*Appendix No. 1 to the Study Program – Description of learning outcomes for the field of Computer Science 2022/2023*

**THE LEARNING OUTCOMES FOR THE FIELD OF COMPUTER SCIENCE OF FIRST-CYCLE STUDIES**

**PRACTICAL PROFILE**

**AT THE UNIVERSITY COLLEGE OF ENTERPRISE AND ADMINISTRATION IN LUBLIN**

**Graduate profile**

The graduate of the first-cycle engineering studies in the field of computer science has knowledge and skills in general issues of computer science and knowledge and technical skills in various types of information systems. They are well acquainted with the principles of construction of modern computers and devices cooperating with them, computer networks, operating systems and databases. They have the ability to program computers and know the principles of software engineering to an extent which enables them to work effectively in programming teams working under different project management methodologies. They also have basic knowledge of artificial intelligence, computer graphics and human-computer communication. They are able to use their knowledge and skills in their professional work and are characterized by initiative and ability to skilfully use technologies and IT tools, honesty and responsibility, respect for the law (including copyrights) and loyalty to their employers, as well as by mastering their skills and willingness for further development. The graduates are prepared to work in IT companies of various profiles - from the production of various types of software (desktop, web and mobile), through software implementation, to its development and operation. They are also prepared to work as IT specialists using IT tools and systems. The graduates are able to independently undertake and carry out business activities, demonstrating elementary knowledge of entrepreneurship and management. They have a good command of English at B2 level according to the Common European Framework of Reference for Languages of the Council of Europe and can use specialist language in the field of information technology. Is aware of the importance and understands the non-technical aspects and effects of engineering activities, including its impact on the environment and the related responsibility for the decisions made. In addition, the graduate has the ability to be creative and entrepreneurial and can work in a group. A graduate of Computer Science is aware of the social role of a graduate of the technical faculty, and especially understands the need to formulate and provide information and opinions on the achievements of technology and other aspects of engineering activities to the public.

Thus, the study program developed in this way allows for the acquisition of knowledge both in theoretical and practical aspects. The possibility of deepening knowledge during studies in the field of Computer Science also results from the profile of the university, where the emphasis is put on the practical acquisition of knowledge, skills and social competences by students. The graduate is able to solve professional problems, has the ability to communicate with the environment at the workplace, efficiently use the available information resources, actively participate in group work and organize and manage small teams.

In addition, apart from the achievements related to the acquisition of knowledge and substantive skills, the graduate also acquires social and personal competences by participating in classes on, inter alia, the idea of human subjectivity, interpersonal and intercultural communication, creative development of the subject and constructive conflict resolution.

The graduates are prepared to undertake second-cycle studies in the field of computer science.

Specializations:

1. **Designing and operating IT systems**

A graduate of the "Designing and operating IT systems" specialization is prepared to work as a programmer, software engineer and implementer. The person can design and build multi-layer business applications using databases. The specialization program introduces the student to the techniques of designing graphic interfaces, develops programming skills in the field of modern programming languages and databases. The graduate has the skills of programming, modelling and designing systems, and develops advanced skills and knowledge in the field of algorithmics and theory of programming languages. The subjects covered by the program are aimed at developing practical skills, inter alia, in the field of programming in JAVA, programming in C #, advanced programming engineering, advanced algorithms and data structures as well as obtaining requirements in IT projects.

1. **Databases**

A graduate of the "Databases" specialization has extensive knowledge and skills in the field of construction, design, programming and administration of databases and data warehouses. In addition, they have knowledge in the field of exploring large databases and the use of Business Intelligence techniques. The program of the specialization provides practical information about the possibilities of popular database systems, shows mobile applications of databases, develops administrative skills and introduces students to computer network design techniques. The graduate has the knowledge and skills in the field of BI concepts, data exploration and analysis techniques, and database administration. The graduate has been introduced to the subject of BIG DATA and the processing and analysing large volumes of data. The specialization covers such subjects as: Relational database systems, Database programming, Introduction to data warehouse, Business Intelligence, Graph databases, Database administration, Introduction to BIG DATA, Mobile databases, Non-relational databases.

