15	-	-	-	45	-	-	60	5
3	Analog technology and fundamentals of electronics (E)	CP1S01003	30	15	15	-	-	-	-	60	5
4	Engineering software	CP1S01004	15	-	-	-	30	-	-	45	3
5	C programming	CP1S01005	15	-	-	-	30	-	-	45	3
6	Operating systems	CP1S01006	15	-	-	-	30	-	-	45	3
7	Occupational safety, health and ergonomics	CP1S01007	15	-	-	-	-	-	-	15	1
8	New trends in AEE and ID technologies	CP1S01008	15	-	-	-	-	-	-	15	1
	Innovative solutions for engineering problems	CP1S01009									
9	Methodology of studies	CP1S01010	30	-	-	-	-	-	-	30	2
	Development of professional career	CP1S01011									
10	Physical education 1	CP1S01012	-	30	-	-	-	-	-	30	-
		<b>TOTAL</b>	<b>180</b>	<b>105</b>	<b>15</b>	<b>-</b>	<b>135</b>	<b>-</b>	<b>-</b>	<b>435</b>	<b>30</b>

### SEMESTER 2

No	Course name	Course code	Hours per week							Hours per semester	ECTS credits
			L	C	LC	P	SW	FW	S		
1	Mathematics 2 (E)	CP1S02001	45	45	-	-	-	-	-	90	8
2	Physics (E)	CP1S02002	30	30	-	-	-	-	-	60	5
3	Electronic components and subsystems	CP1S02003	15	-	30	-	-	-	-	45	3
4	Mechanical components and subsystems	CP1S02004	15	-	-	-	30	-	-	45	3
5	Python programming 1	CP1S02005	15	-	-	-	30	-	-	45	3
6	3D prototyping and additive manufacturing	CP1S02006	15	-	-	-	15	-	-	30	2
7	Metrology (E)	CP1S02007	15	-	30	-	-	-	-	45	4
8	Foreign language 1	CP1S02008	-	30	-	-	-	-	-	30	2
9	Physical education 2	CP1S02009	-	30	-	-	-	-	-	30	-
		<b>TOTAL</b>	<b>150</b>	<b>135</b>	<b>60</b>	<b>-</b>	<b>75</b>	<b>-</b>	<b>-</b>	<b>420</b>	<b>30</b>

**SEMESTER 3**

No	Course name	Course code	Hours per week							Hours per semester	ECTS credits
			L	C	LC	P	SW	FW	S		
1	Fundamentals of control (E)	CP1S03001	30	-	30	-	30	-	-	90	7
2	Fundamentals of robotics (E)	CP1S03002	30	30	30	-	-	-	-	90	7
3	Computer aided design 1	CP1S03003	15	-	-	-	30	-	-	45	3
4	Computer aided design 2	CP1S03004	15	-	-	-	30	-	-	45	3
5	Python programming 2	CP1S03005	-	-	-	-	30	-	-	30	2
6	Digital signal processing (E)	CP1S03006	15	-	30	-	-	-	-	45	4
7	Materials processing technologies	CP1S03007	15	-	-	-	-	-	-	15	1
8	Foreign language 2	CP1S03008	-	30	-	-	-	-	-	30	2
9	Intellectual property protection	CP1S03009	15	-	-	-	-	-	-	15	1
	Legal aspects of industry digitization	CP1S03010									
<b>TOTAL</b>			<b>135</b>	<b>60</b>	<b>90</b>	<b>-</b>	<b>120</b>	<b>-</b>	<b>-</b>	<b>405</b>	<b>30</b>

**SEMESTER 4**

No	Course name	Course code	Hours per week							Hours per semester	ECTS credits
			L	C	LC	P	SW	FW	S		
1	Automatic control (E)	CP1S04001	30	-	30	-	-	-	-	60	6
2	Fluid drive systems	CP1S04002	15	-	30	-	-	-	-	45	3
3	Electric drive systems	CP1S04003	15	-	30	-	-	-	-	45	3
4	Programming of mobile applications	CP1S04004	15	-	-	-	30	-	-	45	3
5	PLCs programming (E)	CP1S04005	30	-	-	-	45	-	-	75	7
6	Computer networks and wireless systems	CP1S04006	15	-	30	-	-	-	-	45	3
7	Sensors and measurement systems (E)	CP1S04007	15	-	-	-	30	-	-	45	3
8	Foreign language 3	CP1S04008	-	30	-	-	-	-	-	30	2
<b>TOTAL</b>			<b>135</b>	<b>30</b>	<b>120</b>	<b>-</b>	<b>105</b>	<b>-</b>	<b>-</b>	<b>390</b>	<b>30</b>

