Programme: Mathematics
Level of studies: I[st] degree
Polish Qualifications Framework PRK level: 6
Programme profile: general academic profile
Field of science/arts: Natural sciences, Humanities, Social sciences
Discipline/Disciplines [i]: mathematics - indicated discipline, computer and information sciences, philosophy, management and quality studies

Learning outcomes for general university courses (foreign language classes, physical education, entrepreneurship, university mission courses) are specified in the relevant resolutions of the Senate

Symbol of the programme learning outcome	Programme learning outcomes	Reference to universal first stage descriptors – PRK levels 6-8[ii]	Reference to second stage descriptors - PRK levels 6-8[iii]	Reference to second stage descriptors - PRK levels 6 and 7 in the field of art sciences [iv]	Reference to second stage descriptors - PRK levels 6 and 7 for engineering qualifications [v]
	Knowledge: Graduate knows and understands	**Descriptor symbol**	**Descriptor symbol**	**Descriptor symbol**	**Descriptor symbol**
K_W01	The student understands the importance of mathematics and its applications, in particular its role in the context of contemporary civilization's dilemmas	P6U_W2	P6S_WK1		
K_W02	The student has a good understanding of the role and importance of proof in mathematics, and the notion of essence of hypotheses	P6U_W1	P6S_WG1		
K_W03	The student understands the structure of mathematical theories, can use mathematical formalism to construct and analyze simple mathematical models in other areas of science	P6U_W1	P6S_WG1		
K_W04	The student Has advanced knowledge of the basic areas of higher mathematics, in particular in calculus, algebra, geometry, logic, measure and integral, probability theory, differential equations, statistics, set theory, topology and others selected fields of mathematics and its applications.	P6U_W1	P6S_WG1		

				Descriptor symbol	Descriptor symbol
K_W05	The student knows basic examples both those that illustrate concrete mathematical notions, and those that allow false hypotheses or unsupported argumentation	P6U_W1	P6S_WG1		
K_W06	The student knows selected notions and methods of mathematical logic, set theory and discrete mathematics contained in the fundamentals of other branches of mathematics	P6U_W1	P6S_WG1		
K_W07	The student knows the fundamentals of differential and integral calculus of one and several variable functions, and other branches of mathematics applied in differential calculus with special attention of linear algebra and topology	P6U_W1	P6S_WG1		
K_W08	The student knows basics of computation techniques and programming, supporting the work of mathematicians and understands their limitations	P6U_W1	P6S_WG1		
K_W09	The student has basic knowledge of at least one software packet used for symbolic computations	P6U_W1	P6S_WG1		
K_W10	The student knows the basic concepts and principles in the field of economic, legal and ethical aspects of mathematics professional activity, in particular regarding: fundamental rules of work safety and hygiene, protection of industrial property and copyright law	P6U_W2	P6S_WK2		
	Skills: a graduate can	**Descriptor symbol**	**Descriptor symbol**	**Descriptor symbol**	**Descriptor symbol**
K_U01	The student can in a clear manner, in speech and writing, present correct mathematical reasoning, formulate theorems and definitions	P6U_U1 P6U_U3	P6S_UW1 P6S_UK1		
K_U02	The student uses sentential and quantifier calculus, can properly use quantifiers in colloquial language	P6U_U1	P6S_UW1		
K_U03	The student is able to conduct easy and more advanced proofs be means of complete induction, can define functions and recurrent relations	P6U_U1	P6S_UW1		
K_U04	The student can apply classical logic system to formalize mathematical theories	P6U_U1	P6S_UW1		
K_U05	The student is capable to create new object by means of construction of quotient spaces or Cartesian products	P6U_U1	P6S_UW1		
K_U06	The student utilizes the language of set theory when interpreting problems from the various branches of mathematics	P6U_U1	P6S_UW1		
K_U07	The student understands issues connected with the different kinds of infinity and orderings in sets	P6U_U1	P6S_UW1		
K_U08	The student knows how to use the notion of the real number, knows examples of irrational and transcendental numbers	P6U_U1	P6S_UW1		

K_U09	The student can define functions, including limits, and describe their properties	P6U_U1	P6S_UW1		
K_U10	The student uses the idea of convergence and limit in various contexts, can -- on low and medium level of difficulty - compute limits of sequences and functions, examine absolute and conditional convergence of series	P6U_U1	P6S_UW1		
K_U11	The student can examine and explain functional interconnections, expressed in the form of formulas, tables, schemes and apply them in practical problems	P6U_U1	P6S_UW1		
K_U12	The student can use theorems and methods of differential calculus of the one and several variable functions in connection with optimization, searching for global and local extremes and examine graphs of functions, giving precise and direct reasoning for the correctness of his argumentation	P6U_U1	P6S_UW1		
K_U13	The student uses definition of the integral of one and several variable real functions, can explain the analytical and geometrical sense of this notion	P6U_U1	P6S_UW1		
K_U14	The student is able to integrate one and several variable functions by parts and substitution, can interchange ordering of integration, can express the area of smooth surfaces and volume as appropriate integrals	P6U_U1	P6S_UW1		
K_U15	The student can utilize numerical tools and methods to solve selected problems of differential and integral calculus, in particular those based on its applications	P6U_U1	P6S_UW1		
K_U16	The student uses the notion of linear space, vector, linear transformation and matrix	P6U_U1	P6S_UW1		
K_U17	The student perceives presence of algebraic structures (group, ring, field, linear space) in various mathematical contexts, not necessarily in direct connection with algebra	P6U_U1	P6S_UW1		
K_U18	The student can compute determinants and knows their properties, can give geometrical interpretation of determinant and understands its connection with mathematical analysis	P6U_U1	P6S_UW1		
K_U19	The student solves systems of differential equations with constant coefficients, can utilize geometrical interpretation of solutions	P6U_U1	P6S_UW1		
K_U20	The student finds matrices of linear transformations in various bases, computes eigenvalues and eigenvectors of matrices, can explain geometrical sense of these notions	P6U_U1	P6S_UW1		
K_U21	The student reduces matrices to canonical form, can apply this capability to solve linear differential equations with constant coefficients	P6U_U1	P6S_UW1		
K_U22	The student can interpret the system of ordinary differential equations in geometrical language, applying the notion of vector field and phase space	P6U_U1	P6S_UW1		

