Wydział Elektroniki i Informatyki

STUDY PROGRAMME

Applied Computer Science

FIRST-CYCLE STUDIES

PROFILE OF EDUCATION: GENERAL ACADEMIC

KOSZALIN, 2025

1. GENERAL CHARACTERISTICS OF THE FIELD OF STUDY

Name of the field of study: *Applied Computer Science.*
Level of study: *first-cycle studies.*
Form of study: *full-time studies.*
Profile of studies: *general academic.*
Professional title awarded to graduates: *engineer.*

Field and scientific discipline:

Field name	Discipline name	Percentage of points ECTS (%)	Leading discipline
Engineering and technology	Automation, electronics, electrical engineering and space technology	**60**	**YES**
Engineering and technology	Information and communication technology	**40**	

Number of semesters: *7*
Number of ECTS credits required for a qualification: *210*
Language of education: English

2. GRADUATE QUALIFICATIONS

The first-cycle studies in *Applied Computer Science* enable students to acquire the knowledge and skills necessary to independently solve problems in the field of design, implementation and operation of intelligent devices used in areas such as smart buildings and cities, the Internet of Things (*IoT*), embedded systems or wearable electronics. This is a combination of analogue and digital circuits, devices and electronic and microprocessor systems with data processing, analysis and transmission techniques, programming languages and artificial intelligence methods.

Graduates also have general preparation in mathematics and physics, economic and humanistic subjects, a foreign language and general IT education.

A graduate can work in any company involved in the design, implementation, programming and testing of industrial and home automation devices, mobile and embedded systems or the Internet of Things, performing professions such as: embedded systems programmer, FPGA programmer, PLC programmer, automation engineer, data analysis specialist, industrial process engineer, IT support specialist, control systems designer.

The graduate is also prepared to undertake second-cycle studies and specialist training.

3. LEARNING OUTCOMES

The learning outcomes of the *Applied Computer Science* programme relate to the field of engineering and technology, in the disciplines of *Automation, electronics, electrical engineering and space technology* (leading discipline) and *Information and communication technology*. Directional learning outcomes, defined in terms of knowledge, skills and social competences, take into account the universal characteristics of the Integrated Qualifications System for qualifications at level 6. of the Polish Qualifications Framework, the characteristics of the second level of the Integrated Qualifications System for qualifications at level 6. of the Polish Qualifications Framework and the second-level characteristics of the Integrated Qualifications System for qualifications at level 6. Polish Qualifications Framework enabling the acquisition of engineering competences.

The learning outcomes take into account, in particular, the acquisition by students of knowledge, skills, including research skills, and social competences necessary both in research activities and in the labour market. The study program assumes the use of various teaching methods, enabling the student to achieve the assumed learning outcomes. The basic forms of classes are lectures, classes, laboratories and project-based classes, enabling the design and creation of innovative solutions using the latest technologies, as part of tasks carried out individually or in groups. Classes will be carried out in the university's laboratories. As part of the diploma seminars, the student acquires knowledge and skills that prepare him or her to conduct his or her own research. The use of activating teaching methods makes it possible to achieve all the assumed learning outcomes.

3.1 Learning outcomes taking into account the universal characteristics of the first level of the Integrated Qualifications System for qualifications at level 6. of the Polish Qualifications Framework

Tab. 1. Learning outcomes for the first-cycle programme in Applied Computer Science taking into account the universal characteristics of the first cycle of the Integrated Qualifications System for qualifications at level 6. of the Polish Qualifications Framework

Universal Characteristics of the first degree for qualifications at PQF level 6		**First-cycle studies in the field of *Applied Computer Science***	
Knowledge (*knows and understands*)			
P6U_W	– at an advanced level, facts, theories, methods and complex relationships between them; – various complex conditions of the conducted activities.	**K1A_P6_W**	- has knowledge in mathematics, including mathematical analysis, linear algebra, probabilistics and statistics, numerical methods, mathematical logic, discrete mathematics. - has knowledge of physics, including mechanics, thermodynamics, optics, electricity and magnetism, nuclear physics and solid state physics - has structured and theoretically based knowledge of the principles of operation of electronic components, analogue and digital electronic circuits and simple electronic systems - knows and understands the design methodology and manufacturing processes of electronic components, integrated circuits and microsystems, - knows the languages of equipment description and appropriate design tools - knows and understands the processes of constructing and manufacturing simple electronic devices - has a well-structured knowledge of the theory of electrical circuits and the theory of signals and methods of their processing - has basic knowledge in the field of metrology, knows and understands the methods of measurement and extraction of basic quantities characterizing electronic elements and systems of various types, knows the calculation methods and IT tools necessary to analyze the results of the experiment - is familiar with the current state and the latest development trends in electronics and IT - has structured knowledge of computer architecture, in particular the hardware layer - has structured knowledge of programming - has structured knowledge of computer architecture, embedded systems, pipeline and parallel processing, external devices and operating systems - has systematic knowledge of network technologies, in particular network topologies, data transmission, including wireless, network protocols, network devices, network traffic control and network security mechanisms - has elementary knowledge of the basics of telecommunications and telecommunications systems and networks - has a structured knowledge of electromagnetic fields and waves, including the knowledge necessary to understand the ways in which wireless (radio) systems work - has the basic knowledge necessary to understand the non-technical conditions of engineering activity - has elementary knowledge in the field of intellectual property protection as well as copyright and patent law - has elementary knowledge in the field of management and running a business - has knowledge in the field of computer graphics - knows and understands the methods of artificial intelligence, the structure, operation and applications of expert systems - has the basic knowledge necessary to understand the social, economic, legal and other non-technical conditions of engineering activity in the field of information technology - has structured and theoretically based knowledge necessary to carry out an engineering diploma thesis

Universal Characteristics of the first degree for qualifications at PQF level 6		First-cycle studies in the field of *Applied Computer Science*	
Skills (is able to)			
P6U_U	- Innovatively perform tasks and solve complex and unusual problems in variable and not fully predictable conditions; - Independently plan their own lifelong learning; - Communicate with their surroundings, justify their position.	**K1A_P6_U**	- is able to obtain information from literature, databases and other sources; is able to integrate the information obtained, interpret it, as well as draw conclusions, formulate and justify opinions - can work individually and in a team, define goals and priorities, develop a work schedule - is able to develop documentation of the task carried out and prepare a concise presentation of the achieved results - speaks a foreign language to a sufficient degree to communicate - has the ability to independently deepen and update his/her general and professional knowledge - is able to use the learned mathematical methods and models, as well as computer simulations to analyze and evaluate the operation of electronic components as well as analog and digital electronic circuits - is able to use the learned mathematical and physical methods and models to design, build and operate IT systems and networks - is able to analyse signals and simple signal processing systems in the time and frequency domain, using analogue and digital techniques and appropriate hardware and software tools - is able to use properly selected programming environments, simulators and computer-aided design tools for simulation, design and verification of electronic components and systems as well as simple electronic systems - is able to use properly selected methods and devices enabling the measurement of basic quantities characterizing electronic components and systems - can design the process of testing components, analogue and digital electronic circuits and simple electronic systems and - if errors are detected - diagnose them - can formulate the specification of simple electronic systems at the level of the functions performed, also with the use of hardware description languages - is able to design electronic, analogue and digital circuits (also in integrated versions) and electronic systems, taking into account the given utility and economic criteria, using appropriate methods, techniques and tools - can build, commission and test a designed circuit or a simple electronic system - can configure communication devices in local (wired and radio) ICT networks - is able to formulate an algorithm, uses high- and low-level programming languages and appropriate IT tools to develop computer programs controlling an electronic system and to software microcontrollers or microprocessors controlling an electronic system - is able - when formulating and solving tasks involving the design of electronic components, circuits and systems - notice their non-technical aspects, including environmental, economic and legal - applies the principles of occupational health and safety - is able to assess the usefulness of routine methods and tools used to solve simple engineering tasks, typical for electronics, and to select and use appropriate methods and tools - is able to apply the principles of software engineering to the implementation of software projects

Universal Characteristics of the first degree for qualifications at PQF level 6		First-cycle studies in the field of *Applied Computer Science*	
			- can use typical programming tools (programming environments, installation and configuration programs, programming libraries, frameworks) in programming practice - can design a database structure and develop a database application based on client-server architecture - can design and create a graphical user interface of an application taking into account the principles of human-computer communication - can implement an IT system and ensure the security of data and software storage and transmission - can use artificial intelligence methods in programming practice - can design and independently construct a local computer network, including a wireless network - can assess the state of health and safety in the workplace – especially the conditions for effective work at the computer - can inspire and organize the education of others and formulate and promote opinions on achievements in the field of electronics and information technology - can organize their own and others' work, define goals and priorities, negotiate, act and think in an entrepreneurial way
Social competences (is prepared to)			
P6U_K	- Cultivate and promote models of proper conduct in the workplace and beyond; - Make decisions independently, critically assess their own actions, the actions of teams they lead, and the organizations they participate in, taking responsibility for the consequences of these actions.	**K1A_P6_K**	- is prepared to conscientiously and reliably perform the duties entrusted to him, in accordance with ethical norms, standards and procedures applicable in the workplace - is prepared to work independently and cooperate, taking on various roles in a team or managing the work of a team - is ready to use the knowledge and experience of colleagues and share their own experience, in particular in the field of issues related to electronics and IT - critically evaluates his/her own knowledge and understands the need for further education (second- and third-cycle studies, postgraduate studies and specialist courses/training) and improvement of professional competences - understands the non-technical aspects and effects of engineering activities, including their impact on the environment and social behaviour

3.2 Learning outcomes taking into account the second-level characteristics of the Integrated Qualifications System for qualifications at level 6. of the Polish Qualifications Framework

Tab. 2. Learning outcomes for the first-cycle programme in Applied Computer Science taking into account the characteristics of the second-cycle Integrated Qualifications System for qualifications at level 6. of the Polish Qualifications Framework

Characteristics of the second degree of the IQS for qualifications at PQF level 6		**First-cycle studies in the field of *Applied Computer Science***	
Knowledge (*knows and understands*)			
P6S_WG	- At an advanced level – selected facts, objects, and phenomena as well as the methods and theories explaining the complex relationships between them, constituting basic general knowledge in the fields of scientific or artistic disciplines that form the theoretical foundations, and selected issues from the area of detailed knowledge – appropriate for the study program, and in the case of studies with a practical profile – also the practical applications of this knowledge in professional activities related to their field.	**K1A_P6_W**	- has knowledge in mathematics, including mathematical analysis, linear algebra, probabilistics and statistics, numerical methods, mathematical logic, discrete mathematics. - has knowledge of physics, including mechanics, thermodynamics, optics, electricity and magnetism, nuclear physics and solid state physics - has structured and theoretically based knowledge of the principles of operation of electronic components, analogue and digital electronic circuits and simple electronic systems - knows and understands the design methodology and manufacturing processes of electronic components, integrated circuits and microsystems, - knows the languages of equipment description and appropriate design tools - knows and understands the processes of constructing and manufacturing simple electronic devices - has a well-structured knowledge of the theory of electrical circuits and the theory of signals and methods of their processing - has basic knowledge in the field of metrology, knows and understands the methods of measurement and extraction of basic quantities characterizing electronic elements and systems of various types, knows the calculation methods and IT tools necessary to analyze the results of the experiment - has structured knowledge of computer architecture, in particular the hardware layer - has structured knowledge of programming - has structured knowledge of computer architecture, embedded systems, pipeline and parallel processing, external devices and operating systems - has systematic knowledge of network technologies, in particular network topologies, data transmission, including wireless, network protocols, network devices, network traffic control and network security mechanisms - has elementary knowledge of the basics of telecommunications and telecommunications systems and networks - has a structured knowledge of electromagnetic fields and waves, including the knowledge necessary to understand the ways in which wireless (radio) systems work - has knowledge in the field of computer graphics - knows and understands artificial intelligence methods - has structured and theoretically based knowledge necessary to carry out an engineering diploma thesis

Characteristics of the second degree of the IQS for qualifications at PQF level 6		First-cycle studies in the field of *Applied Computer Science*	
P6S_WK	- Fundamental dilemmas of contemporary civilization; - Basic economic, legal, ethical, and other conditions of various types of professional activity related to the field of study, including basic concepts and principles in the area of industrial property protection and copyright law; - Basic principles of creating and developing various forms of entrepreneurship.	**K1A_P6_W**	- has the basic knowledge necessary to understand the social, economic, legal and other non-technical conditions of engineering activity in the field of information technology - is familiar with the current state and the latest development trends in electronics and IT - has the basic knowledge necessary to understand the non-technical conditions of engineering activity - has elementary knowledge in the field of management and running a business - has elementary knowledge in the field of intellectual property protection as well as copyright and patent law
Skills (*is able to*)			
P6S_UW	- Utilize the knowledge they possess to formulate and solve complex and unusual problems and to perform tasks in conditions that are not fully predictable by: appropriately selecting sources and the information derived from them, making assessments, critical analysis, and synthesis of this information, choosing and applying the appropriate methods and tools, including advanced information and communication techniques; - Utilize the knowledge they possess; - Formulate and solve problems and perform tasks typical for professional activities related to their field of study – in the case of studies with a practical profile.	**K1A_P6_U**	- is able to obtain information from literature, databases and other sources; is able to integrate the information obtained, interpret it, as well as draw conclusions, formulate and justify opinions - is able to develop documentation of the task carried out and prepare a concise presentation of the achieved results - is able to use the learned mathematical methods and models, as well as computer simulations to analyze and evaluate the operation of electronic components as well as analog and digital electronic circuits - is able to use the learned mathematical and physical methods and models to design, build and operate IT systems and networks - is able to analyse signals and simple signal processing systems in the time and frequency domain, using analogue and digital techniques and appropriate hardware and software tools - is able to use properly selected programming environments, simulators and computer-aided design tools for simulation, design and verification of electronic components and systems as well as simple electronic systems - is able to use properly selected methods and devices enabling the measurement of basic quantities characterizing electronic components and systems - can design the process of testing components, analogue and digital electronic circuits and simple electronic systems and, if errors are detected, diagnose them - can formulate the specification of simple electronic systems at the level of the functions performed, also with the use of hardware description languages - is able to design electronic, analogue and digital circuits (also in integrated versions) and electronic systems, taking into account the given utility and economic criteria, using appropriate methods, techniques and tools

