Learning outcomes

Outcome symbol	After completing first-cycle studies in mathematics, the graduate:	Reference to PRK level 6
KNOWLEDGE		
K_W01	understands significance of mathematics and its applications to the development of modern civilization	P6S_WG-O1
K_W02	understands the importance of proof and assumptions in mathematics	P6S_WG-O1
K_W03	knows methods of mathematical analysis, linear algebra, probability theory and mathematical statistics, enabling to build models of medium complexity in other branches of science	P6S_WK-O2.1 P6S_WG-O1
K_W04	knows basic theorems of previously studied branches of mathematics	P6S_WG-O1
K_W05	knows basic examples which present mathematical concepts and enable to refute wrong hypotheses or invalid reasoning	P6S_WG-O1
K_W06	knows selected concepts and methods of mathematical logic, set theory, discrete mathematics included in fundamentals of other branches of mathematics	P6S_WG-O1
K_W07	knows fundamentals of differential and integral calculus of functions of one and many variables; knows other branches of mathematics used in the calculus, linear algebra and topology in particular	P6S_WG-O1
K_W08	knows fundamentals of computing techniques and programming which help mathematicians to carry out their tasks, and is aware of their limitations	P6S_WG-O1
K_W09	has basic knowledge of at least one software package used for symbolic calculations	P6S_WG-O1
K_W10	has achieved English language proficiency equivalent to level B2 of European Framework of Reference for Languages and is familiar with specialist terminology from selected branches of mathematics	P6S_UK-O4.3
K_W11	knows principles of occupational health and safety	P6S_WK-O2.2
K_W12	has basic knowledge of the law and ethics relating to scientific research activities and teaching, as well as to forms of individual entrepreneurship and copyright law	P6S_WK-O2.2 P6S_WK-O2.2 P6S_WK-O2.3
SKILLS		
K_U01	is able to present in a clear manner, both in speech and writing, correct mathematical reasoning, and formulate theorems and definitions	P6S_UW-O3 P6S_UK-O4.1 P6S_UU-O6
K_U02	demonstrates the ability to use propositional logic and quantifiers; can properly use quantifiers in colloquial language	P6S_UW-O3
K_U03	demonstrates the ability to perform mathematical proofs by complete induction; can define functions and recurrence relations	P6S_UW-O3
K_U04	is able to support mathematical reasoning using simple diagrams, such as Vienna or Hasse diagrams, or graphs	P6S_UW-O3
K_U05	is able to create new objects by means of constructing quotient spaces or Cartesian products	P6S_UW-O3
K_U06	uses the language of multiplicity theory to interpret problems relating to different branches of mathematics	P6S_UW-O3
K_U07	understands issues concerning different types of infinity and orders in sets	P6S_UW-O3
K_U08	can use the concept of real number; can give examples of irrational numbers and leap numbers	P6S_UW-O3
K_U09	is able to define functions, also using boundary crossings, and describe	P6S_UW-O3