K_U23	The student recognizes and determines the main topological properties of subsets of the Euclidean space and metric spaces	P6U_U1	P6S_UW1		
K_U24	The student can use topological properties of sets and functions to solve problems of qualitative character	P6U_U1	P6S_UW1		
K_U25	The student recognizes problems, in particular practical issues, which can be solved algorithmically; can perform specification of such a problem	P6U_U1	P6S_UW1		
K_U26	The student can compose and analyze an algorithm consistent with specification and record it in a selected programming language	P6U_U1	P6S_UW1		
K_U27	The student is able to compile, start and test a self-designed computer program	P6U_U1	P6S_UW1		
K_U28	The student can use computer software in the area of data analysis	P6U_U1	P6S_UW1		
K_U29	The student can model and solve discrete problems	P6U_U1	P6S_UW1		
K_U30	The student utilizes the notion of a probability space; can build and perform analysis of the mathematical model of a random experiment	P6U_U1	P6S_UW1		
K_U31	The student can give examples of various discrete and continuous probability distributions and describe selected random experiments as well as mathematical models, in which these probability distributions appear; knows practical applications of basic probability distributions	P6U_U1	P6S_UW1		
K_U32	The student can apply the law of total probability and Bayes' formula	P6U_U1	P6S_UW1		
K_U33	The student can determine parameters of a random variable with discrete and continuous distribution; can apply limit theorems and laws of large numbers to estimate probabilities	P6U_U1	P6S_UW1		
K_U34	The student can employ statistical characteristics of population and their sample analogues	P6U_U1	P6S_UW1		
K_U35	The student can perform simple statistical inference, also with the use of computer tools	P6U_U1	P6S_UW1		
K_U36	The student can discuss mathematical problems in a comprehensible, colloquial language	P6U_U1 P6U_U3	P6S_UW1 P6S_UK1		
K_U37	The student knows at least one foreign language	P6U_U3	P6S_UK3		
K_U38	The student is able to use his knowledge to formulate complex and unusual mathematical problems in a correct and understandable way, discuss them and	P6U_U1 P6U_U3	P6S_UW1 P6S_UK1 P6S_UK2		

		Descriptor symbol	Descriptor symbol	Descriptor symbol	Descriptor symbol
	methods of solving them and present mathematical results and contents, in particular using information and communication techniques				
K_U39	The student can properly select sources of information, in particular electronic, based on their analysis and evaluation, and synthesize the knowledge gathered on their basis	P6U_U1	P6S_UW1		
K_U40	The student is able to communicate in the strict language of mathematicians, use specialist terminology, present and evaluate opinions, in particular, take part in debates on the foundations of higher mathematics	P6U_U3	P6S_UK1 P6S_UK2		
K_U41	The student can plan and organize own work and effectively perform and coordinate tasks in a team, also of an interdisciplinary nature	P6U_U1 P6U_U3 P6U_K2	P6S_UO1 P6S_UO2		
K_U42	The student can independently acquire knowledge and develop professional skills and plan their own path of self-education and consistently strive to achieve it throughout their lives	P6U_U2	P6S_UU1		
	Social competence: a graduate is ready to	**Descriptor symbol**	**Descriptor symbol**	**Descriptor symbol**	**Descriptor symbol**
K_K01	The student is prepared to take into account the limits of his own knowledge and skills, adequate assessment of his level of competence, his weaknesses, the need to constantly improve his professional skills, and at the same time know his strengths and present a critical attitude towards opinions not supported by rational justification	P6U_K2	P6S_KK1		
K_K02	The student is prepared to appreciate the role and importance of knowledge in solving cognitive and practical problems, typical of occupations and workplaces appropriate for graduates in the field of mathematics and consulting experts in the case of difficulties in solving the problem	P6U_K2	P6S_KK2		
K_K03	he is ready to fulfill social obligations resulting from the nature of work typical of mathematics, in particular he actively works for the public interest	P6U_K1	P6S_KO1 P6S_KO2		
K_K04	is ready to responsibly carry out professional roles, respect professional achievements and traditions, and observe professional ethics and act on behalf of others	P6U_K1 P6U_K2	P6S_KR1		
K_K05	is ready to present selected achievements of higher mathematics in a popular way	P6U_K1	P6S_KO1		

i In the case of programmes assigned to more than one discipline a leading discipline should be indicated.

ii Universal first stage descriptors for PRK levels 6-8 – Act of 22 December 2015 on the Integrated Qualifications System (Journal of Law of 2016, item 64).

iii Second stage descriptors for PRK levels 6-8 typical for qualifications awarded by higher education institutions – Regulation of MNiSW of 14 November 2018 r. - part I.

iv Second stage descriptors for PRK levels 6-8 typical for qualifications awarded by higher education institutions in the field of art sciences. – Regulation of MNiSW of 14 November 2018 r. - part II.

v Second stage descriptors for PRK levels 6-8 typical for engineering qualifications awarded by higher education institutions – Regulation of MNiSW of 14 November 2018 r. - part III.