1. **Web Technologies and the Internet of Things**

A graduate of the "Web technologies and the Internet of Things" specialization is prepared to design, program, implement and develop web applications. They know and use technology to build server-side applications and client-side software, are equipped with knowledge about the Internet of Things and how to use this idea, have competence in graphic interface design techniques, as well as programming skills in the field of databases and modern programming languages, typical for internet applications. The program of the specialization is based on deepening issues related to frontend and backend technologies, programming in JAVA, database programming, creating network services and introducing to BIG DATA.

1. **Mobile technologies**

A graduate of the "Mobile Technologies" specialization has the knowledge and skills needed to design, program and implement systems on mobile platforms, including specialist knowledge and practical skills in the field of modern programming languages and databases, graphic interface design techniques and used mobile operating systems and their specificity. The program of the specialization includes such subjects as: JAVA programming, Database programming, C # programming, iOS system for mobile platforms, Android system for mobile platforms, Android application design, iOS application design, Cross-platform mobile application development.

1. **Computer graphics and game design**

The specialization “Computer Graphics and Game Design” enables the acquisition of comprehensive knowledge, competence and practical skills in the field of graphic design, modelling, and image processing, as well as the design and implementation of games and computer simulations. The graduate also has knowledge and skills in the field of photography, basics of spatial body shaping, 3D design, applied graphics, design thinking, 3D visualization with elements of physics, and psychophysiology of sensory perception.

1. **Cybersecurity and computer forensics**

The Cybersecurity and computer forensics specialization introduces the graduates to the problems of security of computer networks, computer systems and applications. At the same time, it develops skills in cybersecurity. The graduate has specialized knowledge and skills related to server administration and services in the Linux/Unix environment, basics of security and cryptography, designing and configuration of security-oriented computer networks, scripting languages in server administration, data security management, Internet of Things and IT security audit.