Characteristics of the second degree of the IQS for qualifications at PQF level 6		First-cycle studies in the field of *Applied Computer Science*	
P6S_UW		**K1A_P6_U**	- can build, commission and test a designed circuit or a simple electronic system - can configure communication devices in local (wired and radio) ICT networks - is able to formulate an algorithm, uses high- and low-level programming languages and appropriate IT tools to develop computer programs controlling an electronic system and to software microcontrollers or microprocessors controlling an electronic system - is able to perceive their non-technical aspects, including environmental, economic and legal aspects when formulating and solving tasks involving the design of electronic components, circuits and systems - is able to assess the usefulness of routine methods and tools used to solve simple engineering tasks, typical for electronics, and to select and use appropriate methods and tools - is able to apply the principles of software engineering to the implementation of software projects - can use typical programming tools (programming environments, installation and configuration programs, programming libraries, frameworks) in programming practice - can design a database structure and develop a database application based on client-server architecture - can design and create a graphical user interface of an application taking into account the principles of human-computer communication - can implement an IT system and ensure the security of data and software storage and transmission - can use artificial intelligence methods in programming practice - can design and independently construct a local computer network, including a wireless network
P6S_UK	- Communicate with the environment using specialized terminology; - Participate in debates – present and evaluate different opinions and positions and discuss them; - Use a foreign language at the B2 level of the Common European Framework of Reference for Languages.	**K1A_P6_U**	- is able to obtain information from literature, databases and other sources; is able to integrate the information obtained, interpret it, as well as draw conclusions, formulate and justify opinions - is able to develop documentation of the task carried out and prepare a concise presentation of the achieved results - can inspire and organize the education of others and formulate and promote opinions on achievements in the field of electronics and information technology - speaks a foreign language to a sufficient degree to communicate
P6S_UO	- Plan and organize individual work as well as teamwork; - Collaborate with others within team projects (including interdisciplinary ones).	**K1A_P6_U**	- can organize their own and others' work, define goals and priorities, negotiate, act and think in an entrepreneurial way - can inspire and organize the education of others and formulate and promote opinions on achievements in the field of electronics and information technology - is able to obtain information from literature, databases and other sources; is able to integrate the information obtained, interpret it, as well as draw conclusions, formulate and justify opinions - can work individually and in a team, define goals and priorities, develop a work schedule - can assess the state of health and safety in the workplace – especially the conditions for effective work at the computer

Characteristics of the second degree of the IQS for qualifications at PQF level 6		First-cycle studies in the field of *Applied Computer Science*	
P6S_UU	- Independently plan and carry out their own lifelong learning.	**K1A_P6_U**	- is able to obtain information from literature, databases and other sources; is able to integrate the information obtained, interpret it, as well as draw conclusions, formulate and justify opinions - can organize their own and others' work, define goals and priorities, negotiate, act and think in an entrepreneurial way - can work individually and in a team, define goals and priorities, develop a work schedule
Social competences (*is prepared to*)			
P6S_KK	- Critically evaluate their knowledge and the content they receive; - Recognize the importance of knowledge in solving cognitive and practical problems and seek experts' opinions in cases where they encounter difficulties in solving a problem on their own.	**K1A_P6_K**	- is prepared to work independently and cooperate, taking on various roles in a team or managing the work of a team - is ready to use the knowledge and experience of colleagues and share their own experience, in particular in the field of issues related to electronics and IT - critically evaluates his/her own knowledge and understands the need for further education (second- and third-cycle studies, postgraduate studies and specialist courses/training) and improvement of professional competences
P6S_KO	- Fulfill social obligations, co-organize activities for the benefit of the social environment; - Initiate actions for the public interest and think and act in an entrepreneurial manner.	**K1A_P6_K**	- is prepared to work independently and cooperate, taking on various roles in a team or managing the work of a team - understands the non-technical aspects and effects of engineering activities, including their impact on the environment and social behaviour
P6S_KR	- Responsibly perform professional roles, including: – Adhering to the principles of professional ethics and demanding the same from others, – Caring for the heritage and traditions of the profession.	**K1A_P6_K**	- is prepared to conscientiously and reliably perform the duties entrusted to him, in accordance with ethical norms, standards and procedures applicable in the workplace

3.3 Learning outcomes taking into account the second-level characteristics of the Integrated Qualifications System for qualifications at level 6. Polish Qualifications Framework, enabling the acquisition of engineering competences.

Tab. 3. Learning outcomes for the first-cycle programme in Applied Computer Science taking into account the characteristics of the second-cycle Integrated Qualifications System for qualifications at level 6. Polish Qualifications Framework, enabling the acquisition of engineering competences

Characteristics of the second degree of the IQS, enabling the acquisition of engineering competences		**First-cycle studies in the field of *Applied Computer Science***	
Knowledge (*knows and understands*)			
P6S_WG_KI	- basic processes occurring in the life cycle of devices, facilities and technical systems.	**K1A_P6_W**	- has structured and theoretically based knowledge of the principles of operation of electronic components, analogue and digital electronic circuits and simple electronic systems - knows and understands the design methodology and manufacturing processes of electronic components, integrated circuits and microsystems, - knows and understands the processes of constructing and manufacturing simple electronic devices - has structured knowledge of computer architecture, embedded systems, pipeline and parallel processing, external devices and operating systems - has systematic knowledge of network technologies, in particular network topologies, data transmission, including wireless, network protocols, network devices, network traffic control and network security mechanisms - has elementary knowledge of the basics of telecommunications and telecommunications systems and networks - has a structured knowledge of electromagnetic fields and waves, including the knowledge necessary to understand the ways in which wireless (radio) systems work - knows and understands the methods of artificial intelligence, the structure, operation and applications of expert systems - has the basic knowledge necessary to understand the social, economic, legal and other non-technical conditions of engineering activity in the field of information technology - has structured and theoretically based knowledge necessary to carry out an engineering diploma thesis
P6S_WK_KI	- basic principles of creating and developing various forms of individual entrepreneurship.	**K1A_P6_W**	- has the basic knowledge necessary to understand the social, economic, legal and other non-technical conditions of engineering activity in the field of information technology - has elementary knowledge in the field of management and running a business

Skills (*is able to*)			

P6S_UW_KI	- plan and conduct experiments, including computer measurements and simulations, interpret the results obtained and draw conclusions,
	- in identifying, formulating and solving specifications of engineering tasks:
	  - use analytical, simulation and experimental methods,
	  - notice their systemic and non-technical aspects,
	  - make a preliminary economic assessment of the proposed solutions and engineering activities undertaken.
	- critically analyse and evaluate the way existing technical solutions work.
	- design – in accordance with the set specification – and make simple devices, objects, systems or carry out processes typical for the field of study, using appropriately selected methods, techniques, tools and materials
		K1A_P6_U	- is able to use the learned mathematical methods and models, as well as computer simulations to analyze and evaluate the operation of electronic components as well as analog and digital electronic circuits
			- is able to use the learned mathematical and physical methods and models to design, build and operate IT systems and networks
			- is able to analyse signals and simple signal processing systems in the time and frequency domain, using analogue and digital techniques and appropriate hardware and software tools
			- is able to use properly selected programming environments, simulators and computer-aided design tools for simulation, design and verification of electronic components and systems as well as simple electronic systems
			- is able to use properly selected methods and devices enabling the measurement of basic quantities characterizing electronic components and systems
			- can design the process of testing components, analogue and digital electronic circuits and simple electronic systems and, if errors are detected, diagnose them
			- can formulate the specification of simple electronic systems at the level of the functions performed, also with the use of hardware description languages
			- is able to design electronic, analogue and digital circuits (also in integrated versions) and electronic systems, taking into account the given utility and economic criteria, using appropriate methods, techniques and tools
			- can build, commission and test a designed circuit or a simple electronic system
			- can configure communication devices in local (wired and radio) ICT networks
			- is able to formulate an algorithm, uses high- and low-level programming languages and appropriate IT tools to develop computer programs controlling an electronic system and to software microcontrollers or microprocessors controlling an electronic system
			- is able to assess the usefulness of routine methods and tools used to solve simple engineering tasks, typical for electronics and computer science, and to select and use appropriate methods and tools
			- is able to apply the principles of software engineering to the implementation of software projects
			- can use typical programming tools (programming environments, installation and configuration programs, programming libraries, frameworks) in programming practice
			- can design a database structure and develop a database application based on client-server architecture
			- can design and create a graphical user interface of an application taking into account the principles of human-computer communication
			- can implement an IT system and ensure the security of data and software storage and transmission
			- can design and independently construct a local computer network, including a wireless network

3.4 Summary list of learning outcomes in first-cycle studies in *Applied Computer Science* in accordance with the Integrated Qualifications System at level 6. of the Polish Qualifications Framework

Tab. 4. Summary list of learning outcomes for the first-cycle programme in Applied Computer Science in accordance with the Integrated Qualifications System for qualifications at level 6. of the Polish Qualifications Framework

SYMBOL KEU	DIRECTIONAL LEARNING OUTCOMES (KEU)	REFERENCE OF DIRECTIONAL LEARNING OUTCOMES TO THE PRK		
		Universal characteristics of the IQS (level 6.PQF)	Characteristics of the second degree of the IQS (level 6.PQF)	Secondary Characterization Curves enabling the acquisition of engineering competences
Knowledge (*knows and understands*)				
K1A_P6_W01	has knowledge in mathematics, including mathematical analysis, linear algebra, probabilistics and statistics, numerical methods, mathematical logic, discrete mathematics.	**P6U_W**	**P6S_WG**	
K1A_P6_W02	has knowledge of physics, including mechanics, thermodynamics, optics, electricity and magnetism, nuclear physics and solid state physics	**P6U_W**	**P6S_WG**	
K1A_P6_W03	has structured and theoretically based knowledge of the principles of operation of electronic components, analogue and digital electronic circuits and simple electronic systems	**P6U_W**	**P6S_WG**	**P6S_WG_KI**
K1A_P6_W04	knows and understands the design methodology and manufacturing processes of electronic components, integrated circuits and microsystems,	**P6U_W**	**P6S_WG**	**P6S_WG_KI**
K1A_P6_W05	knows the languages of equipment description and appropriate design tools	**P6U_W**	**P6S_WG**	
K1A_P6_W06	knows and understands the processes of constructing and manufacturing simple electronic devices	**P6U_W**	**P6S_WG**	**P6S_WG_KI**
K1A_P6_W07	has a well-structured knowledge of the theory of electrical circuits and the theory of signals and methods of their processing	**P6U_W**	**P6S_WG**	
K1A_P6_W08	has basic knowledge in the field of metrology, knows and understands the methods of measurement and extraction of basic quantities characterizing electronic elements and systems of various types, knows the calculation methods and IT tools necessary to analyze the results of the experiment	**P6U_W**	**P6S_WG**	
K1A_P6_W09	is familiar with the current state and the latest development trends in electronics and IT	**P6U_W**	**P6S_WK**	
K1A_P6_W10	has structured knowledge of computer architecture, in particular the hardware layer	**P6U_W**	**P6S_WG**	**P6S_WG_KI**

SYMBOL KEU	DIRECTIONAL LEARNING OUTCOMES (KEU)	REFERENCE OF DIRECTIONAL LEARNING OUTCOMES TO THE PRK		
		Universal characteristics of the IQS (level 6.PQF)	Characteristics of the second degree of the IQS (level 6.PQF)	Secondary Characterization Curves enabling the acquisition of engineering competences
K1A_P6_W11	has structured knowledge of programming	**P6U_W**	**P6S_WG**	
K1A_P6_W12	has structured knowledge of computer architecture, embedded systems, pipeline and parallel processing, external devices and operating systems	**P6U_W**	**P6S_WG**	**P6S_WG_KI**
K1A_P6_W13	has systematic knowledge of network technologies, in particular network topologies, data transmission, including wireless, network protocols, network devices, network traffic control and network security mechanisms	**P6U_W**	**P6S_WG**	**P6S_WG_KI**
K1A_P6_W14	has elementary knowledge of the basics of telecommunications and telecommunications systems and networks	**P6U_W**	**P6S_WG**	**P6S_WG_KI**
K1A_P6_W15	has a structured knowledge of electromagnetic fields and waves, including the knowledge necessary to understand the ways in which wireless (radio) systems work	**P6U_W**	**P6S_WG**	**P6S_WG_KI**
K1A_P6_W16	has the basic knowledge necessary to understand the non-technical conditions of engineering activity	**P6U_W**	**P6S_WK**	
K1A_P6_W17	has elementary knowledge in the field of intellectual property protection as well as copyright and patent law	**P6U_W**	**P6S_WK**	
K1A_P6_W18	has elementary knowledge in the field of management and running a business	**P6U_W**	**P6S_WK**	**P6S_WK_KI**
K1A_P6_W19	has knowledge in the field of computer graphics	**P6U_W**	**P6S_WG**	
K1A_P6_W20	knows and understands the methods of artificial intelligence, the structure, operation and applications of expert systems	**P6U_W**	**P6S_WG**	
K1A_P6_W21	has the basic knowledge necessary to understand the social, economic, legal and other non-technical conditions of engineering activity in the field of information technology	**P6U_W**	**P6S_WK**	**P6S_WG_KI** **P6S_WK_KI**
K1A_P6_W22	has structured and theoretically based knowledge necessary to carry out an engineering diploma thesis	**P6U_W**	**P6S_WG**	**P6S_WG_KI**
	Skills (Is *able to*):			
K1A_P6_U01	is able to obtain information from literature, databases and other sources; is able to integrate the information obtained, interpret it, as well as draw conclusions, formulate and justify opinions	**P6U_U**	**P6S_UW** **P6S_UK** **P6S_UO** **P6S_UU**	

