CURRICULUM DESCRIPTION FOR THE FIELD OF STUDY
COMPUTER SCIENCE
1st degree, of a practical profile

1. GENERAL CHARACTERISTICS OF THE STUDY PROGRAMME	
Faculty conducting the studies:	**Faculty of Transport and Computer Science**
1.1 Name of programme/discipline/specialisation	Computer Science, elective specialisations: 1. Software engineering and mobile technologies, 2. Cyber security and network technologies 3. Implementation of IT systems
1.2 Level of study	First degree
1.3 Polish Qualifications Framework level	Level 6 of the Polish Qualifications Framework
1.4 Profile of studies	Practical
1.5 Form(s) of study	Full-time, part-time studies
1.6 Number of semesters and ECTS credits required for graduation	7 semesters, 210 ECTS credits
1.7 Total teaching hours for full-time/ part-time studies	2650 - teaching hours for full-time students; 1850 - teaching hours for part-time students; including a six-month work placement for full-time and part-time students.
1.8 Total number of ECTS of courses in humanities or social sciences	13 ECTS credits
1.9 Professional title awarded to graduates, ISCED CODE, Synthetic description of professional characteristics, graduate's job position after graduation	Engineer; ISCED code: information and communication technology subgroup 061; The holder of this qualification has the general and practical knowledge in the fields of computer science, telecommunications and electrical engineering necessary to develop specialised competence in a variety of information systems, both from the point of view of the theory of operation of these systems, their design, and from the point of view of their practical use in the economy, business and administration. He/she is able to use the acquired competences to formulate and solve complex and unusual problems of a practical nature in the field of computer science and, in particular, is able to perform tasks including: • software engineering, as well as the selection of development environments and tools for the design, implementation, testing and deployment of information systems, including web-based applications, • design, implementation and management of modern multimedia applications, **including those** operating in various areas of ICT service delivery; • Design, implementation and maintenance of computer networks and computer/IT systems with particular emphasis on their security; • analysis of the ways in which computer and network systems function and the diagnosis and monitoring of these systems using available software and hardware tools, • design and management of complex ICT projects. A person with the above-mentioned qualification is prepared to work in companies/units with different profiles, in particular in: • IT companies and telecommunications network operators • state administration, • financial and insurance institutions, especially where BI analytical systems are used • companies developing and implementing application software • companies that deal with the use of modern information technology in practice, in positions: • developer of IT systems and web applications; • computer systems designer; • information systems tester; • IT specialist; • head of information technology • hardware sales and diagnostics specialist; • computer network and information systems administrator; • a specialist in the security of computer systems and networks; • designer, programmer and database administrator; • IT implementation consultant - supporting organisations in the implementation process; • systems integration specialist - dealing with the combination of different components and applications; • business analyst - analysing and converting customer needs into technical requirements; • process optimisation consultant - improving organisational performance through effective use of IT systems • an independent entrepreneur running his own IT company.

2. THE LEARNING OUTCOMES DEFINED IN THE PROGRAMME OF STUDY AND THE ASSIGNMENT OF ACADEMIC DISCIPLINES

2.1 Assignment of scientific disciplines

Scientific area: Engineering and technical sciences

Lp.	Name of scientific discipline	Number of ECTS credits	%
1.	Technical Computer Science and Telecommunications	**210**	**100**
Total number and percentage of ECTS in the study programme		**210**	**100**