	their properties	
K_U10	can use in different contexts the concept of convergence and limit; is able to – on easy and medium difficulty levels – calculate limits of sequences and functions, determine absolute and conditional convergence of series	P6S_UW-O3
K_U11	can interpret and explain functional dependencies presented in the form of formulae, charts, graphs, schemes and apply them to practical problems	P6S_UW-O3
K_U12	can apply theorems and methods of differential calculus of functions of one and many variables to problems relating to optimization, to finding local and global extrema, and to function investigation; can give precise justification of their reasoning	P6S_UW-O3
K_U13	can use the definition of an integral of a function of one and many real variables; can explain analytical and geometric sense of the concept	P6S_UW-O3
K_U14	can integrate functions of one and many variables by parts and substitution; can change order of integration; can present areas of plane surfaces and volumes in forms of integrals	P6S_UW-O3
K_U15	can apply numeric tools and methods to solving selected problems of differential and integral calculus, including those basing on its applications	P6S_UW-O3
K_U16	uses the concepts of linear space, vector, linear transformation, matrix	P6S_UW-O3
K_U17	notices algebraic structures (group, ring, body, linear space) in different mathematical issues, not necessarily associated directly with algebra	P6S_UW-O3
K_U18	can compute determinants and know their properties; can give a geometric representation of a determinant and understands its relation to mathematical analysis	P6S_UW-O3
K_U19	solves sets of linear equations with constant coefficients; can use geometric interpretation of solutions	P6S_UW-O3
K_U20	finds matrices of linear transformations with respect to different bases; computes eigenvalues and eigenvectors of matrices; can explain geometric sense of these concepts	P6S_UW-O3
K_U21	reduces matrices to a canonical form; can use this skill to solve linear differential equations with constant coefficients	P6S_UW-O3
K_U22	is able to interpret a system of ordinary differential equations in the language of geometry by means of vector field and phase space	P6S_UW-O3
K_U23	recognizes and determines most important topological properties of subsets of Euclidean space and metric spaces	P6S_UW-O3
K_U24	applies topological properties of sets and functions to solving problems relating to quality	P6S_UW-O3
K_U25	recognizes problems, including practical issues, which can be solved using algorithms; can specify this type of problem	P6S_UW-O3
K_U26	can construct and analyze an algorithm in accordance with a specification and write it in a selected programming language	P6S_UW-O3
K_U27	is able to compile, start and test an independently written computer program	P6S_UW-O3
K_U28	is able to use computer programs for data analysis	P6S_UW-O3
K_U29	is able to model and solve discrete problems	P6S_UW-O3
K_U30	uses the concept of probabilistic space; is able to construct and analyze a mathematical model of a random experiment	P6S_UW-O3
K_U31	can give various examples of discrete and continuous probability distributions and discuss selected random experiments and mathematical models in which these distributions occur; knows practical applications of basic distributions	P6S_UW-O3

K_U32	knows how to use formula of total probability and Bayes formula	P6S_UW-O3
K_U33	can identify parameters for the distribution of a discrete and continuous random variable; can apply boundary theorems and law of large numbers to probability evaluation	P6S_UW-O3
K_U34	knows how to use statistical characteristics of a population and the equivalent sample	P6S_UW-O3
K_U35	is able to conduct simple statistical inference, also with the use of computer tools	P6S_UW-O3
K_U36	is able to present mathematical problems and issues in a simple colloquial language	P6S_UK-O4.1 P6S_UK-O4.2
K_U37	has acquired English language proficiency in the field of mathematics according to the requirements for level B2 of European Framework of Reference for Languages	P6S_UK-O4.3 P6S_UK-O4.2 P6S_UK-O4.3
K_U38	can write a short paper and deliver an oral presentation, both in English and Polish, relating to previously studied problems; uses relevant resources to fulfill the task	P6S_UK-O4.3 P6S_UK-O4.2
K_U39	can prepare a longer presentation discussing a selected problem in mathematics and its applications	P6S_UW-O3
SOCIAL COMPETENCES		
K_K01	understands the need for lifelong education	P6S_UU-O6 P6S_KK-O7.1
K_K02	demonstrates the ability to formulate precise questions to deepen his understanding of a given topic or to find missing elements of reasoning	P6S_UU-O6 P6S_KR-O9
K_K03	can interact and work in a team; understands the need of systematic work on long term projects	P6S_KR-O9 P6S_KK-O7.2
K_K04	understands the significance of intellectual honesty, both in his own and in other people's activities; demonstrate ethical behavior	P6S_KK-O7.2 P6S_KO-O8.2
K_K05	understands the need to popularize selected achievements in the field of higher mathematics	P6S_KK-O7.1
K_K06	deepen his knowledge and abilities relating to the scope of his interests; is able to obtain information from specialist literature independently, also in foreign languages	P6S_UU-O6 P6S_KO-O8.3
K_K07	demonstrates the ability to formulate opinions concerning important mathematical issues	P6S_KO-O8.1