**Field of engineering and technical sciences**

**Field of study:** Computer science

**Level of study:** first-cycle studies

**Education profile:** practical

**Explanation of symbols:**

**INF** – Directional Effect

**W** – knowledge category

**U** - skill category

**K** – category of social competences

**01**, **02, 03 and subsequent** – learning outcome number

**Table 1. Intended detailed learning outcomes**

| **Learning outcomes****for the direction** | **DESCRIPTION OF DIRECTIONAL LEARNING OUTCOMES****After completing first-cycle studies in the field, the graduate:** | **Reference to learning outcomes for qualifications at level 6 of the Polish Qualifications Framework** | **Reference to learning outcomes for qualifications covering engineering competences** |
| --- | --- | --- | --- |
| **KNOWLEDGE** |  |
| INF\_W01 | has knowledge in the field of electrical engineering and other areas specific to the studied field of study, necessary to formulate and solve typical, simple tasks related to the studied field of study | P6S\_WG | P6S\_WG |
| INF\_W02 | has knowledge in the field of mathematics, linear algebra and discrete mathematics, including the concepts of functions, relations and sets, elements of mathematical logic, recursion, combinatorics, trees and graphs | P6S\_WG | - |
| INF\_W03 | has knowledge of database systems, relational database design, database query languages and transaction processing | P6S\_WK, P6S\_WG |  P6S\_WG |
| INF\_W04 | has theoretical general knowledge of databases and their management, programming and modeling of data, creation of data collection and exploration systems, including methods of data analysis | P6S\_WK, P6S\_WG | - |
| INF\_W05 | has knowledge of information systems architecture, existing technologies and their development | P6S\_WK, P6S\_WG | P6S\_WG |
| INF\_W06 | has general knowledge of the basics of control and automation, including programmable controllers and elements of digital technology | P6S\_WG, P6S\_WK | P6S\_WG |
| INF\_W07 | has structured knowledge of software engineering tools and methods | P6S\_WK, P6S\_WG | P6S\_WG |
| INF\_W08 | has knowledge of basic programming paradigms | P6S\_WG | - |
| INF\_W09 | has general knowledge of computer graphics and image processing | P6S\_WK, P6S\_WG | - |
| INF\_W10 | has general knowledge of artificial intelligence | P6S\_WK, P6S\_WG | P6S\_WG |
| INF\_W11 | has theoretical general knowledge regarding algorithms and their computational complexity | P6S\_WG | - |
| INF\_W12 | has general knowledge related to distributed systems and cloud technologies and systems | P6S\_WK, P6S\_WG | P6S\_WG |
| INF\_W13 | has theoretical general knowledge in the construction of operating systems and their most important functions | P6S\_WK, P6S\_WG | - |
| INF\_W14 | has general theoretical knowledge of computer networks and network technologies | P6S\_WK, P6S\_WG | P6S\_WG |
| INF\_W15 | knows and understands the basic concepts and principles in the field of intellectual property and copyright protection as well as data protection and security; can use the resources of patent information | P6S\_WK, P6S\_WG | P6S\_WK |
| INF\_W16 | knows the general principles of creating and developing various forms of entrepreneurship that use knowledge in the field of science and scientific disciplines appropriate for the studied field of study | P6S\_WK, P6S\_WG | P6S\_WK |
| INF\_W17 | has structured, theoretically grounded general knowledge covering key issues in the field of innovation management and project management in business institutions | P6S\_WK, P6S\_WG | P6S\_WK, P6S\_WG |
| INF\_W18 | has knowledge of parallel and distributed processing | P6S\_WK, P6S\_WG | - |
| INF\_W19 | has knowledge of the use of tools for modeling and computer simulation of real systems | P6S\_WK, P6S\_WG | P6S\_WG |
| INF\_W20 | has knowledge regarding designing, programming and architecture of applications in selected IT applications | P6S\_WK, P6S\_WG | P6S\_WG |
| INF\_W21 | has knowledge of user experience, can identify principles of good human-computer interface design | P6S\_WG, P6S\_WK | - |
| INF\_W22 | knows and understands the practical application of acquired knowledge in the field of computer science in professional activities related to the field of study | P6S\_WG |  |
| **SKILLS** |
| INF\_U01 | is able to obtain information from literature, databases and other adequately selected sources, also in English or another foreign language recognized as the language of international communication in the field of study | P6S\_UW | - |
| INF\_U02 | is able to integrate the obtained information, interpret it, draw conclusions and formulate and justify opinions, can implement self-development | P6S\_UW, P6S\_UU | P6S\_UW |
| INF\_U03 | is able to plan and conduct experiments, including computer simulations, interpret the obtained results and draw conclusions | P6S\_UW, P6S\_UO, P6S\_UU | P6S\_UW |
| INF\_U04 | can use microcomputer systems in the design of simple electrotechnical circuits and systems | P6S\_UW, P6S\_UO | P6S\_UW |
| INF\_U05 | can design simple electrotechnical circuits and systems designed for various applications, also those using digital signal processing techniques | P6S\_UW, P6S\_UO | P6S\_UW |
| INF\_U06 | is able to make an initial economic analysis of the undertaken engineering activities | P6S\_UW | P6S\_UW |
| INF\_U07 | is able to make an initial analysis of the proposed project solutions and the undertaken engineering activities appropriate for the field of study | P6S\_UW | P6S\_UW |