2.2 Directional learning outcomes in relation to the PRK

Name of direction:	**Computer Science**			
Level of education:	**PRK LEVEL 6 - First degree studies**			
Learning profile:	**Practical**	Reference to:		
Symbol of the learning outcomes for the study programme	**Learning outcomes after completing a first degree in Computer Science**	universal characteristics for a given PRK level	second-level characteristics of learning outcomes for qualifications at levels 6-7 PRK	
			Level 6	Engineering competence
KNOWLEDGE The graduate knows and understands:				
K_W01	to an advanced degree the key concepts of the scientific discipline of Technical Computer Science and Telecommunications necessary to: • description and analysis of algorithms and data structures, • description and analysis of the operation, implementation and security of information systems, • description and analysis of the operation of analogue and digital circuits, and the practical application of this knowledge in professional activities related to the Bachelor's degree in Computer Science.	P6U_W	P6S_WG	P6S_WG
K_W02	to an advanced degree, the electrical, electronic and metrology subjects necessary for an understanding of the fundamentals of computer systems and telecommunications, and methods of recording, processing and secure data transmission.	P6U_W	P6S_WG	P6S_WG
K_W03	to an advanced level, selected issues relating to the technical and and mathematical foundations of computer science, and is able to use this knowledge in professional activities related to his/her field of study.	P6U_W	P6S_WG	P6S_WG
K_W04	to an advanced degree the issues and terminology of computer architecture, peripherals and network equipment used in professional activities.	P6U_W	P6S_WG	P6S_WG
K_W05	to an advanced degree and uses software design methodologies and information systems description languages in practice.	P6U_W	P6S_WG	P6S_WG
K_W06	advanced issues in computer systems software.	P6U_W	P6S_WG	P6S_WG
K_W07	in an advanced degree, issues in computer architecture and networks as well as operating systems, necessary for the installation, configuration and operation, maintenance and security of these systems.	P6U_W	P6S_WG	P6S_WG
K_W08	in an advanced degree, electrical engineering issues for the operation of ICT network equipment and the configuration and security of this equipment in local and wide area networks.	P6U_W	P6S_WG	P6S_WG
K_W09	to an advanced degree, issues related to the design and operation of database systems used in professional activities related to the field of study.	P6U_W	P6S_WG	P6S_WG
K_W10	in an advanced degree, issues related to software engineering, including the implementation process of IT systems	P6U_W	P6S_WG	P6S_WG
K_W11	to an advanced degree, issues relating to the security of computer systems and networks.	P6U_W	P6S_WG	P6S_WG
K_W12	in advanced issues in data structures and algorithms for information processing, data analysis, machine learning.	P6U_W	P6S_WG	P6S_WG
K_W13	in an advanced degree and uses digital information processing in practice.	P6U_W	P6S_WG	P6S_WG
K_W14	to an advanced degree, and uses in practice the processes of selecting appropriate hardware components of computer systems and network systems.	P6U_W	P6S_WG	P6S_WG
K_W15	has an advanced understanding of technical standards and norms in computer science and electrical engineering; is familiar with English/Russian	P6U_W	P6S_WG	P6S_WG

	terminology in the field of computer science at level B2 of the Common European Framework of Reference for Languages - and the practical application of this knowledge in professional activities related to the field of study.			
K_W16	to an advanced degree, issues related to the life cycle of computer and network equipment and software components; has knowledge of active and healthy lifestyles necessary for the IT profession.	P6U_W	P6S_WG	P6S_WG
K_W17	issues necessary to understand non-technical conditions of engineering activities; basic health and safety principles applicable to the work of a computer scientist and knowledge of physical culture.	P6U_W	P6S_WK	P6S_WK
K_W18	issues in the protection of industrial property, intellectual property and patent and copyright law, as well as issues of professional ethics.	P6U_W	P6S_WK	P6S_WK
K_W19	management and business issues including specialist IT companies	P6U_W	P6S_WK	P6S_WK
K_W20	general principles for the creation and development of forms of individual entrepreneurship.	P6U_W	P6S_WK	P6S_WK
SKILLS **A graduate can:**				
K_U01	obtain information from literature, databases and other sources; is able to integrate the information obtained, interpret it and draw conclusions and formulate and justify opinions.	P6U_U	P6S_UU	
K_U02	work individually and as part of a team; is able to estimate the time needed to complete a commissioned task; is able to develop and implement a work schedule to ensure deadlines are met and takes care of his/her health and fitness.	P6U_U	P6S_UO	
K_U03	prepare documentation on the implementation of the engineering task.	P6U_U	P6S_UW	P6S_UW
K_U04	prepare, present and discuss a short presentation on the results of the engineering task and participate in the debate.	P6U_U	P6S_UW; P6S_UK	P6S_UW
K_U05	communicate in a foreign language at B2 level, including the ability to read technical documentation used in their professional activity.	P6U_U	P6S_UK	P6S_UW
K_U06	identify directions for further learning and implement a process of self-education.	P6U_U	P6S_UU	
K_U07	use the mathematical methods learned as well as computer simulations to analyse and evaluate the performance of computer systems.	P6U_U	P6S_UW	P6S_UW
K_U08	critically analyse how computer and network systems function and carry out diagnostics on these systems using available software and hardware tools.	P6U_U	P6S_UW	P6S_UW
K_U09	compare the components of computer systems and networks with regard to given performance and economic criteria (security, reliability, speed, cost, etc.).	P6U_U	P6S_UW	P6S_UW
K_U10	use appropriately selected development environments and tools to design, develop, test and implement information systems, including mobile applications.	P6U_U	P6S_UW	P6S_UW
K_U11	plan and carry out simulation and measurement of the characteristics of the equipment comprising computer and data communication network systems.	P6U_U	P6S_UW	P6S_UW
K_U12	formulate the specification of information systems using the UML language.	P6U_U	P6S_UW	P6S_UW
K_U13	design individual software components through the correct selection of methods and tools.	P6U_U	P6S_UW	P6S_UW
K_U14	design computer networks through the correct choice of methods and tools.	P6U_U	P6S_UW	P6S_UW
K_U15	use datasheets and application notes to select the appropriate hardware components of designed computer networks and software.	P6U_U	P6S_UW	P6S_UW