SYMBOL KEU	DIRECTIONAL LEARNING OUTCOMES (KEU)	REFERENCE OF DIRECTIONAL LEARNING OUTCOMES TO THE PRK		
		Universal characteristics of the IQS (level 6.PQF)	Characteristics of the second degree of the IQS (level 6.PQF)	Secondary Characterization Curves enabling the acquisition of engineering competences
K1A_P6_U02	can work individually and in a team, define goals and priorities, develop a work schedule	**P6U_U**	**P6S_UO** **P6S_UU**	
K1A_P6_U03	is able to develop documentation of the task carried out and prepare a concise presentation of the achieved results	**P6U_U**	**P6S_UW** **P6S_UK**	
K1A_P6_U04	speaks a foreign language to a sufficient degree to communicate	**P6U_U**	**P6S_UK**	
K1A_P6_U05	has the ability to independently deepen and update his/her general and professional knowledge	**P6U_U**		
K1A_P6_U06	is able to use the learned mathematical methods and models, as well as computer simulations to analyze and evaluate the operation of electronic components as well as analog and digital electronic circuits	**P6U_U**	**P6S_UW**	**P6S_UW_KI**
K1A_P6_U07	is able to use the learned mathematical and physical methods and models to design, build and operate IT systems and networks	**P6U_U**	**P6S_UW**	**P6S_UW_KI**
K1A_P6_U08	is able to analyse signals and simple signal processing systems in the time and frequency domain, using analogue and digital techniques and appropriate hardware and software tools	**P6U_U**	**P6S_UW**	**P6S_UW_KI**
K1A_P6_U09	is able to use properly selected programming environments, simulators and computer-aided design tools for simulation, design and verification of electronic components and systems as well as simple electronic systems	**P6U_U**	**P6S_UW**	**P6S_UW_KI**
K1A_P6_U10	is able to use properly selected methods and devices enabling the measurement of basic quantities characterizing electronic components and systems	**P6U_U**	**P6S_UW**	**P6S_UW_KI**
K1A_P6_U11	can design the process of testing components, analogue and digital electronic circuits and simple electronic systems and, if errors are detected, diagnose them	**P6U_U**	**P6S_UW**	**P6S_UW_KI**
K1A_P6_U12	can formulate the specification of simple electronic systems at the level of the functions performed, also with the use of hardware description languages	**P6U_U**	**P6S_UW**	**P6S_UW_KI**
K1A_P6_U13	is able to design electronic, analogue and digital circuits (also in integrated versions) and electronic systems, taking into account the given utility and economic criteria, using appropriate methods, techniques and tools	**P6U_U**	**P6S_UW**	**P6S_UW_KI**
K1A_P6_U14	can build, commission and test a designed circuit or a simple electronic system	**P6U_U**	**P6S_UW**	**P6S_UW_KI**
K1A_P6_U15	can configure communication devices in local (wired and radio) ICT networks	**P6U_U**	**P6S_UW**	**P6S_UW_KI**
K1A_P6_U16	is able to formulate an algorithm, uses high- and low-level programming languages and appropriate IT tools to develop computer programs controlling an electronic system and to software microcontrollers or microprocessors controlling an electronic system	**P6U_U**	**P6S_UW**	**P6S_UW_KI**

SYMBOL KEU	DIRECTIONAL LEARNING OUTCOMES (KEU)	REFERENCE OF DIRECTIONAL LEARNING OUTCOMES TO THE PRK		
		Universal characteristics of the IQS (level 6.PQF)	Characteristics of the second degree of the IQS (level 6.PQF)	Secondary Characterization Curves enabling the acquisition of engineering competences
K1A_P6_U17	is able to perceive their non-technical aspects, including environmental, economic and legal aspects when formulating and solving tasks involving the design of electronic components, circuits and systems	**P6U_U**	**P6S_UW**	
K1A_P6_U18	applies the principles of occupational health and safety	**P6U_U**		
K1A_P6_U19	is able to assess the usefulness of routine methods and tools used to solve simple engineering tasks, typical for electronics, and to select and use appropriate methods and tools	**P6U_U**	**P6S_UW**	**P6S_UW_KI**
K1A_P6_U20	is able to apply the principles of software engineering to the implementation of software projects	**P6U_U**	**P6S_UW**	**P6S_UW_KI**
K1A_P6_U21	can use typical programming tools (programming environments, installation and configuration programs, programming libraries, frameworks) in programming practice	**P6U_U**	**P6S_UW**	**P6S_UW_KI**
K1A_P6_U22	can design a database structure and develop a database application based on client-server architecture	**P6U_U**	**P6S_UW**	**P6S_UW_KI**
K1A_P6_U23	can design and create a graphical user interface of an application taking into account the principles of human-computer communication	**P6U_U**	**P6S_UW**	**P6S_UW_KI**
K1A_P6_U24	can implement an IT system and ensure the security of data and software storage and transmission	**P6U_U**	**P6S_UW**	**P6S_UW_KI**
K1A_P6_U25	can use artificial intelligence methods in programming practice	**P6U_U**	**P6S_UW**	
K1A_P6_U26	can design and independently construct a local computer network, including a wireless network	**P6U_U**	**P6S_UW**	**P6S_UW_KI**
K1A_P6_U27	can assess the state of health and safety in the workplace – especially the conditions for effective work at the computer	**P6U_U**	**P6S_UO**	
K1A_P6_U28	can inspire and organize the education of others and formulate and promote opinions on achievements in the field of electronics and information technology	**P6U_U**	**P6S_UK** **P6S_UO**	
K1A_P6_U29	can organize their own and others' work, define goals and priorities, negotiate, act and think in an entrepreneurial way	**P6U_U**	**P6S_UO** **P6S_UU**	
Social competences (i*s ready to*):				
K1A_P6_K01	is prepared to conscientiously and reliably perform the duties entrusted to him, in accordance with ethical norms, standards and procedures applicable in the workplace	**P6U_K**	**P6S_KR**	
K1A_P6_K02	is prepared to work independently and cooperate, taking on various roles in a team or managing the work of a team	**P6U_K**	**P6S_KK** **P6S_KO**	

SYMBOL KEU	DIRECTIONAL LEARNING OUTCOMES (KEU)	REFERENCE OF DIRECTIONAL LEARNING OUTCOMES TO THE PRK		
		Universal characteristics of the IQS (level 6.PQF)	Characteristics of the second degree of the IQS (level 6.PQF)	Secondary Characterization Curves enabling the acquisition of engineering competences
K1A_P6_K03	is ready to use the knowledge and experience of colleagues and share their own experience, in particular in the field of issues related to electronics and IT	**P6U_K**	**P6S_KK**	
K1A_P6_K04	critically evaluates his/her own knowledge and understands the need for further education (second- and third-cycle studies, postgraduate studies and specialist courses/training) and improvement of professional competences	**P6U_K**	**P6S_KK**	
K1A_P6_K05	understands the non-technical aspects and effects of engineering activities, including their impact on the environment and social behaviour	**P6U_K**	**P6S_KO**	

3.5. Matrix of directional learning outcomes in relation to the implemented modules

Tab. 5. Reference of the KEU directional learning outcomes to the modules for the field of study Applied Computer Science

SYMBOL KEU	Directional learning outcomes (KEU)	Module names														
		General education	Mathematics and physics	Electronics and metrology	Digital technology	Computer Engineering	Programming	IT systems	Automation	Telecommunications	Embedded systems	Mobile technologies	Web technologies	Project management	Software quality	Diplomas and internships
Knowledge																
K1A_P6_W01	has knowledge in mathematics, including mathematical analysis, linear algebra, probabilistics and statistics, numerical methods, mathematical logic, discrete mathematics.		x													
K1A_P6_W02	has knowledge of physics, including mechanics, thermodynamics, optics, electricity and magnetism, nuclear physics and solid state physics		x													
K1A_P6_W03	has structured and theoretically based knowledge of the principles of operation of electronic components, analogue and digital electronic circuits and simple electronic systems			x	x				x		x					
K1A_P6_W04	knows and understands the design methodology and manufacturing processes of electronic components, integrated circuits and microsystems,			x	x				x		x					
K1A_P6_W05	knows the languages of equipment description and appropriate design tools			x												
K1A_P6_W06	knows and understands the processes of constructing and manufacturing simple electronic devices			x	x	x			x	x	x			x		
K1A_P6_W07	has a well-structured knowledge of the theory of electrical circuits and the theory of signals and methods of their processing			x												
K1A_P6_W08	has basic knowledge in the field of metrology, knows and understands the methods of measurement and extraction of basic quantities characterizing electronic elements and systems of various types, knows the calculation methods and IT tools necessary to analyze the results of the experiment			x												
K1A_P6_W09	is familiar with the current state and the latest development trends in electronics and IT	x						x	x		x	x	x	x	x	
K1A_P6_W10	has structured knowledge of computer architecture, in particular the hardware layer			x	x	x		x	x		x					
K1A_P6_W11	has structured knowledge of programming						x	x			x	x	x	x	x	
K1A_P6_W12	has structured knowledge of computer architecture, embedded systems, pipeline and parallel processing, external devices and operating systems			x	x	x		x	x	x	x					

SYMBOL KEU	Directional learning outcomes (KEU)	Module names														
		General education	Mathematics and physics	Electronics and metrology	Digital technology	Computer Engineering	Programming	IT systems	Automation	Telecommunications	Embedded systems	Mobile technologies	Web technologies	Project management	Software quality	Diplomas and internships
K1A_P6_W13	has systematic knowledge of network technologies, in particular network topologies, data transmission, including wireless, network protocols, network devices, network traffic control and network security mechanisms					x		x	x	x		x				
K1A_P6_W14	has elementary knowledge of the basics of telecommunications and telecommunications systems and networks							x	x	x	x					
K1A_P6_W15	has a structured knowledge of electromagnetic fields and waves, including the knowledge necessary to understand the operation of wireless (radio) systems							x	x	x	x					
K1A_P6_W16	has the basic knowledge necessary to understand the non-technical conditions of engineering activity	x														
K1A_P6_W17	has elementary knowledge in the field of intellectual property protection as well as copyright and patent law	x														
K1A_P6_W18	has elementary knowledge in the field of management and running a business	x														x
K1A_P6_W19	has knowledge in the field of computer graphics						x	x				x	x			
K1A_P6_W20	knows and understands the methods of artificial intelligence, the structure, operation and applications of expert systems							x			x					
K1A_P6_W21	has the basic knowledge necessary to understand the social, economic, legal and other non-technical conditions of engineering activity in the field of information technology	x														
K1A_P6_W22	has structured and theoretically based knowledge necessary to carry out an engineering diploma thesis															x
Skills																
K1A_P6_U01	is able to obtain information from literature, databases and other sources; is able to integrate the information obtained, interpret it, as well as draw conclusions, formulate and justify opinions	x	x					x	x	x	x	x	x	x	x	x
K1A_P6_U02	can work individually and in a team, define goals and priorities, develop a work schedule			x	x	x	x	x	x	x	x			x	x	
K1A_P6_U03	is able to develop documentation of the task carried out and prepare a concise presentation of the achieved results						x	x	x	x	x	x	x	x		x

SYMBOL KEU	Directional learning outcomes (KEU)	Module names														
		General education	Mathematics and physics	Electronics and metrology	Digital technology	Computer Engineering	Programming	IT systems	Automation	Telecommunications	Embedded systems	Mobile technologies	Web technologies	Project management	Software quality	Diplomas and internships
K1A_P6_U04	speaks a foreign language to a sufficient degree to communicate	x		x			x	x	x	x	x	x				
K1A_P6_U05	has the ability to independently deepen and update his/her general and professional knowledge						x	x			x	x	x			x
K1A_P6_U06	is able to use the learned mathematical methods and models, as well as computer simulations to analyze and evaluate the operation of electronic components as well as analog and digital electronic circuits			x	x	x										
K1A_P6_U07	is able to use the learned mathematical and physical methods and models to design, build and operate IT systems and networks					x	x	x		x	x					
K1A_P6_U08	is able to analyse signals and simple signal processing systems in the time and frequency domain, using analogue and digital techniques and appropriate hardware and software tools			x	x	x										
K1A_P6_U09	is able to use properly selected programming environments, simulators and computer-aided design tools for simulation, design and verification of electronic components and systems as well as simple electronic systems			x				x	x		x					
K1A_P6_U10	is able to use properly selected methods and devices enabling the measurement of basic quantities characterizing electronic components and systems			x												
K1A_P6_U11	can design the process of testing components, analogue and digital electronic circuits and simple electronic systems and, if errors are detected, diagnose them			x	x			x					x		x	
K1A_P6_U12	can formulate the specification of simple electronic systems at the level of the functions performed, also with the use of hardware description languages			x	x											
K1A_P6_U13	is able to design electronic, analogue and digital circuits (also in integrated versions) and electronic systems, taking into account the given utility and economic criteria, using appropriate methods, techniques and tools			x	x	x		x	x							
K1A_P6_U14	can build, commission and test a designed circuit or a simple electronic system					x		x	x		x					
K1A_P6_U15	can configure communication devices in local (wired and radio) ICT networks					x				x		x				
K1A_P6_U16	is able to formulate an algorithm, uses high- and low-level programming languages and appropriate IT tools to develop computer programs controlling an electronic system and to software microcontrollers or microprocessors controlling an electronic system					x	x	x	x		x	x	x			

SYMBOL KEU	Directional learning outcomes (KEU)	Module names														
		General education	Mathematics and physics	Electronics and metrology	Digital technology	Computer Engineering	Programming	IT systems	Automation	Telecommunications	Embedded systems	Mobile technologies	Web technologies	Project management	Software quality	Diplomas and internships
K1A_P6_U17	is able to perceive their non-technical aspects, including environmental, economic and legal aspects when formulating and solving tasks involving the design of electronic components, circuits and systems	x										x	x	x	x	
K1A_P6_U18	applies the principles of occupational health and safety	x														
K1A_P6_U19	is able to assess the usefulness of routine methods and tools used to solve simple engineering tasks, typical for electronics, and to select and use appropriate methods and tools					x		x			x			x	x	
K1A_P6_U20	is able to apply the principles of software engineering to the implementation of software projects															
K1A_P6_U21	can use typical programming tools (programming environments, installation and configuration programs, programming libraries, frameworks) in programming practice					x	x	x	x		x	x	x	x	x	
K1A_P6_U22	can design a database structure and develop a database application based on client-server architecture							x			x		x			
K1A_P6_U23	can design and create a graphical user interface of an application taking into account the principles of human-computer communication							x	x		x	x	x			
K1A_P6_U24	can implement an IT system and ensure the security of data and software storage and transmission					x		x				x	x	x	x	
K1A_P6_U25	can use artificial intelligence methods in programming practice							x				x	x	x		
K1A_P6_U26	can design and independently construct a local computer network, including a wireless network							x	x	x						
K1A_P6_U27	can assess the state of health and safety in the workplace – especially the conditions for effective work at the computer						x	x						x		x
K1A_P6_U28	can inspire and organize the education of others and formulate and promote opinions on achievements in the field of electronics and information technology							x						x		x
K1A_P6_U29	can organize their own and others' work, define goals and priorities, negotiate, act and think in an entrepreneurial way	x												x		x
Social competences																
K1A_P6_K01	is prepared to conscientiously and reliably perform the duties entrusted to him, in accordance with ethical norms, standards and procedures applicable in the workplace	x				x	x									