### SEMESTER 5

No	Course name	Course code	Hours per week							Hours per semester	ECTS credits
			L	C	LC	P	SW	FW	S		
1	Programming of autonomous robots (E)	CP1S05001	15	-	30	-	-	-	-	45	4
	Applications of autonomous robots (E)	CP1S05002									
2	Programming of industrial robots (E)	CP1S05003	15	-	30	-	-	-	-	45	4
	Applications of industrial robots (E)	CP1S05004									
3	Programming of embedded systems	CP1S05005	15	-	30	-	-	-	-	45	3
4	Databases	CP1S05006	15	-	-	-	30	-	-	45	3
5	Cybersecurity	CP1S05007	15	-	15	-	-	-	-	30	2
	Security and reliability of computer systems	CP1S05008									
6	Process visualization	CP1S05009	15	-	-	-	30	-	-	45	3
7	Industrial networks 1 (E)	CP1S05010	15	-	-	-	45	-	-	60	6
8	Internet of Things	CP1S05011	15	-	30	-	-	-	-	45	3
9	Foreign language 4	CP1S05012	-	30	-	-	-	-	-	30	2
		<b>TOTAL</b>	<b>120</b>	<b>30</b>	<b>135</b>	<b>-</b>	<b>105</b>	<b>-</b>	<b>-</b>	<b>390</b>	<b>30</b>

### SEMESTER 6

No	Course name	Course code	Hours per week							Hours per semester	ECTS credits
			L	C	LC	P	SW	FW	S		
1	Robotization of industrial processes	CP1S06001	15	-	-	-	30	-	-	45	4
2	Algorithms of artificial intelligence 1 (E)	CP1S06002	15	-	-	-	30	-	-	45	4
	Algorithms of intelligent controllers (E)	CP1S06003									
3	Image processing algorithms (E)	CP1S06004	30	-	-	-	30	-	-	60	6
	Object recognition in industrial processes (E)	CP1S06005									
4	Interim team project	CP1S06006	-	-	-	30	-	-	-	30	3
5	Cloud databases	CP1S06007	15	-	-	-	30	-	-	45	3
6	Systems virtualization	CP1S06008	15	-	-	-	30	-	-	45	4
	Cyberphysical systems	CP1S06009									
7	Industrial networks 2 (E)	CP1S06010	15	-	-	-	45	-	-	60	6
		<b>TOTAL</b>	<b>105</b>	<b>-</b>	<b>-</b>	<b>30</b>	<b>195</b>	<b>-</b>	<b>-</b>	<b>330</b>	<b>30</b>

## SEMESTER 7

No	Course name	Course code	Hours per week							Hours per semester	ECTS credits
			L	C	LC	P	SW	FW	S		
1	Digital factory	CP1S07001	15	-	30	-	-	-	-	45	4
	Digitization of factory processes	CP1S07002									
2	Algorithms of artificial intelligence 2	CP1S07003	15	-	-	-	15	-	-	30	3
	Knowledge based control systems	CP1S07004									
3	Diploma seminar	CP1S07005	-	-	-	-	-	-	30	30	3
4	Realization of diploma thesis	CP1S07006	-	-	-	-	-	-	-	-	15
5	Vocational training*	CP1S07007	-	-	-	-	-	-	-	-	4
6	Economics	CP1S07008	15	-	-	-	-	-	-	15	1
	Organization and management	CP1S07009									
<b>TOTAL</b>			<b>45</b>	<b>-</b>	<b>30</b>	<b>-</b>	<b>15</b>	<b>-</b>	<b>30</b>	<b>120</b>	<b>30</b>

\*Vocational training of at least four weeks, carried out until the end of the seventh semester.