K_U16	design websites and webpages through the correct selection of methods and tools.	P6U_U	P6S_UW	P6S_UW
K_U17	plan the process of application software, including its implementation; is able to make an initial estimate of its costs.	P6U_U	P6S_UW	P6S_UW
K_U18	build, configure, commission, test and properly secure the designed computer network.	P6U_U	P6S_UW	P6S_UW
K_U19	configure computer and communications equipment in local (wired and radio) ICT networks; is able to administer hardware and software in local networks, as well as monitor the security level of networks and detect possible incidents.	P6U_U	P6S_UW	P6S_UW
K_U20	formulate an algorithm for information processing, use high- and low-level programming languages through the use of appropriate IT tools.	P6U_U	P6S_UW	P6S_UW
K_U21	recognise, when formulating and solving tasks involving the design, production and implementation of information systems, their non-technical aspects, including environmental, economic and legal aspects.	P6U_U	P6S_UW	P6S_UW
K_U22	undertake work in an industrial environment, particularly in the IT sector, and is able to perform the tasks of his job safely by applying the principles of health and safety.	P6U_U	P6S_UW	P6S_UW
K_U23	assess the suitability of typical methods and tools for solving computer engineering tasks and select and apply appropriate methods and tools.	P6U_U	P6S_UW	P6S_UW
K_U24	use available software to process multimedia data, including for advertising and web promotion.	P6U_U	P6S_UW	P6S_UW
K_U25	design databases; formulate database queries using appropriate tools.	P6U_U	P6S_UW	P6S_UW
K_U26	use the standards for design, implementation, testing and use applicable to computer science and electrical engineering.	P6U_U	P6S_UW	P6S_UW
K_U27	use technical standards and comply with applicable regulations, and process and archive data, including measurement data.	P6U_U	P6S_UW	P6S_UW
SOCIAL COMPETENCIES Graduates are ready to:				
K_K01	continuous further training (second and third level studies, postgraduate studies, courses) - enhancing professional, personal and social competences and social competences.	P6U_K	P6S_KK	
K_K02	critically respect the non-technical aspects and implications of the engineer's activities, including their impact on the environment.	P6U_K	P6S_KK P6S_KO	
K_K03	behave in a professional manner, observe professional ethics and respect diversity of views and cultures, and promote the social and cultural importance of sport.	P6U_K	P6S_KR	
K_K04	take responsibility for their own work and submit to the rules of teamwork and take responsibility for decisions made and tasks carried out together.	P6U_K	P6S_KO	
K_K05	thinking and acting in an entrepreneurial way.	P6U_K	P6S_KO	
K_K06	critically formulate and communicate to the public - including through the mass media - information and opinions on the achievements of computer science, electrical engineering and other aspects of engineering; he/she is prepared to communicate such information and opinions in a widely understood manner, including in a foreign language.	P6U_K	P6S_KK	