SYMBOL KEU	Directional learning outcomes (KEU)	Module names														
		General education	Mathematics and physics	Electronics and metrology	Digital technology	Computer Engineering	Programming	IT systems	Automation	Telecommunications	Embedded systems	Mobile technologies	Web technologies	Project management	Software quality	Diplomas and internships
K1A_P6_K02	is prepared to work independently and cooperate, taking on various roles in a team or managing the work of a team						x	x	x	x	x	x	x	x		x
K1A_P6_K03	is ready to use the knowledge and experience of colleagues and share their own experience, in particular in the field of issues related to electronics and IT			x												x
K1A_P6_K04	critically evaluates his/her own knowledge and understands the need for further education (second- and third-cycle studies, postgraduate studies and specialist courses/training) and improvement of professional competences															x
K1A_P6_K05	understands the non-technical aspects and effects of engineering activities, including their impact on the environment and social behaviour	x														x

Tab. 6. Learning outcomes assigned to learning modules

GENERAL EDUCATION MODULE (M1_KO)		Subject/Course Names					SYMBOL (REFERENCE TO) KEU
Module description: General education is aimed at preparing for life and functioning in the information society, lifelong learning, understanding basic economic processes and the principles of controlling them, shaping innovative attitudes and developing communication skills (including in a foreign language), negotiation and presentation of technical issues.		Physical education	Foreign language	Intellectual property protection	Humanities (elective)	Economics (elective)	
SYMBOL MEU	**LEARNING OUTCOMES**						
KNOWLEDGE							
M1_KO_W01	knows the principles of ergonomics, in particular the methods of humanizing work and the principles of health and safety				x	x	K1A_P6_W16
M1_KO_W02	has elementary knowledge in the field of intellectual property protection, in particular legal protection of data and software			x			K1A_ P6_W17 K1A_ P6_W21
M1_KO_W03	has structured general knowledge of the selected foreign language,		x				K1A_ P6_U04
M1_KO_W04	knows the basics of professional development and functioning in the information society, understands the non-technical aspects of the engineer's activity				x		K1A_ P6_W16 K1A_ P6_W21
M1_KO_W05	has basic knowledge of economics and management, including quality management, and running a business					x	K1A_ P6_W16 K1A_ P6_W18
M1_KO_W06	has basic psychological and pedagogical knowledge allowing them to understand the process of professional development of employees and the development of forms of individual entrepreneurship				x		K1A_ P6_W18 K1A_ P6_W21
SKILLS							
M1_KO_U01	can obtain information from literature, databases and other sources in a foreign language		x				K1A_ P6_U01 K1A_ P6_U04
M1_KO_U02	can describe their origin, surroundings in a simple way, as well as raise issues related to the most important needs of everyday life.		x				K1A_ P6_U04
M1_KO_U03	comply with copyright and licensing requirements		x	x			K1A_ P6_W17
SOCIAL COMPETENCES							

M1_KO_K01	can plan a professional career and take care of psychophysical fitness	x		x	x		K1A_ P6_K04
M1_KO_K02	can inspire and organize the education of others				x		K1A_ P6_K02
ECTS CREDITS		0	8	1	5	2	
TOTAL NUMBER OF ECTS CREDITS FOR THE MODULE		16					
METHODS OF VERIFICATION OF LEARNING OUTCOMES FOR THE MODULE		Verification of knowledge outcomes: colloquium or exam. Verification of the outcomes in terms of skills and competences: exam, colloquium, exercise report, control work with particular emphasis on examples of engineering issues taking into account non-technical aspects					

MATHEMATICS AND PHYSICS MODULE (M1_MF)		**Subject/Course Names**						
Module description: Education in the area of mathematics and physics is aimed at learning mathematical methods and models for the analysis of basic physical and technical phenomena and understanding the physical foundations of electronics and the functioning of technical devices. It provides the basis for the use of mathematical calculus in solving optimization problems and the use of the rules of mathematical logic in technical applications.		Fundamentals of mathematical analysis	Mathematical analysis and linear algebra	Probabilistic and statistics	Discrete mathematics	Physics	Physics laboratory	**SYMBOL (REFERENCE TO) KEU**
SYMBOL EKM	**LEARNING OUTCOMES**							
KNOWLEDGE								
M1_MF_W01	has knowledge in mathematics, including mathematical analysis, linear algebra, probabilistics and statistics, numerical methods, mathematical logic, discrete mathematics.		x					K1A_ P6_W01
M1_MF_W02	has knowledge of the basics of mathematical analysis: differential and integral calculus, ordinary differential equations	x			x			K1A_ P6_W01
M1_MF_W03	has knowledge in the field of experimental data processing: probability theory, stochastic processes, mathematical statistics, elements of correlation and regression theory and logic			x	x			K1A_ P6_W01
M1_MF_W04	knows basic numerical methods: solving systems of linear equations, finding roots of a nonlinear equation, solving a differential equation, numerical calculation of the integral, methods of interpolation and approximation		x					K1A_ P6_W01
M1_MF_W05	has knowledge of the basics of mechanics, electro and thermodynamics, electricity and magnetism as well as optics					x	x	K1A_ P6_W02

SKILLS								
M1_MF_U01	skillfully uses mathematical knowledge to describe and analyze phenomena occurring in physics and technology					x		K1A_ P6_U06
M1_MF_U02	is able to interpret and explain functional relationships in the form of formulas, tables, charts, diagrams and apply them in practical problems	x	x	x	x	x	x	K1A_ P6_U06 K1A_ P6_U07
M1_MF_U03	can prepare a report on the conducted experimental research with its interpretation						x	K1A_ P6_U03
M1_MF_U04	can critically evaluate the result of measurement or calculation					x	x	K1A_ P6_U03
SOCIAL COMPETENCES								
M1_MF_K01	understands the civilizational significance of mathematics (the significance of assumptions, the importance of proofs, etc.) and its applications	x	x	x	x			K1A_ P6_K05
M1_MF_K02	is able to formulate opinions on basic mathematical issues and physical phenomena	x	x	x	x	x	x	K1A_ P6_K05
	ECTS CREDITS	4	5	6	4	4	2	
	TOTAL NUMBER OF ECTS CREDITS FOR THE MODULE	25						
METHODS OF VERIFICATION OF LEARNING OUTCOMES FOR THE MODULE		Verification of knowledge outcomes: colloquium or exam. Verification of the outcomes in terms of skills and competences: exam, colloquium, exercise report, control work with particular emphasis on examples of engineering issues taking into account non-technical aspects						

ELECTRONICS AND METROLOGY MODULE (M1_EM)		**Subject/Course Names**								**SYMBOL (REFERENCE TO) KEU**
Module description: the module includes a set of subjects aimed at mastering the ability to measure basic parameters and characteristics of selected electronic components and systems		Basics of electronics and electrical engineering	Laboratory of basics of electronics	Basics of measurements	Laboratory of basics of measurements	Electronic systems	Laboratory of electronic systems	Material engineering and equipment construction	Circuit and signal theory	
SYMBOL EKM	**LEARNING OUTCOMES**									
KNOWLEDGE										
M1_EM_W01	has structured and theoretically supported knowledge in the field of metrology, principles of operation of electronic and analogue and digital electronic circuits	x	x	x	x	x	x	x	x	K1A_ P6_W08

M1_EM_W02	has a structured knowledge of the basics of electrical engineering and the most important methods of calculating electrical circuits	x	x	x	x	x	x		x	K1A_ P6_W03 K1A_ P6_W07
M1_EM_W03	knows the basic analog and digital blocks found in integrated circuits and has basic knowledge of the structure and methods of manufacturing integrated circuits	x	x			x	x		x	K1A_ P6_W03 K1A_ P6_W04
M1_EM_W04	has basic knowledge of the construction of electronic systems, their complexity and areas of their application			x	x	x		x		K1A_ P6_W03 K1A_ P6_W06
M1_EM_W05	knows the methods of recording basic electrical quantities in metrology			x	x					K1A_ P6_W08
SKILLS										
M1_EM_U01	can use methods of calculating electronic circuits in order to verify the results of measurements of electronic components and systems	x	x	x	x	x	x		x	K1A_ P6_U06 K1A_ P6_U09
M1_EM_U02	can carry out measurements of basic parameters and characteristics of selected electronic components and systems		x		x	x	x		x	K1A_ P6_U09 K1A_ P6_U10
M1_EM_U03	can prepare and carry out a computer simulation of the operation of simple electronic circuits and systems		x		x	x	x		x	K1A_ P6_U06 K1A_ P6_U09
M1_EM_U04	is able to use information and communication techniques appropriate for the implementation of tasks typical for engineering activity		x			x	x	x	x	K1A_ P6_U01
M1_EM_U05	is able to plan and conduct experiments, including computer measurements and simulations, interpret the results obtained and draw conclusions		x		x	x	x		x	K1A_ P6_U09 K1A_ P6_U10 K1A_ P6_U11
M1_EM_U06	is able to use analytical, simulation and experimental methods to formulate and solve engineering tasks		x		x	x	x		x	K1A_ P6_U06 K1A_ P6_U09
SOCIAL COMPETENCES										
M1_EM_K01	knows the terminology of the basics of metrology, electronics and electrical engineering and can explain it in a non-technical environment	x	x	x	x	x	x	x	x	K1A_ P6_K03 K1A_ P6_K05
M1_EM_K02	understands the need to improve the ways of exchanging information and expanding their knowledge, especially in the case of cooperation with specialists in other fields, for example in the creation of hardware and software systems, based on knowledge in the field of electronics and computer science	x	x	x	x	x	x	x	x	K1A_ P6_K03 K1A_ P6_K04

ECTS CREDITS	2	1	1	2	4	2	3	4	
TOTAL NUMBER OF ECTS CREDITS FOR THE MODULE	19								
METHODS OF VERIFICATION OF LEARNING OUTCOMES FOR THE MODULE	Verification of knowledge outcomes: colloquium or exam. Verification of the outcomes in terms of skills and competences: exam, colloquium, exercise report, control work with particular emphasis on examples of engineering issues taking into account non-technical aspects								

DIGITAL TECHNOLOGY MODULE (M1_TC)		**Subject/Course Names**							
Module description: education in the field of digital technology is aimed at familiarizing students with the elements, circuits and digital systems used in modern electronic devices. For this purpose, it is necessary to know the structure of digital components, systems and systems, as well as methods of their description, analysis and design.		Digital technique	Laboratory of digital technique	Basics of digital systems	Laboratory of digital systems	Reprogrammable digital systems	Laboratory of reprogrammable digital systems	Signal processing	**SYMBOL (REFERENCE TO) KEU**
SYMBOL EKM	**LEARNING OUTCOMES**								
KNOWLEDGE									
M1_TC_W01	has knowledge of mathematics including Boolean algebra (its elements – logical operators, axioms, logical expressions and functions) and the basics of graph theory necessary to describe the operation of digital elements, systems and systems	x	x	x	x			x	K1A_ P6_W01
M1_TC_W02	has structured and theoretically based knowledge of the structure, principles of operation, purpose of elements, systems, systems and their design	x		x		x			K1A_ P6_W03
M1_TC_W03	knows and understands methods of description, analysis, design and simulation of functional systems, arithmetic and logic circuits, asynchronous and synchronous systems	x	x	x	x			x	K1A_ P6_W06
M1_TC_W04	has detailed knowledge of how to configure reprogrammable circuits and digital systems using the VHDL hardware description language					x	x		K1A_ P6_W05
SKILLS									
M1_TC_U01	can set up a measuring station and examine simple digital circuits		x		x		x	x	K1A_ P6_U10
M1_TC_U02	can describe, analyze, design and commission a layout and a simple digital system		x		x		x		K1A_ P6_U06 K1A_ P6_U08
M1_TC_U03	uses programming environments, simulators and computer-aided design tools when simulating, designing and commissioning systems and simple digital systems	x	x	x	x	x	x	x	K1A_ P6_U09

M1_TC_U04	can check the operation of the designed circuit, and use it at a later time. Can correctly determine the limitations of the designed system.		x		x		x		K1A_ P6_U06 K1A_ P6_U11
M1_TC_U05	is fluent in all constructions of the VHDL equipment description language. Can design and implement a digital system or system of any complexity, taking into account the given utility and economic criteria		x		x		x		K1A_ P6_U11 K1A_ P6_U13
SOCIAL COMPETENCES									
M1_TC_K01	is able to expand and transfer knowledge in the field of digital technology		x		x		x	x	K1A_ P6_K03
M1_TC_K02	can organize their own and others' work, can work in a team, can estimate the time needed to complete an assigned task		x		x		x	x	K1A_ P6_K02 K1A_ P6_K03
M1_TC_K03	can draw conclusions and formulate their own opinions on issues in digital technology	x	x	x	x	x	x	x	K1A_ P6_K03
ECTS CREDITS		3	2	3	2	3	2	4	
TOTAL NUMBER OF ECTS CREDITS FOR THE MODULE		19							
METHODS OF VERIFICATION OF LEARNING OUTCOMES FOR THE MODULE		Verification of knowledge outcomes: colloquium or exam. Verification of the outcomes in terms of skills and competences: exam, colloquium, exercise report, control work with particular emphasis on examples of engineering issues taking into account non-technical aspects.							

