Learning outcomes

Outcome symbol	After completing first-cycle studies in data engineering, the graduate:	Reference to PRK level 6 +KI
KNOWLEDGE		
K_W01	knows the importance of computational mathematics in modern science and technology and in the development of the information society	P6S_WK-O2.1
K_W02	knows selected methods, theorems and concepts of mathematical logic, linear algebra, discrete mathematics, graph theory and geometry and understands their application to engineering modelling issues	P6S_WG-O1
K_W03	knows selected methods, theorems and concepts of differential and integral calculus, ordinary differential equations, probability and statistics, and understands their application to engineering modelling issues	P6S_WG-O1
K_W04	knows and understands basic examples illustrating the application of specific mathematical concepts in solving problems in exact, technical and/or economic sciences	P6S_WG-O1
K_W05	has knowledge of higher mathematics necessary to build and analyse simple mathematical models in technical sciences	P6S_WG-O1
K_W06	knows selected mathematical software packages used for symbolic and numerical calculations, used in modelling and simulation of dynamic systems and processes	P6S_WG-O1 P6S_WG-I1
K_W07	knows the basics of computational and programming techniques supporting the analyst's work and understands their limitations; has knowledge of the process approach and object-oriented methods in engineering issues	P6S_WG-O1 P6S_WG-I1
K_W08	knows selected programming languages and the basics of object-oriented programming; knows basic data structures (arrays, lists, trees, objects, graphs), their computer representations and operations performed on them	P6S_WG-O1
K_W09	knows various IT tools supporting data processing and analysis as well as statistical inferencing	P6S_WG-O1 P6S_WG-I1
K_W10	knows the most important problems that is able to be solved algorithmically using mathematics and IT techniques	P6S_WG-O1
K_W11	knows the basic techniques of constructing and analysing algorithms and understands the basic limitations in solving algorithmic problems	P6S_WG-O1
K_W12	knows the basic concepts of numerical issues and selected techniques for constructing numerical algorithms	P6S_WG-O1
K_W13	knows methods of information and database systems' management	P6S_WG-O1
K_W14	has basic knowledge and knows various IT tools related to the design and use of databases and computer decision support systems; has basic knowledge of the life cycle of IT devices and systems	P6S_WG-O1 P6S_WG-I1
K_W15	has basic knowledge of network technologies, including computer network architecture, communication protocols, security and construction of network applications	P6S_WG-O1 P6S_WG-I1
K_W16	has basic knowledge of the social aspects of computer science as well as ethical, legal and economic conditions related to the profession of an	P6S_WK-O2.2

	analyst, mathematician and computer scientist; knows the general principles of creating and developing forms of individual entrepreneurship; has basic knowledge of intellectual property protection and patent law	P6S_WK-O2.3 P6S_WK-I2
K_W17	knows the basic principles of occupational health and safety applicable to computers and computer networks	P6S_WK-O2.2 P6S_WG-I1
K_W18	has basic knowledge of economics, work organization and management; has basic knowledge of IT activities supporting the work of small and medium-sized companies and enterprises	P6S_WK-O2.3 P6S_WK-I2
K_W19	knows English at the B2 level of proficiency of the European System of Language Education of the Council of Europe and knows specialized vocabulary in selected areas of mathematics	P6S_UK-O4.3
SKILLS		
K_U01	is able to apply mathematical knowledge to model simple engineering tasks	P6S_UW-O3 P6S_UW-I4
K_U02	is able to correctly formulate a problem in the language of mathematics and perform the analysis necessary to select the appropriate software needed to solve it, as well as assesses the possibilities and limitations of such an approach	P6S_UW-O3
K_U03	is able to effectively use mathematical software and IT tools to solve typical discrete and continuous mathematics problems, simulate the solution, visualize and interpret the obtained results	P6S_UW-O3 P6S_UW-I3 P6S_UW-I4
K_U04	is able to design algorithms that solve typical problems of discrete and continuous mathematics by designing and selecting appropriate algorithmic techniques and data structures	P6S_UW-O3
K_U05	is able to analyse designed algorithms in terms of correctness and computational complexity	P6S_UW-O3
K_U06	is able to skilfully and effectively implement classical and self-designed discrete and continuous mathematics algorithms using a mathematical package or programming tools appropriately selected for the problem under consideration; is able to present the solution in a clear, graphical form	P6S_UW-O3 P6S_UW-I4
K_U07	is able to introduce the necessary mathematical concepts and objects, e.g. functions, relations, recursive data sequences, in order to solve an engineering problem	P6S_UW-O3
K_U08	is able to analyse and solve selected engineering problems in the field of linear algebra using typical mathematical packages and programming languages	P6S_UW-O3
K_U09	is able to solve numerically systems of equations (linear and non-linear) and the initial problem for ordinary differential equations	P6S_UW-O3
K_U10	is able to use the concept of limit to approximate and define numbers and functions and critically evaluate the effects of numerical approximation of numbers and functions; is able to examine the convergence of methods and the speed of convergence to a solution	P6S_UW-O3
K_U11	uses the concept of derivative and integral of functions of one and many variables; is able to use these concepts to study functions, in optimization problems and to determine the areas and volumes of figures; uses selected mathematical packages and numerical methods to solve selected problems of differential and integral calculus	P6S_UW-O3
K_U12	is able to create and interpret graphs of functions and/or available data	P6S_UW-O3