2.3	**Means of verification and assessment of learning outcomes**	Written examinations, written credits, online tests and assignments, projects, presentations, preparation of reports and presentation of their results, completion of the diploma seminar, as well as assessment of the student's behaviour and engagement in class, are used to verify the learning outcomes at module level in the Computer Science degree programme. The verification covers all characteristics of the PRK level 6 relating to the full spectrum of requirements in the category (knowledge, skills and social competences), and the learning outcomes will be the basis for determining the scope of the educational content, their location within the educational modules. Within individual modules, the verification of learning outcomes will take place through formative (formative) assessment, which will be carried out during the semester and will serve both the student and the lecturer to assess the progress of learning and to verify the methods of learning, and summative (summative) assessment at the end of the semester, which makes it possible to ascertain whether and to what extent the student has achieved the assumed learning outcomes. These

assessments are defined and made available to the student on an ongoing basis in the electronic journal on the university platform and in the virtual dean's office.
The adequacy of the learning outcomes adopted for the degree programme is assessed not only by the students themselves (e.g. by means of an evaluation questionnaire), but also by the academic teachers implementing the individual modules and the employers involved in the work of the Faculty Curriculum and Quality Assurance Committee. The evaluations and observations of the learning outcomes achieved during the studies are also used in the course of the study of graduates' career paths.
At the WSEI Academy in Lublin, tools have been developed that are used to verify the assumed learning outcomes of the course. Measures of the degree to which students achieve the learning outcomes will be helpful in this, which have been divided into two groups:

- quantitative measures;
- qualitative measures.

Consequently, the verification of the assumed learning outcomes of a degree programme takes place at two main levels: the module and the programme. Within the scope of the module, the level of realisation of specific learning outcomes is analysed, while within the scope of the programme, the so-called directional learning outcomes defined for the respective field of study and level of education (PRK level 6) are assessed.

2.4 Analysis of the compatibility of the assumed learning outcomes with the needs of the labour market and conclusions from the analysis of the monitoring results

The learning outcomes for the course are fully in line with the expectations of a wide range of employers and give graduates the basis for running their own business.
The analysis of the compatibility of the assumed learning outcomes with the needs of the labour market is carried out successively with the participation of academic staff, students, graduates and employers, and the conclusions of the monitoring analysis are used to improve the study programme.

3. LIST OF SUBJECTS/MODULES, DETAILED STUDY PLAN

3.1 Courses or groups of courses (modules) with associated ECTS credits and hours

List of modules		Number of ECTS points	Number of "practical" ECTS credits	Form of assessment
University-wide modules		**18**	**5**	
1	General module (health and safety, basics of intellectual property protection, library, IT)	5	0	ZAO
2	Foreign language (elective: English, Russian)	8	5	EGZ
3	Socio-humanities module (elective: professional ethics, sociology, psychology, philosophy)	5	0	ZAO
4	Physical education	0	0	ZAL
Directional modules		**80**	**30**	
5	Operating systems	5	2	ZAO
6	Programming basics	5	2	EGZ
7	Computer systems architecture	5	2	EGZ
8	Electrical and electronic engineering	5	2	ZAO
9	Mathematical analysis with linear algebra	5	1	ZAO
10	Algorithms and data structures	5	2	EGZ
11	Fundamentals of structured programming in C / C++	5	2	EGZ
12	Web design with elements of computer graphics	5	2	ZAO
13	Discrete mathematics	5	1	ZAO
14	Introduction to computer networks	5	2	EGZ
15	Software engineering	5	2	EGZ
16	ICT and multimedia systems	5	2	ZAO
17	IT project management	5	2	ZAO
18	Database systems	5	2	ZAO
19	Fundamentals of object-oriented programming in Java	5	2	EGZ
20	Fundamentals of artificial intelligence	5	2	EGZ
Optional modules		**5**	**5**	
21	Entrepreneurship/business management	5	5	ZAO
Speciality 1: Software engineering and mobile technologies		**60**	**40**	
22a	Information technology and design patterns	6	4	ZAO
23a	Parallel programming	6	4	ZAO
24a	Mobile device programming	6	4	EGZ
25a	Advanced databases	6	4	ZAO
26a	Design of information systems	6	4	ZAO
27a	Communication security and cryptography	6	4	EGZ
28a	Cyber attacks on infrastructure - techniques and countermeasures	6	4	EGZ
29a	Application testing	6	4	ZAO
30a	Virtualisation techniques, containerisation	6	4	ZAO
31a	Advanced software engineering methods	6	4	EGZ
Speciality 2: Cyber security and network technologies		**60**	**40**	
22b	Introduction to cyber security	6	4	ZAO
23b	Computer network design	6	4	ZAO
24b	LAN basics	6	4	EGZ