COMPUTER ENGINEERING MODULE (M1_IK)		**Subject/Course Names**					**SYMBOL (REFERENCE TO) KEU**
Module description: the aim of education in the area of the computer engineering module is to familiarize with microprocessors, network equipment and operating systems. For this purpose, it is necessary to familiarize yourself with the necessary software and the basics of designing and managing computer networks. An essential component of education in the module is the acquisition of information protection skills, compliance with the principles of software legality and computer network security		Network technologies	Computer systems architecture	Laboratory of computer systems architecture	Microprocessor technology	Laboratory of microprocessor technology	
SYMBOL EKM	**LEARNING OUTCOMES**						
KNOWLEDGE							
M1_IK_W01	knows the structure and operation of a computer, operating system, computer network and network equipment	x	x		x		K1A_ P6_W10 K1A_ P6_W12 K1A_ P6_W13
M1_IK_W02	has knowledge of microprocessors and devices in which microprocessors are used		x	x	x	x	K1A_ P6_W12

M1_IK_W03	knows the structures of various microprocessor systems, microcontrollers, principles of microcontroller addressing, instruction lists and basics of microcontroller programming				x	x	K1A_ P6_W12
M1_IK_W04	knows the methods of modulation and coding used in Ethernet technologies and in wide area networks	x					K1A_ P6_W13
M1_IK_W05	knows the tools and mechanisms for optimizing and controlling data flow in local and wide area networks	x					K1A_ P6_W13
M1_IK_W06	knows the basic algorithms and mechanisms used in the protection and security of ICT networks	x	x	x			K1A_ P6_W13 K1A_ P6_W14
M1_IK_W07	knows how to solve the problems of communication between the processor and other chips of the computer system, knows the basic functions of assembly		x	x	x	x	K1A_ P6_W05 K1A_ P6_W10 K1A_ P6_W12
M1_IK_W08	knows the ways of implementing computer systems. Knows the tools for designing such systems		x	x			K1A_ P6_W05 K1A_ P6_W10 K1A_ P6_W12
M1_IK_W09	has knowledge in the field of construction and design of ICT networks and selection of transmission media	x					K1A_ P6_W14
SKILLS							
M1_IK_U01	can write and run their own programs in the internal language of the microprocessor				x	x	K1A_ P6_U09 K1A_ P6_U16
M1_IK_U02	has the ability to work in operating systems at the basic level		x	x			K1A_ P6_U20 K1A_ P6_U24
M1_IK_U03	can design and implement a computer system of any complexity		x	x			K1A_ P6_U09 K1A_ P6_U13
M1_IK_U04	can check the correctness of the designed system, make possible corrections		x	x			K1A_ P6_U11
M1_IK_U05	can configure a simple computer network in hardware and software; can administer the network	x					K1A_ P6_U26
M1_IK_U06	can connect devices to the Internet, divide into subnets and connect networks	x					K1A_ P6_U26
SOCIAL COMPETENCES							
M1_IK_K01	can think and act in a creative and entrepreneurial way			x			K1A_ P6_K03
M1_IK_K02	can work individually and in a team, lead a small team, assess the time-consuming nature of a task, meet deadlines			x		x	K1A_ P6_K02
M1_IK_K03	knows and complies with the principle of hardware liability, software legality, data protection	x	x	x	x	x	K1A_ P6_K01
	ECTS CREDITS	4	3	2	5	2	

TOTAL NUMBER OF ECTS CREDITS FOR THE MODULE	16
METHODS OF VERIFICATION OF LEARNING OUTCOMES FOR THE MODULE	Verification of knowledge outcomes: colloquium or exam. Verification of the outcomes in terms of skills and competences: exam, colloquium, exercise report, control work with particular emphasis on examples of engineering issues taking into account non-technical aspects.

PROGRAMMING MODULE (M1_PR)		Subject/Course Names						
Module description: the module includes a set of subjects aimed at mastering the ability to program computers in high-level languages and the use of programming tools and libraries.		Basics of programming	Programming languages and paradigms	Programming of computers and devices	Application design	Graphics and human-computer communication	Interface design	SYMBOL (REFERENCE TO) KEU
SYMBOL EKM	**LEARNING OUTCOMES**							
KNOWLEDGE								
M1_PR_W01	knows the structure of a program, data types and operators, instructions and principles of memory management in C/C++ and Java	x	x	x				K1A_ P6_W11
M1_PR_W02	knows programming paradigms, including in detail the technique of object-oriented, event-oriented, generic and component programming		x	x		x	x	K1A_ P6_W11
M1_PR_W03	knows typical programming libraries for entering and exiting data, handling files, building a graphical user interface, using containers, processing XML documents	x	x	x	x	x	x	K1A_ P6_W11 K1A_ P6_W19
M1_PR_W04	knows the types of computer graphics and methods of building graphical interfaces of applications, taking into account the psychological aspects of human-computer communication		x	x		x	x	K1A_ P6_W19
M1_PR_W05	knows the principles of defining the structure of a document using marking languages and the methods of document processing			x				K1A_ P6_W11
SKILLS								
M1_PR_U01	can build, run and test a computer program using a typical programming environment	x	x	x	x	x	x	K1A_ P6_U20 K1A_ P6_U21
M1_PR_U02	is able to use typical programming tools (programming environments, installation and configuration programs, programming libraries) in programming practice	x	x	x	x	x	x	K1A_ P6_U20 K1A_ P6_U21
M1_PR_U03	can use in practice the technique of object-oriented, event-oriented, generic and component-based structural programming	x	x	x	x	x	x	K1A_ P6_U20 K1A_ P6_U21

M1_PR_U04	can design and build a graphical user interface using appropriate support tools		x	x	x	x	x	K1A_ P6_U23
M1_PR_U05	can work in a programming team, develop program documentation and present the achieved results				x	x	x	K1A_ P6_U02 K1A_ P6_U03
M1_PR_U06	can build an image using a standard API and perform basic transformations on it					x	x	K1A_ P6_U20
SOCIAL COMPETENCES								
M1_PR_K01	knows programming terminology and can explain it in a non-technical environment	x	x	x		x	x	K1A_ P6_K03
M1_PR_K02	understands the need to independently expand knowledge in the field of programming, develop and continuously improve programming skills	x	x	x	x	x	x	K1A_ P6_K04
ECTS CREDITS		5	4	4	1	4	1	
TOTAL NUMBER OF ECTS CREDITS FOR THE MODULE		19						
METHODS OF VERIFICATION OF LEARNING OUTCOMES FOR THE MODULE		Verification of knowledge outcomes: colloquium or exam. Verification of the outcomes in terms of skills and competences: exam, colloquium, exercise report, control work with particular emphasis on examples of engineering issues taking into account non-technical aspects.						

IT SYSTEMS MODULE (M1_SI)		**Subject/Course Names**							**SYMBOL (REFERENCE TO) KEU**
Module description: the module includes a set of subjects aimed at receiving knowledge of the basic components and fields of information systems, operating platforms, security principles, software engineering, computational intelligence, intelligent systems, data structures, database design and database applications.		Operating systems	Databases	Algorithms and data structures	Artificial intelligence	Applications of artificial intelligence	Cybersecurity	Internet of Things	
SYMBOL EKM	**LEARNING OUTCOMES**								
KNOWLEDGE									
M1_SI_W01	knows the architecture, principles of operation and the most important technologies of operating systems, mechanisms of task implementation and ways of solving conflicts of concurrent processes	x	x		x	x	x	x	K1A_ P6_W12
M1_SI_W02	knows security models and mechanisms at various levels of IT system construction	x	x		x	x	x	x	K1A_ P6_W12
M1_SI_W03	knows the standards, basics and stages of designing databases, database applications, data normalization, relationship algebra, SQL, logical, conceptual and physical models		x	x			x	x	K1A_ P6_W11 K1A_ P6_W12 K1A_ P6_W20

M1_SI_W04	knows methods and techniques of accessing data warehouses in the World Wide Web using software interfaces of ASP.NET and ADO.NET technologies	x	x	x			x	x	K1A_ P6_W11 K1A_ P6_W12
M1_SI_W05	knows DOTNET architecture, ASP.NET, event delegation mechanisms, ASP.NET provider models, client-server database application design techniques		x						K1A_ P6_W11 K1A_ P6_W12
M1_SI_W06	knows the basic techniques of creating intelligent programs using artificial neural networks, fuzzy logic, evolutionary algorithms			x	x	x		x	K1A_ P6_W11 K1A_ P6_W20
M1_SI_W07	knows the basic models of IT system design processes using software engineering standards and techniques	x	x	x	x	x	x	x	K1A_ P6_W11
SKILLS									
M1_SI_U01	can configure, install, run and test MS Windows or Linux operating systems for typical programming applications, control system processes, disks and drivers, write scripts for administrative purposes	x	x	x	x	x	x	x	K1A_ P6_U24
M1_SI_U02	can use typical protection and security mechanisms of operating systems to implement authentication and authorization functions	x	x	x	x	x	x	x	K1A_ P6_U24
M1_SI_U03	can create structures of artificial neural networks depending on the problem posed, train them with appropriate algorithms, implement fuzzy logic algorithms, apply and create evolutionary algorithms to a selected optimization problem		x	x	x	x		x	K1A_ P6_U25
M1_SI_U04	can create any relational data model, analyze the correctness and integrity of data, perform normalization, develop queries in SQL	x	x	x	x	x		x	K1A_ P6_U20 K1A_ P6_U22
M1_SI_U05	can create transactions, provide access to databases in ODBC, OLEDB, JDBC standards, use the data administrator function	x	x	x	x	x			K1A_ P6_U22
M1_SI_U06	can design a conceptual and physical data model in ERD technology, create virtual tables, cursors, memorized procedures and triggers		x		x	x			K1A_ P6_U20 K1A_ P6_U22
M1_SI_U07	can design a database application in a web environment using MS Visual Studio and object-oriented technology ASP.NET		x					x	K1A_ P6_U21 K1A_ P6_U22
M1_SI_U08	is able to carry out basic activities related to the analysis of user requirements, application (system) modelling in UML standards, design of application modules, implementation and testing of software	x	x		x	x		x	K1A_ P6_U20
M1_SI_U09	is able to use modern techniques of designing, implementing and testing IT system software using CASE tools	x	x		x	x		x	K1A_ P6_U20
M1_SI_U10	can classify and assess the correctness and efficiency of algorithms		x	x			x	x	K1A_ P6_U17
SOCIAL COMPETENCES									
M1_SI_K01	knows the terminology of information systems and can explain it in a non-technical environment	x	x	x	x	x	x	x	K1A_ P6_K03 K1A_ P6_K05
M1_SI_K02	understands the need to independently expand knowledge in the field of information systems, develop and continuously improve programming skills	x	x	x	x	x	x	x	K1A_ P6_K04
	ECTS CREDITS	5	4	4	4	2	4	5	

TOTAL NUMBER OF ECTS CREDITS FOR THE MODULE	28	
METHODS OF VERIFICATION OF LEARNING OUTCOMES FOR THE MODULE	Verification of knowledge outcomes: colloquium or exam. Verification of the outcomes in terms of skills and competences: exam, colloquium, exercise report, control work with particular emphasis on examples of engineering issues taking into account non-technical aspects.	

ELECTIVE COURSES MODULE (M1_PO)		Block names							SYMBOL (REFERENCE TO) KEU
Module description: education in the field of automation, telecommunications and mobile and embedded systems, aimed at presenting the areas of application of intelligent electronic systems with the possibility of changing their functionality through the use of programmable elements. Solution-specific programming languages will also be discussed, along with important aspects of project management as well as software quality.		Automation	Mobile technology	Project management	Software quality	Web technologies	Embedded systems	Telecommunications	
SYMBOL EKM	**LEARNING OUTCOMES**								
KNOWLEDGE									
M1_PO_W01	has systematized knowledge and describes the operation of transmission systems	x					x	x	K1A_ P6_W13 K1A_ P6_W14
M1_PO_W02	has knowledge of the principle of operation and applications of microcontrollers and the peripherals present in them	x	x				x		K1A_ P6_W03 K1A_ P6_W12
M1_PO_W03	has knowledge and describes issues in the field of modern utility microsystems used in intelligent electronic devices	x					x	x	K1A_ P6_W12 K1A_ P6_W20
M1_PO_W04	has knowledge of automation systems, describes and explains issues in the field of automation used in industry	x							K1A_ P6_W06 K1A_ P6_W12
M1_PO_W05	knows the architecture of applications in selected mobile systems		x						K1A_ P6_W11 K1A_ P6_W12
M1_PO_W06	knows models, methodologies and methods of software quality assurance in multi-person production teams		x	x	x				K1A_ P6_W09 K1A_ P6_W16 K1A_ P6_W18
M1_PO_W07	knows technologies for creating client-side and server-side Internet systems					x			K1A_ P6_W11

									K1A_ P6_W21
M1_PO_W08	knows representative technologies and knows how to select and use them for a specific class of projects		x			x			K1A_ P6_W18
M1_PO_W09	has knowledge and describes issues in the field of optical telecommunications networks							x	K1A_ P6_W14 K1A_ P6_W15
M1_PO_W10	knows the basic methods of assessing the quality of developed solutions			x	x				K1A_ P6_W18 K1A_ P6_W21
M1_PO_W11	knows the basic aspects related to the creation and presentation of web content and the basics of selecting solutions for specific business needs					x			K1A_ P6_W11 K1A_ P6_W21
M1_PO_W12	knows the design patterns used in software quality control			x	x				K1A_ P6_W11 K1A_ P6_W12
M1_PO_W13	has knowledge of code defect management and the principles of cooperation in project teams		x	x	x	x	x		K1A_ P6_W12 K1A_ P6_W21
SKILLS									
M1_PO_U01	can develop a control program for a microcontroller, including support for peripherals	x	x				x		K1A_ P6_U09 K1A_ P6_U16
M1_PO_U02	can select utility microsystems that meet the application assumptions of an intelligent device	x					x	x	K1A_ P6_U07 K1A_ P6_U09
M1_PO_U03	is able to identify and describe selected methods and tools for control and acquisition of measurement data in programmable controller systems	x					x		K1A_ P6_U14 K1A_ P6_U24
M1_PO_U04	is able to select and use an industrial automation device, as well as the methods and tools used in intelligent devices	x					x	x	K1A_ P6_U14 K1A_ P6_U25
M1_PO_U05	has the skills to design and program mobile devices for the selected platform		x						K1A_ P6_U20 K1A_ P6_U24
M1_PO_U06	is able to carry out the process of software development, including a web application, selecting architecture, technologies and tools depending on business needs		x	x	x	x			K1A_ P6_U20 K1A_ P6_U21
M1_OP_U07	can plan and launch a web server with a multimedia service using selected technological solutions			x		x			K1A_ P6_U21 K1A_ P6_U22
M1_PO_U08	can develop documentation related to software quality control		x	x	x	x			K1A_ P6_U20 K1A_ P6_U24
M1_PO_U09	can describe the basic elements and properties as well as the principles of operation of telecommunications systems							x	K1A_ P6_U07 K1A_ P6_U15

SOCIAL COMPETENCES									
M1_PO_K01	is able to expand and transfer knowledge in the field of automation, electronics and computer science	x	x	x	x	x	x	x	K1A_ P6_K03
M1_PO_K02	can organize their own and others' work, can work in a team, can estimate the time needed to complete an assigned task	x	x	x	x	x	x	x	K1A_ P6_K02
M1_PO_K03	can draw conclusions and formulate their own opinions on issues in automation, electronics and computer science	x	x	x	x	x	x	x	K1A_ P6_K03 K1A_ P6_K05
ECTS CREDITS		10	7	8	5	5	5	3	
TOTAL NUMBER OF ECTS CREDITS FOR THE MODULE		43							
METHODS OF VERIFICATION OF LEARNING OUTCOMES FOR THE MODULE		Verification of knowledge outcomes: colloquium or exam. Verification of the outcomes in terms of skills and competences: exam, colloquium, exercise report, control work with particular emphasis on examples of engineering issues taking into account non-technical aspects.							