	using mathematical software	P6S_UW-I4
K_U13	knows how to use the concepts of probability theory; is able to analyse an appropriate mathematical model of a random experiment and simulate it numerically	P6S_UW-O3 P6S_UW-I4
K_U14	is able to perform statistical inference using appropriate software	P6S_UW-O3 P6S_UW-I4
K_U15	is able to solve combinatorial, graph and number theory problems using algorithmic methods	P6S_UW-O3
K_U16	is able to speak about computational mathematics issues in generally understandable language	P6S_UK-O4.1 P6S_UK-O4.2
K_U17	is able to formulate definitions and theorems in an understandable way, both orally and in writing, and present examples of applications of mathematical concepts mastered during studies	P6S_UK-O4.1 P6S_UK-O4.2
K_U18	is able to communicate with the engineering, scientific and business community on the subject of computational mathematics and its applications	P6S_UK-O4.1 P6S_UK-O4.2
K_U19	is able to prepare studies and written works on the applications of mathematics in selected engineering problems and issues	P6S_UK-O4.1
K_U20	is able to obtain information from literature, the Internet and other reliable sources, process it, interpret it, draw conclusions and formulate opinions	P6S_UK-O4.1
K_U21	is able to learn independently and in a group; is able to take into account the economic aspect of carrying out a given task; is able to develop and implement a work schedule to ensure that deadlines are met; is able to perform financial and economic analyses of projects	P6S_UO-O5.1 P6S_UU-O6 P6S_UW-I4
K_U22	possesses (English) language skills in mathematics consistent with the requirements set out for the B2 proficiency level of the European System for Languages of the Council of Europe	P6S_UK-O4.3
K_U23	is able to assess the usefulness of mathematical and IT methods and tools and select and apply the appropriate method and tools for complex engineering tasks	P6S_UW-O3 P6S_UW-I5
K_U24	has the ability to effectively use existing software for operating systems, databases and computer networks	P6S_UW-O3
K_U25	is able, in accordance with the given specification, to analyse, design and implement a simple database system, using properly selected methods, techniques and tools	P6S_UW-O3 P6S_UW-I6
K_U26	is able to ensure basic security of data and computer networks	P6S_UW-I4
K_U27	is able to use analytical, numerical and experimental methods to formulate and solve engineering tasks; is able to recognize their systemic and non-technical aspects	P6S_UW-I3 P6S_UW-I4
K_U28	solves basic tasks related to information processing and selects appropriate mathematical methods and IT tools for specific types of tasks	P6S_UW-I6
SOCIAL COMPETENCES		
K_K01	understands the need to constantly improve their qualifications by expanding their knowledge and practical skills	P6S_KK-O7.1 P6S_KK-

		O7.2
K_K02	is able to actively conduct a discussion in order to clarify, deepen and/or broaden the level of understanding of the discussed topic; is able to work in a team, taking on various roles;	P6S_UK-O4.2 P6S_UO-O5.2 P6S_KK-O7.2
K_K03	is able to properly define priorities for the implementation of a task specified by himself/herself or others; understands the need to systematically work on long-term projects	P6S_UO-O5.2 P6S_KO-O8.1 P6S_KO-O8.2
K_K04	understands and appreciates the importance of intellectual honesty in one's own and other people's actions; acts ethically	P6S_KR-O9
K_K05	understands the ethical, legal and social aspects of computerization and is able to comply with the principles relating to them in their professional activity	P6S_KR-O9
K_K06	is able to think and act in a creative and entrepreneurial way	P6S_KO-O8.2 P6S_KO-O8.3
K_K07	understands and is aware of the importance of technical and non-technical aspects and effects of the engineer's activities and the related responsibility for decisions made	P6S_KO-O8.1 P6S_KR-O9