		25b	Advanced databases	6	4	ZAO
		26b	Scaling and linking CISCO networks	6	4	ZAO
		27b	Communication security and cryptography	6	4	EGZ
		28b	Cyber attacks on infrastructure - techniques and countermeasures	6	4	EGZ
		29b	Network monitoring and incident detection	6	4	EGZ
		30b	Virtualisation techniques, containerisation	6	4	ZAO
		31b	Internet telephony services	6	4	ZAO
		Speciality 3: Implementation of information systems		**60**	**40**	
		22c	Types, components and configuration of complex information systems	6	4	ZAO
		23c	Technical and economic analysis of the IT systems implementation process	6	4	ZAO
		24c	Strategies for implementing information systems	6	4	EGZ
		25c	Advanced databases	6	4	ZAO
		26c	Legal aspects of implementing IT systems	6	4	ZAO
		27c	Communication security and cryptography	6	4	EGZ
		28c	Cyber attacks on infrastructure - techniques and countermeasures	6	4	EGZ
		29c	Practical aspects of IT system implementation - a case study	6	4	ZAO
		30c	Virtualisation techniques and containerisation	6	4	ZAO
		31c	Testing and maintenance of information systems	6	4	EGZ
		Seminar and diploma exam		**15**	**15**	
		32	Seminar and diploma exam	15	15	EGZ
		Work placement 6 months		**32**	**32**	
		33	Work placement 6 months	32	32	ZAL
		Total number of ECTS credits in the study programme		**210**	**127**	

3.2 Detailed study plan, ECTS credits

A detailed study plan is available in paper form at the Dean's Office of the Faculty of Transport and Information Technology or in electronic form on the University's e-learning platform.

4. DIMENSION, RULES AND FORM OF PROFESSIONAL PRACTICE, NUMBER OF ECTS FOR THE FIELD OF STUDY WITH PRACTICAL PROFILE

Apprenticeships are carried out over a period of 6 months (32 ECTS credits) and the detailed learning outcomes of apprenticeships are defined in the Apprenticeship Programme and the Apprenticeship Diary and the syllabus for the course of study Information Technology I degree practical profile.

The conditions for WSEI students to receive credit for learning outcomes during professional practice are defined by the Resolution of the Senate of WSEI in Lublin, according to which professional practice is divided into two parts:

I. Professional practice carried out at the University,
II. Apprenticeship with an employer

Part one of the apprenticeship follows the following pattern:

- Introduction to apprenticeship - 30 teaching hours in the first semester of study (1 ECTS)
- Project related to the field of study - 60 didactic hours in the fourth semester (2 ECTS)
- Project related to the field of study and professional practice report - 60 hours in the 6th semester of study (2 ECTS)

The second part of the professional practice includes 810 didactic hours and takes place between 1 June and 30 September of a given year in the second, fourth and sixth semester respectively after the completion of the didactic classes. The student receives 27 ECTS for completing this part. Approval of the individual parts of the in-service training carried out at the employer by the in-service training supervisor and by the dean shall take place by 30 September of each year at the latest.

5. STUDENTS' CHOICE OF COURSE MODULES INCLUDED IN THE STUDY PROGRAMME

Number of ECTS credits a student earns by completing elective courses: **88** ECTS credits, which represents 42% of the total number of ECTS credits in the programme. Elective modules include:

- Foreign language (English, Russian) - 8 ECTS credits,
- optional module: 5 ECTS credits
- Specialisation modules (10 modules) - 60 ECTS credits,
- seminar and diploma exam - 15 ECTS credits,

6. NUMBER OF ECTS CREDITS FOR PRACTICAL SKILLS IN THE STUDY PROGRAMME WITH A PRACTICAL PROFILE

A total of 127 ECTS credits shaping practical skills have been identified in the practical profile study programme for Computer Science.

