## Learning outcomes

Outcome	After completing first-cycle studies in mathematics, the graduate:	Reference to		
symbol		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	P6S_WK-O2.1		
	theory and mathematical statistics, enabling to build models of medium complexity in other branches of science	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			
	is able to present in a clear manner, both in speech and writing, correct	P6S UW-O3		
K_U01	mathematical reasoning, and formulate theorems and definitions	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	
	can use in different contexts the concept of convergence and limit; is able	P6S_UW-O3
K_U10	to - on easy and medium difficulty levels - calculate limits of sequences	
	and functions, determine absolute and conditional convergence of series	
K 1111	can interpret and explain functional dependencies presented in the form of	P6S_UW-O3
K_011	formulae, charts, graphs, schemes and apply them to practical problems	
	can apply theorems and methods of differential calculus of functions of	P6S_UW-O3
К 1112	one and many variables to problems relating to optimization, to finding	
K_012	local and global extrema, and to function investigation; can give precise	
	justification of their reasoning	
К 1113	can use the definition of an integral of a function of one and many real	P6S_UW-O3
<u></u>	variables; can explain analytical and geometric sense of the concept	
	can integrate functions of one and many variables by parts and	P6S_UW-O3
K_U14	substitution; can change order of integration; can present areas of plane	
	surfaces and volumes in forms of integrals	
	can apply numeric tools and methods to solving selected problems of	P6S_UW-O3
K_U15	differential and integral calculus, including those basing on its	
	applications	
<u>K_UI6</u>	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	$P6S_UW-O3$
—	mathematical issues, not necessarily associated directly with algebra	DIG LULIO
17 1110	can compute determinants and know their properties; can give a geometric	$P6S_UW-O3$
K_U18	representation of a determinant and understands its relation to	
	mainematical analysis	DCC LINE O2
K_U19	solves sets of linear equations with constant coefficients; can use	P65_Uw-U3
	finds matrices of linear transformations with respect to different bases	DES LIW O2
K 1120	computes eigenvalues and eigenvectors of matrices: can explain	r05_0w-05
K_020	geometric sense of these concents	
	reduces matrices to a canonical form: can use this skill to solve linear	P6S LIW-O3
K_U21	differential equations with constant coefficients	105_0 ₩-05
	is able to interpret a system of ordinary differential equations in the	P6S LIW-O3
K_U22	language of geometry by means of vector field and phase space	105_0 11 05
K_U23	recognizes and determines most important topological properties of	P6S_UW-O3
	subsets of Euclidean space and metric spaces	105_01105
K_U24	applies topological properties of sets and functions to solving problems	P6S UW-O3
	relating to quality	
	recognizes problems, including practical issues, which can be solved	P6S UW-O3
K_025	using algorithms; can specify this type of problem	_
W 1126	can construct and analyze an algorithm in accordance with a specification	P6S UW-O3
K_026	and write it in a selected programming language	—
K 1127	is able to compile, start and test an independently written computer	P6S UW-O3
K_027	program	—
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	P6S_UW-O3
	mathematical model of a random experiment	_
K_U31	can give various examples of discrete and continuous probability	P6S_UW-O3
	distributions and discuss selected random experiments and mathematical	—
	models in which these distributions occur; knows practical applications of	
	basic distributions	

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	P6S_UW-O3		
	random variable; can apply boundary theorems and law of large numbers			
	to probability evaluation			
K_U34	knows how to use statistical characteristics of a population and the	P6S_UW-O3		
	equivalent sample			
K_U35	is able to conduct simple statistical inference, also with the use of	P6S UW-O3		
	computer tools	—		
K_U36	is able to present mathematical problems and issues in a simple colloquial	P6S UK-O4.1		
	language	P65 UK-O4.2		
K U37	has acquired English language proficiency in the field of mathematics	P6S UK-O4.3		
	according to the requirements for level B2 of European Framework of	P65 UK-O4.2		
_	Reference for Languages	P65_UK-O4.3		
	can write a short paper and deliver an oral presentation, both in English	P6S UK-O4.3		
K U38	and Polish, relating to previously studied problems; uses relevant	P65 UK-O4.2		
	resources to fulfill the task			
V 1120	can prepare a longer presentation discussing a selected problem in	P6S_UW-O3		
K_039	mathematics and its applications			
SOCIAL COMPETENCES				
V VOI	understands the need for lifelong education	P6S UU-O6		
K_K01		P65_KK-07.1		
V VOO	demonstrates the ability to formulate precise questions to deepen his	P6S UU-O6		
K_K02	understanding of a given topic or to find missing elements of reasoning	P6S_KR-O9		
K_K03	can interact and work in a team; understands the need of systematic work	P6S KR-O9		
	on long term projects	P65_KK-O7.2		
IZ IZOA	understands the significance of intellectual honesty, both in his own and in	P6S KK-07.2		
K_K04	other people's activities; demonstrate ethical behavior	P65 KO-08.2		
K_K05	understands the need to popularize selected achievements in the field of	P6S KK-07.1		
	higher mathematics	—		
K_K06	deepen his knowledge and abilities relating to the scope of his interests; is	P6S UU-O6		
	able to obtain information from specialist literature independently, also in	P65 KO-08.3		
	foreign languages	—		
K_K07	demonstrates the ability to formulate opinions concerning important	P6S KO-08.1		
	mathematical issues	—		