DIPLOMA AND INTERSHIP MODULE (M1_DP)		Subject/Course Names				SYMBOL (REFERENCE TO) KEU
Module description: the aim of the teaching activity within this module is to integrate the knowledge and skills acquired during the course of study, to use them in professional practice, as well as to master the ability to present one's achievements clearly and concisely.		Professional practice	Proseminar	Engineering diploma seminar	Engineering diploma project	
SYMBOL EKM	**LEARNING OUTCOMES**					
KNOWLEDGE						
M1_DP_W01	has extensive knowledge of the engineering specialization of his/her choice, in particular in the area related to the thesis				x	K1A_ P6_W09 K1A_ P6_W21 K1A_ P6_W22
M1_DP_W02	knows the basic methods, technologies and IT tools used in the design, implementation and operation of electronic equipment and software	x			x	K1A_ P6_W09 K1A_ P6_W11 K1A_ P6_W16
M1_DP_W03	has knowledge of copyright – both protecting him as the author of the diploma thesis and source materials (programs, articles, other diploma theses, etc.) used in the implementation of the work				x	K1A_ P6_W17
M1_DP_W04	is familiar with the current state and the latest development trends in electronics and IT		x		x	K1A_ P6_W09
SKILLS						

M1_DP_U01	is able to obtain additional information (including in a foreign language) beyond the curriculum (from the Internet, literature, databases and other sources); and is able to integrate the obtained information and interpret it				x	K1A_ P6_U01 K1A_ P6_U28
M1_DP_U02	is able to assess the usefulness of typical methods, technologies and tools used to solve engineering tasks, as well as make a justified choice of appropriate methods and tools	x	x		x	K1A_ P6_U01 K1A_ P6_U02 K1A_ P6_U29
M1_DP_U03	is able to develop documentation of the task (diploma thesis) and prepare a clear and concise presentation of the achieved results			x	x	K1A_ P6_U03 K1A_ P6_U28 K1A_ P6_U29
M1_DP_U04	can test components, electronic systems and simple electronic systems and, if errors are detected, diagnose them			x	x	K1A_ P6_U09
M1_DP_U05	can estimate the time and cost of implementation of individual tasks as well as the entire electronic or IT project				x	K1A_ P6_U02 K1A_ P6_U21
KOMPETENCJE SPOŁECZNE						
M1_DP_K01	is able to work individually and in a team, define goals and priorities, create a schedule for the implementation of work and the structure of a written study (diploma thesis, article)	x			x	K1A_ P6_K02
	ECTS CREDITS	6	2	2	15	
	TOTAL NUMBER OF ECTS CREDITS FOR THE MODULE	25				
METHODS OF VERIFICATION OF LEARNING OUTCOMES FOR THE MODULE		Verification of learning outcomes varies depending on the form of classes. The practice is assessed on the basis of the documentation presented. Seminars based on the course of classes, presentations, group classes and discussions. The learning outcomes achieved with the diploma thesis are assessed according to appropriate criteria by the supervisor and the reviewer of the thesis.				

4. VERIFICATION AND ASSESSMENT OF STUDENTS' ACHIEVEMENT OF LEARNING OUTCOMES

The first-cycle study program in the field of Applied Computer Science includes subject courses that can be carried out in the form of lectures, auditorium exercises, laboratories, project classes and seminars, as well as professional internships. The verification of the learning outcomes achieved by the student is based on solutions specified in the Study Regulations applicable at the Koszalin University of Technology. The process of verifying the student's learning outcomes in terms of knowledge, skills and social competences is carried out through written and oral exams, credit tests, colloquia, assessment of work in classes and assessment of intermediate, homework, reports and projects, as well as through assessment of oral answers, presentations, papers, as well as formal and substantive documentation of completed professional internships and assessment of the diploma thesis. The student's involvement during classes and the ability to work in a group are also assessed. The methods of verifying the learning outcomes acquired during practical classes (exercises, laboratories, projects) confirm the achievement of engineering effects assigned to the field of study. First-cycle studies end with a diploma exam combined with a defense of a diploma thesis, which a student can take after completing the study program. The principles of verification and assessment of learning outcomes in relation to a specific course are written in the course card. After completing the course, the instructor is obliged to submit an Assessment Card for the achievement of the assumed learning outcomes in the course/module, with verification of the learning outcomes achieved by students. Verification of the achieved learning outcomes takes place at the level of the Program Council, which, based on the monitoring and verification of learning outcomes, prepares a report on the achievement of the assumed learning outcomes after the end of each academic year and presents it to the Dean. In addition, comprehensive control of the education process includes the results of observation of didactic classes, results of student surveys on courses carried out, reports on the implementation of student internships, opinions of students and employers on the program and schedule of studies in the field, as well as results of monitoring the professional careers of graduates.

5. STUDY SCHEDULE

Tab. 7. Schedule of full-time studies at the first-cycle programme in Applied Computer Science.

Lp	Modukes	Total hours / ECTS						Sem. I					Sem. II					Sem. III					Sem. IV					Sem. V					Sem. VI					Sem. VII				
		LE	E	LA	P	Σ	P_E	LE	E	LA	P	P_E	LE	E	LA	P	P_E	LE	E	LA	P	P_E	LE	E	LA	P	P_E	LE	E	LA	P	P_E	LE	E	LA	P	P_E	LE	E	LA	P	P_E
M1_KO	GENERAL EDUCATION	90	210			300	16	60	75			7	30	75			5		30			2			2																
1	Humanities	45	30			75	5	15	15			2	30	15			3																								
2	Foreign language		120			120	8		30			2		30			2		30			2		30			2														
3	Physical education		60			60			30					30																											
4	Economics	30				30	2	30				2																													
5	Intellectual property protection	15				15	1	15				1																													
M1_MF	MATHEMATICS AND PHYSICS	150	120	30		300	25	90	60			13	30	30	30		6	30	30			6																			
1	Fundamentals of mathematical analysis	30	15			45	4	30	15			4																													
2	Mathematical analysis and linear algebra	30	30			60	5	30	30			5																													
3	Probabilistics and statistics	30	30			60	6											30	30			6																			
4	Discrete mathematics	30	30			60	4						30	30			4																								
5	Physics	30	15			45	4	30	15			4																													
6	Physics laboratory			30		30	2								30		2																								
M1_EM	ELECTRONICS AND METROLOGY	135	30	75		240	19	45		30		5			15		1	60	15			7	30	15	30		6														
1	Basics of electronics and electrical eng.	30				30	2	30				2																													
2	Laboratory of basics of electronics			15		15	1								15		1																								
3	Basics of measurements	15				15	1	15				1																													
4	Laboratory of basics of measurements			30		30	2			30		2																													
5	Electronic systems	30	15			45	4																30	15			4														
6	Laboratory of electronic systems			30		30	2																		30		2														
7	Material engineering and equipment construct	30				30	3											30				3																			
8	Circuit and signal theory	30	15			45	4											30	15			4																			
M1_TC	DIGITAL TECHNOLOGY	120		105		225	19						30		30		5	60		60		10	30		15		4														
1	Basics of digital systems	30				30	3						30				3																								
2	Laboratory of digital systems			30		30	2								30		2																								
3	Digital technique	30				30	3											30				3																			
4	Laboratory of digital technique			30		30	2													30		2																			
5	Reprogrammable digital systems	30				30	3											30				3																			
6	Lab. of reprogrammable digital systems			30		30	2													30		2																			
7	Signal processing	30		15		45	4																30		15		4														
M1_IK	COMPUTER ENGINEERING	105		75		180	16																75		15		9	30		60		7									
1	Network technologies	30		15		45	4																30		15		4														
2	Computer systems architecture	30				30	3																30				3														
3	Laboratory of computer systems architecture			30		30	2																							30		2								
4	Microprocessor technology	45				45	5																15				2	30				3								
5	Laboratory of microprocessor technology			30		30	2																							30		2								
M1_PR	PROGRAMMING	120	75		30	225	19	30	30			5	60	30		15	9						30	15		15	5														
1	Basics of programming	30	30			60	5	30	30			5																													
2	Programming languages and paradigms	30	15			45	4						30	15			4																								
3	Programming of computers and devices	30	15			45	4						30	15			4																								
4	Application design				15	15	1									15	1																								
5	Graphics and human-computer communicatio	30	15			45	4																30	15			4														
6	Interface design				15	15	1																			15	1														
M1_SI	IT SYSTEMS	180	90	30	30	330	28						30	15			4	30	30			5	30	15			4	60	30		30	10	30		30		5				
1	Operating systems	30	30			60	5											30	30			5																		
2	Databases	30	15			45	4																					30	15			4								
3	Algorithms and data structures	30	15			45	4						30	15			4																								
4	Artificial intelligence	30	15			45	4																30	15			4														
5	Applications of artificial intelligence				30	30	2																								30	2								
6	Cybersecurity	30	15			45	4																					30	15			4								
7	Internet of Things	30		30		60	5																										30		30		5				
M1_PO	ELECTIVE COURSES	285	120	60	105	570	43																					90	15	60	15	13	120	45		60	17	75	15	60	15	13
1	Automation	60	30	30	15	135	10																					15		30		3	30	15			4	15	15		15	3
2	Mobile technology	45	30		15	90	7																					15	15			3	30	15		15	4					
3	Project management	60	30		30	120	8																					30		30		4	30			30	4					
4	Software quality	30		30		60	5																															30		30		5
5	Web technologies	30	15		15	60	5																										30	15		15	5					
6	Embedded Systems	30	15		15	60	5																															30		30		5
7	Telecommunications	30			15	45	3																					30			15	3									
M1_DP	DIPLOMA AND INTERNSHIPS				60	60	25																													30	8				30	17
1	Professional practice (4 weeks/160 hours)						6																														6					
2	Proseminar				30	30	2																														30	2				
3	Engineering diploma seminar				30	30	2																																		30	2
4	Engineering diploma project						15																																			15
	Total	1185	645	375	225	2430	210	225	165	30		30	180	150	75	15	30	180	105	60		30	195	75	60	15	30	##	45	120	45	30	150	45	30	90	30	75	15	60	45	30
								420					420					345					345					390					315					195				
	Number of exams	14						2					2					2					2					2					2					2				

Tab. 8. List and schedule of elective courses

Sem. I					Sem. II				
Humanities I A. Educational technology B. History of technology					**Humanities II** A. Philosophy of technology B. Inventics				
W	**Ć**	**L**	**P**	**ECTS**	**W**	**Ć**	**L**	**P**	**ECTS**
15	15			2	30	15			3
Economics A. Basics of economics B. Management and marketing									
W	**Ć**	**L**	**P**	**ECTS**					
30				2					

Sem. V					Sem. VI					Sem. VII				
Automation I A. Computer measuring, monitoring and diagnostic systems B. Computer signal processing systems					**Automation II** A. Programmable controllers B. Models and methods of automation					**Automation III** A. Computer systems for multimedia, buildings and vehicles B. Computer control and industrial networks				
W	**Ć**	**L**	**P**	**ECTS**	**W**	**Ć**	**L**	**P**	**ECTS**	**W**	**Ć**	**L**	**P**	**ECTS**
15		30		3	30	15			4	15	15		15	3
Mobile Technologies I A. Mobile Operating Systems (Android) B. Mobile Operating Systems (IOS)					**Mobile Technologies II** A. Mobile Device Programming (Android) B. Mobile Device Programming (IOS)					**Software quality** A. Software Quality Assurance Techniques B. Test automation, patterns and tools				
W	**Ć**	**L**	**P**	**ECTS**	**W**	**Ć**	**L**	**P**	**ECTS**	**W**	**Ć**	**L**	**P**	**ECTS**
15	15			3	30	15		15	4	30		30		5
Project management I A. Programming in constraint logic B. Decision support in conditions of uncertainty					**Project management II** A. Computer-Integrated Management Systems B. Planning and management of the project					**Embedded Systems** A. Embedded systems, sensing, actuators and signalling elements B. Anti-burglary, monitoring and access control systems.				
W	**Ć**	**L**	**P**	**ECTS**	**W**	**Ć**	**L**	**P**	**ECTS**	**W**	**Ć**	**L**	**P**	**ECTS**
30		30		4	30			30	4	30		30		5
Telecommunications A. Fiber optic technology B. Telecommunications and data transmission					**Web technologies** A. Web Application Development B. Programming in the .NET environment									
W	**Ć**	**L**	**P**	**ECTS**	**W**	**Ć**	**L**	**P**	**ECTS**					
30			15	3	30	15		15	5					

Tab. 9. Numerical characteristics of the study schedule

Indicator name		Number of ECTS credits/Number of hours
Number of ECTS credits and semesters required to complete studies		210 / 7
Total number of hours of classes	full-time studies	2430
The total number of ECTS credits to be obtained by a student as part of classes conducted with the direct participation of academic teachers or other persons conducting classes	full-time studies	110
Total number of ECTS credits allocated to courses related to research activities conducted at an HEI in the discipline or disciplines to which the field of study is assigned		149
Number of ECTS credits to be awarded by a student in humanities or social sciences – in the case of fields of study assigned to disciplines within fields other than humanities or social sciences, respectively		7
Number of ECTS credits assigned to classes or groups of courses to choose from		73
Number of ECTS credits obtained by the student as part of practical classes, such as exercise, laboratory and project classes		100
The number of professional placements and the number of ECTS credits that the student must obtain as part of these internships		6 ECTS / 160 h
Number of hours of physical education classes – in the case of full-time first-cycle and long-cycle studies		60

6. PROGRAM CONTENT

Humanities

Aim of education: To acquire and consolidate knowledge related to invention, innovation, creativity, history of technology. To make students aware of the ways of solving problems according to a specific methodology using their own creativity. The course presents selected techniques supporting the process of creative problem solving.

Substantive content: using techniques in the field of problem solving (problem identification, searching for a concept, searching for a solution) such as: brainstorming and its 2-3 variations, morphological analysis and techniques of organizing information - Ichikawa, lotus flower, etc. The most important events of technology and the creators of technology of the twentieth century.

Foreign language

Learning objective: Includes the development of the ability to use a foreign language at the level of language proficiency at least A2 of the Council of Europe: "a person using a language at this level understands statements and frequently used expressions related to everyday life (e.g. basic information about the interlocutor and his/her family, shopping, surroundings, work). Can communicate in simple, routine communicative situations requiring only a simple, direct exchange of information on familiar and typical topics. He can describe his or her origins and surroundings in a simple way, as well as raise issues related to the most important needs of everyday life."