7. DESCRIPTION OF THE STUDY CONDITIONS

7.1	**Method of organisation and implementation of the training process**	The first degree programme in computer science is practically profiled and is taught using a modular system. The programme of study comprises 33 modules, including: • modules and the university-wide courses contained within them; • modules and the directional courses contained within them, • speciality modules, • optional modules (Entrepreneurship or Business Management), • seminar module and diploma examination, • 6-month apprenticeship. The modular training system combines the learning of practical skills with the acquisition of the necessary theoretical knowledge and its application to specific work situations. Classes taught by practitioners are an

		integral part of the module, which allows for a more efficient implementation of the learning process, as the student has the chance to master more practical skills. The student also has the opportunity to apply the knowledge gained during laboratory, project and work placements, and has the opportunity to make direct contact with employers and learn about the realities of the labour market and gain work experience during their studies. Some of the teaching in individual modules on selected courses is conducted by practitioners with many years of professional experience in the field of learning outcomes in the Computer Science degree programme. The study programme also provides for the possibility of teaching selected modules using distance learning methods and techniques. The first-degree Computer Science course includes 3 specialisations: • Software engineering and mobile technologies; • Cyber security and network technologies; • Implementation of IT systems
7.2	**Conducting practical skills development activities**	Classes shaping practical skills, as stipulated in the curriculum of the Bachelor of Computer Science with practical profile, are taught: (1) under conditions appropriate to the professional field of activity; 2) in a way that allows students to perform practical activities. The following laboratories operating at the university are used for the above: • Web services security lab; • Audio-video recording and multimedia application realisation laboratory; • IP network services lab; • Audiovisual systems and multimedia technology laboratory; • Cyber security lab; • 10 IT labs with a total of 240 computers. Students also have the opportunity to carry out some specific practical activities during study visits to employers and during a 6-month work placement.
7.3	**Selected indicators characterising the study programme**	The study programme, among other things: • has a total number of ECTS credits to be obtained by the student through classes conducted with the direct participation of academic staff or other persons teaching on a full-time basis, i.e. 106 ECTS; • specifies the number of ECTS credits a student must obtain in social sciences or humanities, i.e. 13 ECTS; • first-cycle programmes conducted as full-time programmes shall also include physical education classes of not less than 60 hours; physical education classes shall not be allocated ECTS credits; • credits la total number of ECTS credits allocated to the practical skills courses, i.e. 127 ECTS credits.
7.4	**Systematic evaluation and improvement of study programmes**	The study programme is systematically evaluated by academic staff, students, graduates and employers, and the conclusions of the analysis are used to improve the programme. The Faculty Curriculum and Quality Assurance Committee ensures that changes are made and that no more than 30% of the total number of learning outcomes specified in the programme of study are made. Changes to the study programme are made at the beginning of a new study cycle and only changes can be made during the study cycle: • in the selection of the educational content provided to students in their courses, taking into account the latest developments related to professional or scientific activities; • necessary to rectify the deficiencies identified by the Polish Accreditation Commission; • necessary to adapt the study programme to changes in generally applicable legislation. Changes to the study programme introduced during the study cycle shall be made available in the BIP on the university's website at least one month before the beginning of the semester to which they relate.
8.	**Library resources**	The university has a state-of-the-art computerised library that fully secures the literature recommended for the course of study and provides access to electronic knowledge resources in Poland and abroad.
9.	**Implementation of activities**	Full-time studies - classes are held from Monday to Friday from 8.00 am to 4.00 pm; Part-time studies - classes are held, fortnightly, on Saturdays and Sundays from 8.00 am to 8.00 pm. The delivery of courses preparing for the engineering profession may take place on the premises and off the premises of the University, including on the premises of another training provider for practical classes and apprenticeships, also with the use of information technology ensuring control over the course of verification of the achieved learning outcomes and its registration.