| INF\_U08 | is able to describe and critically analyse the way of functioning and evaluate existing technical solutions, in particular: objects, systems, processes and services, especially in connection with the studied field of study | P6S\_UW | P6S\_UW |
| INF\_U09 | is able to communicate using various techniques and specialized terminology in the field of study, participate in a debate, present and evaluate various opinions as well as discuss them | P6S\_UW, P6S\_UK | - |
| INF\_U10 | has the necessary preparation to work in an industrial environment, is able to plan and organize individual and teamwork and actively cooperate in the group, taking on specific roles in it | P6S\_UW, P6S\_UO | P6S\_UW |
| INF\_U11 | is able to see the systemic and non-technical aspects when formulating and solving engineering tasks specific to the field of study | P6S\_UW | P6S\_UW |
| INF\_U12 | is able to assess suitability and select and apply methods and tools, including information and communication techniques, suitable for the implementation of typical tasks and complex problems specific to information management and project management | P6S\_UW, P6S\_UK, P6S\_UO | P6S\_UW |
| INF\_U13 | can use analytical, simulation and experimental methods to identify, formulate and solve engineering tasks specific to the field of study | P6S\_UW | P6S\_UW |
| INF\_U14 | is able to properly design a database implementation model, build a database in accordance with the given specification, define queries to the database and interpret their results | P6S\_UW | P6S\_UW |
| INF\_U15 | can independently carry out the design of computer object-oriented and structure-oriented software | P6S\_UW | P6S\_UW |
| INF\_U16 | is able to independently carry out the design of computer software taking into account the principles of data security | P6S\_UW | P6S\_UW |
| INF\_U17 | can design and informally record simple algorithms and verify their correct operation | P6S\_UW | P6S\_UW |
| INF\_U18 | can apply in practice the theorems concerning the computational complexity of algorithms | P6S\_UW | P6S\_UW |
| INF\_U19 | can create software in selected programming environments based on known algorithms, methods and techniques | P6S\_UW, P6S\_UO, P6S\_UK | P6S\_UW |
| INF\_U20 | is able to select and apply in practice the adequate way of organizing programming work, including the technique of testing applications or embedded software | P6S\_UW, P6S\_UO, P6S\_UK | P6S\_UW |
| INF\_U21 | is able to implement projects in selected IT applications | P6S\_UW, P6S\_UO | P6S\_UW |
| INF\_U22 | is able to design a simple device, object, system or process typical for the studied field of study that uses appropriate methods, tools, techniques and materials | P6S\_UW, P6S\_UO | P6S\_UW |
| INF\_U23 | is able to use skills related to designing using design patterns to create ready-to-use software | P6S\_UW, P6S\_UO | P6S\_UW |
| INF\_U24 | can design and configure a simple computer network | P6S\_UW, P6S\_UO | P6S\_UW |
| INF\_U25 | is able to implement the necessary protection of a computer network or information system against unauthorized access | P6S\_UW, P6S\_UO | P6S\_UW |
| INF\_U26 | can use numerical methods for engineering applications | P6S\_UW | P6S\_UW |
| INF\_U27 | is able to process data using data processing engineering methods and broadly understood data mining | P6S\_UW | P6S\_UW |
| INF\_U28 | can design and create modern user interfaces using dedicated tools and description languages | P6S\_UW | P6S\_UW |
| INF\_U29 | can design web applications taking into account client-side programming and use client-side technologies to increase the quality of human-computer interaction | P6S\_UW | P6S\_UW |
| INF\_U30 | has a command of a foreign language, in accordance with the requirements of B2 level of the Common European Framework of Reference for Languages, in particular in the field of scientific disciplines to which the field of study is assigned | P6S\_UK |  |
| INF\_U31 | understands the need to improve their professional qualifications, is able to set directions for their own development and independently plan and implement their own lifelong learning | P6S\_UU |  |
| **SOCIAL COMPETENCES** |
| INF\_K01 | is ready to critically assess the results of their own work, understands the importance of knowledge in solving problems, in case of difficulties, can refer to an expert in a given scientific field | P6S\_KK | ~~-~~ |
| INF\_K02 | is aware of the importance and understands the non-technical aspects and effects of engineering activities, including their impact on the environment, and the related responsibility for the decisions made | P6S\_KO, P6S\_KR | - |
| INF\_K03 | can think and act in an entrepreneurial and creative way | P6S\_KK | - |
| INF\_K04 | is able to properly define priorities for the implementation of a task set by themselves or others | P6S\_KK, P6S\_KO, P6S\_KR | - |
| INF\_K05 | correctly identifies and resolves dilemmas related to practising the profession, is ready to comply with the rules of professional ethics and requires others to do so, takes care of the achievements and tradition of the profession | P6S\_KR | - |
| INF\_K06 | is aware of the social role of a graduate of the Faculty of Technical Sciences, and, in particular, understands the need to formulate and communicate to the public, in particular through mass media, information and opinions on technical achievements and other aspects of engineering activities; tries to communicate such information and opinions in a generally understandable manner. | P6S\_KO, P6S\_KR | - |