Content: developing the language skills of participants to a level of proficiency of at least A2 according to the Common European Framework of Reference for Languages of the Council of Europe.

Intellectual property protection

Aim of education: The course includes gaining knowledge of legal norms and rules related to intellectual property law. Participants will learn about the rules of protection of copyrights, patents, trademarks and other forms of intellectual property. The course aims to understand the legal regulations that govern the creation, protection and use of intellectual property.

Content: Gaining knowledge of legal norms and rules in the area of intellectual property law.

Economics

Aim of education: to obtain in-depth knowledge of the basics of economics, especially the market economy and the enterprise as the basic production and consumption entity.

Substantive content: economic concepts with an example of each of them in connection with reality, financial institutions dealing with accepting deposits and granting loans, macroeconomic concepts being measures of phenomena and processes on the scale of the entire economy, the concept of money and the factors that affect it, i.e. demand and supply.

Fundamentals of mathematical analysis

Aim of education: To familiarize with the applications of mathematical analysis in technology and economics and to prepare for independent solving of technical problems using the learned mathematical tools.

Content: basic concepts of higher algebra: complex numbers, systems of linear equations, matrix calculus, numerical sequences, study of functions of one variable, knowledge of the basics of mathematical analysis: differential and integral calculus, ordinary differential equations.

Mathematical analysis and linear algebra

Learning objective: Mastering the concepts of linear algebra and analytic geometry: matrix, determinant, system of linear equations, Cramer's formulas, inverse matrix, orthogonal matrix, characteristic equation, eigenvalues, eigenvectors, complex numbers, algebraic form, trigonometric form, exponential form, Moivre's formulas, line equation, plane equation, 2nd degree curves, ellipse, hyperbola, parabola, circle, sphere, ellipsoid, hyperboloid, paraboloid, solids rotational, matrix notation of linear transformations, vector. Familiarization with the applications of analytical geometry and linear algebra in technology and economics and preparation for independent solving of technical problems using the learned mathematical tools.

Content: Linear algebra - matrix, determinant, system of linear equations, Cramer's formulas, inverse matrix, orthogonal matrix, characteristic equation, eigenvalues, eigenvectors, complex numbers, algebraic form, trigonometric form, exponential

form, Moivre's formulas. Analytic geometry - equation of a line, equation of a plane, 2nd degree curves, ellipse, hyperbola, parabola, circle, sphere, ellipsoid, hyperboloid, paraboloid, solids of rotation, matrix notation of linear transformations, vector, computer graphics.

Probabilistic and statistics

Learning objective: Mastering the concepts of probabilistics and computation for step and continuous random variables. Mastering the concepts of statistics and basic statistical calculations. Familiarization with the applications of probability theory and statistics in technology and economics and preparation for independent solving of technical problems using the learned mathematical tools.

Substantive content: knowledge of probability theory in the field of step and continuous random variables, knowledge of experimental data processing - probability theory, mathematical statistics, elements of correlation theory and logic.

Discrete mathematics

Aim of education: To familiarize with the mathematical foundations of computer science, applications of discrete mathematics in operations research, technology and economics, and to prepare for independent solving of technical problems using the learned mathematical tools. Providing mathematical knowledge, which in the further course of study allows for faster and more in-depth mastery of issues in many fields, primarily computer science and operations research.

Substantive content: knowledge in the field of discrete mathematics, i.e. arithmetic and power series, rules of inference and theorem proofing, predicate calculus, graph theory, enabling understanding of mechanisms implemented in decision support systems, knowledge of the meaning of selected formal models, e.g. set, graph, predicate theories, used in modern information systems, e.g. databases, expert systems.

Physics/Physics laboratory

Aim of education: To familiarize students with general knowledge in the field of selected branches of physics. Students learn the basic laws of physics. To familiarize students with the description of phenomena observed in technology and nature in the form of the laws of physics. Familiarizing students with the principles of modeling phenomena and processes used in technology.

Content: basic laws of physics in kinematics, dynamics, work, energy and gravity, harmonic motion and collision theory

Basics of electronics and electrical engineering/Laboratory of basics of electronics

Aim of education: to familiarize with the methods of calculating electrical circuits with passive components. Familiarization with the basic components and circuits of semiconductor electronics. Familiarization with models, design and parameters of semiconductor components and systems.

Substantive content: knowledge of the basics of electrical engineering and methods of calculating electrical circuits with passive components, the principle of operation of electronic components and their current-voltage characteristics, basic analogue and digital electronic circuits.

Basics of measurements/Laboratory of basics of measurements

Aim of education: to familiarize with the knowledge of general problems of metrology and electronic measurement, analysis of the uncertainty of measuring tools and measurements of electrical quantities, structure, principle of operation and properties of electronic measuring instruments, measurement methods of signal parameters and parameters of electronic components and components.

Substantive content: The subject matter of the course includes selected issues in the field of general, theoretical and applied metrology, with particular emphasis on methods of measuring basic electrical quantities. It presents the construction and principles of using classic analogue and digital measuring instruments, such as ammeters, voltmeters, oscilloscopes and their basic metrological properties. It also presents the basic principles of analysis and reporting the results of the measurements carried out.

Electronic systems/Laboratory of electronic systems

Aim of education: To learn and consolidate basic knowledge in the field of linear analog electronic circuits. Familiarization with the basic solutions used in linear analog electronic circuits, methods of their analysis and design.

Content: methods of using low-signal alternating current models for the analysis and design of electronic amplifiers, methods of ensuring and stabilizing the operating point of electronic circuits, application of operational amplifiers in analog electronic circuits.

Material engineering and equipment construction

Aim of education: To familiarize with materials and technologies of manufacturing and assembly used in electronics, as well as with methods of assessing the reliability of both electronic components and devices.

Substantive content: knowledge of materials used in electronics, their parameters and production technology of electronic components, environmental exposures and theory and numerical methods used in reliability tests of electronic components and systems, materials and technologies for making connections of electronic components in electronic systems.

Circuit and signal theory

Aim of education: to learn engineering methods of calculation and analysis of circuits, to understand the phenomena of resonance in electrical devices, to master the methods of calculating electrical circuits and the analysis of transients in circuits

Substantive content: basic laws and concepts of electrical engineering, methods of analysis of DC, harmonic and distorted circuits, the essence of resonance in circuits, conditions of its formation and effects, methods of describing an electric circuit using differential-integral equations, methods of transient analysis, commutation laws,
operator description of electrical circuits, Laplace and Fourier transformations.

Basics of digital systems/Laboratory of digital systems

Aim of education: mastering basic knowledge of digital technology, learning the methods of description, analysis, design and simulation of digital circuits, as well as the technologies used for their implementation, mastering the methods of designing functional circuits, arithmetic and logical circuits.

Content: knowledge of mathematics including Boolean algebra, elements of digital technology, methods of description, analysis, design and simulation of digital systems.

Digital technique/Laboratory of digital technique

Aim of education: to consolidate knowledge of digital technology and to develop the ability to see the relationship between theoretical knowledge in the field of digital technology and the actual implementation of digital systems, to familiarize with the methods of description, analysis, design and simulation of digital systems, as well as the technologies used for their implementation. Mastering methods of designing functional circuits, arithmetic and logic circuits, asynchronous and synchronous sequential circuits.

Substantive content: elements, circuits and digital systems used in modern electronic devices, basics of digital technology in the field of logical synthesis, methods of description, analysis and design of digital circuits, methods of creating algorithms and software for designing digital circuits, computer tools for designing digital circuits.

Reprogrammable digital systems/Laboratory of reprogrammable digital systems

Aim of education: to familiarize with digital reprogrammable FPGAs, languages for describing and synthesizing digital circuits and systems, engineering computer programs supporting the design of digital systems, design and implementation of reprogrammable digital circuits and systems.

Content: the use of VHDL language for methods of description and simulation of combinational, sequential, simple digital systems. Configuration of reprogrammable digital circuits and systems, including concurrent systems, using the VHDL hardware description language.

Signal processing

Aim of the course: to familiarize with the mathematical apparatus for the description of discrete signals and systems, as well as the properties and technique of discrete filter design, the technique of fast Fourier transform and the properties of sampled signals.

Content: mathematical apparatus for the description of discrete signals and systems, techniques for describing linear stationary discrete systems using signal graphs, properties and design technique of FIR and IIR filters, fast Fourier transformation technique, properties of sampled signals.

Network technologies

Aim of education: to familiarize with devices used in computer networks, topology of computer networks, communication models, technologies used to design and build wired and wireless computer networks.

Content: devices for building computer networks, technologies used in wired and wireless computer networks, topologies used in computer networks, norms and standards used for network design, communication protocols, principles and protocols for controlling data flow in computer networks, basic methods and algorithms for encryption and transmission security.

Computer systems architecture/Laboratory of computer systems architecture

Aim of education: to familiarize with the theoretical foundations of computer science and the basics of programming and design of computer systems, programs in the microassembler language describing the functioning of a microprogram sequencer.

Substantive content: basics of computer science, including number systems and basic operations in computer systems, methods of description, design and simulation of simple computer systems, tools for designing and simulating computer systems, memory models and methods of addressing memory.

Microprocessor technology/Laboratory of microprocessor technology

Aim of education: familiarization with the structure of a microprocessor system, principles of addressing, list of instructions and basics of programming a simple microprocessor system, familiarization with the structure of a microcontroller, principles of addressing, list of instructions and basics of programming.

Substantive content: construction and purpose of microprocessor systems and microcontrollers implemented in various architectures and principles of their programming, methods of developing programs controlling microprocessor controller and microcontroller in assembler.

Basics of programming

Aim of education: to acquire knowledge of the basic concepts in the field of programming, creation and use of computer algorithms, familiarization with selected programming environments, basic types of data and programming constructs, learning paradigms of procedural and structural programming.

Content: the life cycle of a computer program, procedural and structured programming paradigms, basic C data types and pointers, C control statements and operators, complex data types and structures (arrays, pointers, structures, files), C standard libraries, selected programming tools.

Programming languages and paradigms

Aim of education: to gain knowledge in the field of object-oriented programming and to acquire object-oriented programming skills in C++.

Content: object-oriented programming paradigms and program construction in C++, the concepts of class and object and the problems of class definition, member, friendly and operator functions (defining, running, properties), mechanisms of inheritance and polymorphism and the possibilities of their practical applications, paradigms of generic programming and its practical applications, C++ standard library and advanced elements of the language, problems of creating Windows apps.

Programming of computers and devices

Aim of education: mastering the engineering and methodology of object-oriented programming, learning about typical applications of the object-oriented programming paradigm.

Content: concepts, objectives and concepts of the object-oriented programming paradigm using C++, class libraries for selected applications, object-oriented programming techniques using C++, microprocessor devices.

Application design

Learning objective: to learn about the practically used four-stage methodology of creating a user interface, which consists of the following stages: interface template, application interface prototype, application with a working interface and project documentation containing m.in navigation graph.

Substantive content: methodology of creating multimedia applications taking into account the limitations resulting from the purpose of the application, the way it is used, the basic principles of ergonomics.

Graphics and human-computer communication/Interface design (lab)

Aim of education: to familiarize with the basics of raster and vector graphics, problems of implementation of animation and kinematics, presentation of methods of projection and modeling of lighting in 3D scenes.

Content: affine transformations of objects and projection with a synthetic camera, basic functions of 2D and 3D graphic libraries, basic models of color spaces, methods of creating parametric curves and spliced surfaces.

Operating systems

Aim of education: to familiarize with the structure and methods of operation of operating systems, methods of configuring and managing Windows and Linux operating systems, including security management of these systems.

Content: basic concepts related to the theory of Windows and Linux operating systems, their tasks and structure, types and use of users and groups in operating systems, methods of their authentication and password management, classic methods of data encryption, issues related to files and file systems, methods of file access and file protection, issues related to processes in Windows and Linux family operating systems, planning methods and synchronization mechanisms.

Databases

Aim of education: familiarization with knowledge of the theoretical foundations of database organization and practical skills of their use, familiarization with database architecture, logical data models, relationship algebra, standards of modern databases, familiarization with the main functions of database management systems, standardization and design techniques, transaction mechanisms, distributed data systems, file structures for data storage.

Substantive content: basic models of IT system design processes with the use of databases, models and security mechanisms at various levels of IT system construction, standards, basics and stages of designing databases, database applications, data normalization.

Algorithms and data structures

Aim of education: to gain knowledge in the field of stages of developing algorithms and programs, ways of developing mathematical models, ways of optimizing algorithms and programs, including classical algorithms, basic data structures and methods of developing algorithms and programs, recursive programs, binary arithmetic algorithms, effectiveness of developed algorithms and programs.

Substantive content: stages of algorithm and program development, definitions and forms of algorithm presentation, methods of algorithm development, exhaustive algorithms: advantages and disadvantages, heuristic algorithms, data search and sorting algorithms, structured programming, optimization of algorithms and programs, basic arithmetic operations on numbers presented in binary codes, recursive subroutines and data structures, mechanism of subprogram invocation and return from subroutines, basic binary codes, units of information, unit conversion, positional number systems, floating-point representations of binary numbers.

Artificial intelligence/Applications of artificial intelligence (lab)

Learning objective: to learn the basic theory of fuzzy modeling and artificial neural networks.

Content: basic issues related to fuzzy logic, artificial neural networks and evolutionary algorithms. Fuzzy sets and fuzzy logic, characteristics of fuzzy sets and their programmatic implementation. Artificial neural networks: artificial neuron model,

activation functions, perceptron logic functors, training artificial neural networks. Artificial multilayer neural networks. Error backpropagation algorithm.

Cybersecurity

Aim of education: to familiarize with theoretical and practical knowledge on issues related to data security. Familiarise yourself with online security risks and techniques for protecting data, systems and networks.

Content: User awareness and risks of using the Internet. Basic concepts of cryptology. Functional scope of cryptography (confidentiality, digital signature, non-repudiation, integrity). Encryption methods and algorithms. The essence and role of an electronic signature. Trusted profile – application. Methods and solutions related to authentication and authorization of objects (users/computers/services) in a computer environment. Problems related to security on the Internet when using SMTP, FTP, HTTP protocols. Personal data – legal basis. Sensitive data. Basic definitions related to personal data (ADO, DPO, ASI). Security policy objectives. Rules for the processing of personal data.

Internet of Things

Aim of education: to familiarize with the subject of the "Internet of Things" (IoT) in the field of intelligent wearables, household and intelligent buildings, the most important technologies and communication protocols used by IoT devices, as well as tools for their programming.

Content: operation of microprocessors and microcontrollers based on ARM architecture, characteristics, construction and basic properties of IoT devices, construction, principle of operation and use of individual elements of IoT systems (sensors and actuators). Communication interfaces and protocols used for data transmission by smart devices.

Automation

Aim of education: to gain theoretical and practical knowledge in the field of modeling of automation systems/components as well as to determine and analyze their characteristics, familiarization with topics related to computer control and control systems, with particular emphasis on PLC (*Programmable Logic Controller*) controllers and their programming languages. Familiarization with the functioning of industrial networks, technologies used in them, devices and protocols.

Content: methods of description, transformation and modeling of automation systems. Static and dynamic properties as well as time and frequency characteristics of automation components. Typical open and closed control systems and typical applications. Automatic control systems and their key parameters and properties. Simulation tools as well as parameters and properties of elements and systems. Construction and principle of operation of programmable logic controllers, hardware solutions and I/O systems of PLCs. PLC programming languages. Computer control systems. Methodology of design of control systems, control devices used in industry. Transmission media, interfaces and communication protocols used in industrial networks.

Mobile technology

Learning objective: to familiarize with real-time operating systems and mobile operating systems. Familiarization with the architecture of mobile operating systems (Android, iOS), as well as methodologies of designing and developing mobile applications on Android and iOS platforms. Familiarization with programming languages and ways of creating multi-component applications and transferring information between application components.

Content: architecture and principle of operation of real-time operating systems and selected mobile operating systems (Android, iOS). Application architecture in selected mobile systems. Representative technologies for a specific class of projects. Algorithms for processing audio and images. Basic methods of data protection and online transactions. Programming with constraints. Layered architecture of the Android mobile system. Components used in application development (activities, services, broadcast recipients, content providers). Defining resources outside the application code - capabilities and limitations. Ways of addressing external resources (XML-XML, XML-JAVA). Process priorities. Methodology for creating multi-component applications. Ways of transferring information between components. Use of complex controls working in accordance with the MVC (GridView) pattern. Perform parallel and concurrent operations on the platform, taking into account the need for non-blocking user interface support. Methods of synchronization of processes and communication using objects of the Handler class. Support for graphic assets in mobile apps. Methods of presenting and processing files in raster graphics. Ways to record and play audio. Location services - selection of criteria and location providers.

Introduction to iOS technology and presentation of its main elements. Introduces the basics of Xcode and introduces the iOS simulator. Basics of the Swift programming language. Discussion of the basic elements of the language necessary for the implementation of the material that will be the subject of subsequent lectures. iOS app architecture and lifecycle. An overview of the architecture of an iOS application and its lifecycle. An overview of the MVC pattern and how it compares to the "MVC" created by Apple. Create applications that consist of multiple views. Discusses the elements necessary to support and present the view. Presentation of the delegate pattern and its use for communication between views.

Project management

Aim of education: to familiarize with the theoretical basics of IT project management, IT project management techniques. Familiarization with the basic decision-making problems occurring in production and/or service enterprises and methods of solving them.

Substantive content: basic concepts related to IT project (undertaking) management. Project lifecycle, the organizational structure of the project. Roles in the project team. Competencies of the project manager. Identifying the sources of success and failure of projects. Identification of *Critical Success Factors*. Project resource management. Requirements management. Creating useful functional specifications. Business Use Case Analysis. Planning of project work. Structuring the project: defining and prioritizing tasks. Nodal point plan. Estimation of project parameters. Measures used in information systems. Estimation techniques. Function point method. Problems related to estimating IT projects. Software to support the dimensioning of an IT project. Setting a deadline. Work scheduling: Gantt technique, network methods. The art of completing tasks, the Getting *Things Done* technique. Time management software. Estimating the project budget. Monitoring project costs. Resource analysis of schedules. Risk definition and evaluation (identification and assessment). Risk prevention, risk monitoring. Change management process. Changes and software quality. Managing testing and debugging. Software to support change management. Managing communication in the project team. Reports and reviews. Organization of meetings. Document the project. Psychological foundations of project team management. Effective recruitment. Computer-aided IT team management. Tasks of the project manager. Qualifications and skills of the project manager. Basic requirements for a project manager. IT Project Manager Certification. Quality management. Logistics of production processes. Production scheduling

Software quality

Aim of education: to familiarize with issues improving the quality assurance process, planning software releases, test planning, reporting and monitoring bugs, basic concepts, methods and algorithms in the quality assurance process, popular tools for testing and automating software tests.

Substantive content: issues related to software quality assurance management, elements of the process approach, the Deming cycle, diagnosing the premises indicating the need to improve the process and diagnosing the current situation, indicating measures to measure the progress in improvement and establishing a plan for improving the test process, selected estimation methods, including story-points and value-points, as one of the necessary techniques for planning. Coarse product backlog planning and detailed sprint backlog planning. Backlog refinement, i.e. cyclical cleaning, ordering and updating, which is necessary due to ill-considered planning, reacting to changes and other random events. Testing strategies, types of strategies: analytical, model-driven, methodical, standard or process-compliant, consultative. Risk management, analytical testing and risk-based testing. Introduction of the concepts of probability, impact, level of risk and discussion of types of risk. Risk management in the software development lifecycle, including risk identification, analysis and monitoring. Developing recovery plans and mitigating risks. Incident reporting, definition and types of software bugs. Quality assurance process improvement, generic improvement process based on IDEAL. Discussion of popular models: Lean, CMMI, TQM, ITIL, ISO/IEC 15504 (SPI/SPICE). Discussion of models dedicated to improving the test process: TPI Next and TMM.

Web technologies

Aim of education: to familiarize with the programming of cross-platform multimedia applications and the creation of online stores, current tools and technologies used commercially. Familiarization with programming in HTML, CSS, JavaScript and PHP. Getting to know the CMS WordPress and Joomla.

Content: Creating multimedia applications using HTML, CSS, JavaScript, PHP. Storing data in a MySql database. Supporting tools, WordPress platform, Joomla. Service hosting, data transfer and sharing, software versioning, use of the GIT platform. Adapting the application to RWD (*Responsive Web Design*). Creating a *Progressive Web Application* (PWA).

Embedded Systems

Aim of education: to familiarize with the areas of application of microcontrollers and SoC (System on Chip) systems, the architecture of AVR and ARM microcontrollers. Familiarization with the characteristics, architecture and application of embedded systems, real-time operating systems (RTOS). Familiarization with the principles of designing and programming embedded systems.

Content: General characteristics, architecture and examples of applications of embedded systems. Architecture and application of SoCs (System on Chip). Programming of Atmel AVR microcontrollers. Programming of STM32 (ARM) family microcontrollers. Interfaces and communication modules in embedded systems. Embedded systems design. Real-time operating systems used in embedded systems.

Telecommunications

Aim of education: familiarization with the construction and operation of narrowband and broadband integrated networks, fiber optic technology, signaling network protocols, traffic engineering in multi-service networks, xDSL access network technology, radio communication systems.

Content: Basic properties and structure of integrated networks. ISDN service architecture. Physical implementation of the subscriber link of the integrated network. Teletransmission techniques in subscriber access. Control protocols for the implementation of basic and additional services. Implementation of teleaction and telematics services in an integrated network. Support for channel-switched connections. Basics of service description with the help of SDL. Fundamentals of traffic engineering in multiservice networks. xDSL broadband access networks. Integrated network devices. Procedures and standards for the design of telecommunications networks. Operation and construction of optoelectronic components and systems, in particular those cooperating with fiber optic lines, instruments and measurement methods used in optoelectronics. Basic radio communication systems, general block/functional diagram of the base station and mobile phone, basic functions of components used in RF module structures.

Professional practice

Aim of education: to acquire the ability to combine theoretical knowledge with its practical use, as well as to learn about the real conditions and tasks carried out professionally and to orient oneself with the requirements of the labour market and employers, to develop social competences, to verify the knowledge acquired during studies, and to improve the acquired analytical, design and programming skills. Developing teamwork skills, communication between team members and with people outside the team.

Substantive content: issues related to the organization, management and functioning of the workplace, workplace and safety regulations, methods, technologies and IT tools used in software development, methods, technologies and IT tools used in the design of IT equipment, basic methods, techniques, tools and materials used in solving simple engineering tasks in the field of electronics and telecommunications.

Proseminar

Aim of education: acquisition of knowledge on solving engineering tasks using general and specialist knowledge, acquisition of the ability to use modern tools of engineering work, including computer tools, acquisition of the ability to conduct research and experimental work, consolidation of the acquired knowledge and skills in order to prepare a diploma thesis.

Substantive content: discussion of the method of preparing the diploma thesis, protection of intellectual property, methods of presenting knowledge in the field of the implemented engineering thesis. Ways of exchanging experience and professional knowledge in the field of work. Individual presentations of the diploma students on the work carried out: discussion of the existing solutions, their advantages and disadvantages, justification for taking up the subject. Discussion in the team on the substantive content and form of the speech.

Engineering diploma seminar

Learning objectives: To develop in students the skills and competences related to independent work in the area of diploma thesis.

Substantive content: Includes indication of principles and good practices related to the presentation and discussion of subsequent stages of the diploma thesis, including: analysis of the issue, indication and definition of the problem; preparation and development of project assumptions; definition of requirements and simplifications; presentation of the methodology for solving the problem; presentation and discussion of individual stages of the work; formulation of final conclusions.

7. PRINCIPLES OF THE DIPLOMA PROCESS

A diploma thesis is an independent study of a specific scientific or artistic issue, or an artistic achievement, presenting the student's general knowledge and skills related to a given field of study, the level and profile of education, as well as the ability to independently analyze and draw conclusions. The diploma thesis is carried out in semesters 6 and 7. The work is carried out in consultation and under the substantive supervision of the supervisor of the diploma thesis. The diploma thesis is the culmination of the educational process and should reflect the knowledge and skills acquired during the course of study. The topic of the thesis, its scope and tasks to be performed should be related to the field of study and enable the verification of competences assigned to diploma theses in the curriculum for a given field of study. Confirmation of obtaining all competences in the field of knowledge, skills and social competences described in detail in the curriculum and a positive result of the diploma exam is the basis for awarding the title of engineer to graduates of first-cycle studies. The condition for taking the diploma exam is a positive assessment of the diploma thesis.
An engineering diploma thesis should primarily include in its substantive content a solution to an engineering problem with significant application features using the knowledge gained throughout the entire period of study. An engineering diploma thesis should be characterized in particular:
− demonstrating the ability to solve engineering tasks using general and specialist knowledge,
− demonstrating knowledge and skills in the field applied with the use of modern engineering tools, including computer techniques,
− lower theoretical load, in the case of research work, but with a greater focus on the practical use of engineering skills.

The thesis should also meet the editorial requirements that concern the unification of the format of diploma theses.
In the process of evaluating the diploma thesis, the reviewer is appointed by the dean, from among persons authorized to conduct diploma theses or other persons with appropriate qualifications. The supervisor and the reviewer prepare opinions on the thesis containing its evaluations. Both opinions are made available to the student no later than 3 days before the date of the diploma exam. In the case of a negative assessment of the diploma thesis made by the reviewer, the Dean appoints a second reviewer. If the second reviewer's assessment is also negative, the dean considers the diploma thesis as not completed and its continuation as impossible.
In such a case, the Dean, at the student's request submitted within 14 days, directs the student to repeat the last two semesters of studies, and if such an application is not submitted, deletes the student from the register of students.
The evaluation of the diploma thesis includes the following questions/issues: whether the content of the thesis corresponds to the topic specified in the title, whether the purpose of the thesis has been achieved and the problem has been correctly solved, assessment of the level (degree) of the implementation of the assumed tasks and interpretation of the results of the work, evaluation of the research/project methods and tools used, evaluation of the structure of the work (structure of content division, order of chapters), evaluation of the editorial side of the work, evaluation of the selection and use of sources, assessment of the student's competences (in relation to the study program), proposals for the use of work results (publication, making available to institutions, source material), other comments.
At the Koszalin University of Technology, it is obligatory to verify written diploma theses based on the use of the Uniform Anti-Plagiarism System.

8. MONITORING THE CAREER OF GRADUATES

The survey on monitoring the career paths of graduates is carried out by the Career and Education Promotion Office of the Koszalin University of Technology on the basis of the Ordinance No. 42/2020 of the Rector of the Koszalin University of Technology of 22 June 2020 on monitoring the professional careers of graduates of the Koszalin University of Technology. In order to adapt study programmes to the needs of the labour market, Koszalin University of Technology will use the results of career monitoring of students and graduates, persons applying for a doctoral degree and persons who have obtained this degree, conducted by the Minister of Science and Higher Education in accordance with Article 352 of the Act of 20 July 2018. Law on Higher Education and Science (Journal of Laws of 2020, item 85, as amended). Data on the fate of graduates is obtained from the nationwide system of monitoring the Economic Fate of University Graduates (ELA), which provides reliable information on the situation of graduates of Polish universities on the labour market. The ELA system research is based on data from the Social Insurance Institution and the POL-on system.

9. DESCRIPTION OF THE COMPETENCES EXPECTED OF THE CANDIDATE APPLYING FOR ADMISSION

Recruitment for first-cycle engineering studies in the field *of Applied Computer Science* will be conducted by the University Recruitment Committee. The rules of admission to studies are determined annually by the Senate of CUT by way of a Resolution. According to it, the recruitment of candidates for full-time first-cycle studies in *Applied Computer Science* takes place on the basis of a certificate competition, for which the results of the Matura exam (new Matura) or Matura exam (old Matura) and a document certifying knowledge of English at least at B2 level are taken into account. Based on the total number of points, a ranking list is created. For candidates who obtained the same number of points, the final order is determined by the number of points in preferred subjects. Admission to studies is determined by the position on the ranking list. The subjects specified as preferred are: English, Mathematics, Physics and Astronomy, Computer Science. The number of points obtained during the selection procedure determines the selection of candidates.

A candidate for studies should have the ability to use a computer basicly, including:

− web browsers (e.g. Chrome, Firefox, Safari),
− peripherals (e.g. printers, scanners),
− graphic software (to prepare, for example, a digital photo),
− word processors (e.g. Microsoft Word, LibreOffice - Writer),
− spreadsheets (e.g. Microsoft Excel, LibreOffice - Calc),
- e-mail,
− teamwork and videoconferencing tools (e.g. Microsoft Teams, Zoom, eMeeting).