

Subject card

Subject name and code	Elementary Functions, PG_00206880						
Field of study	Mathematics						
Date of commencement of studies	October 2026		Academic year of realisation of subject			2027/2028	
Education level	Master's studies		Subject group			Obligatory subject group in the field of study Optional subject group Subject group related to scientific research in the field of study	
Mode of study	full-time studies		Mode of delivery			at the university	
Year of study	2		Language of instruction			Polish	
Semester of study	3		ECTS credits			5.0	
Learning profile	academic		Assessment form			exam	
Conducting unit	Institute of Mathematics -> Faculty of Mathematics, Physics and Informatics -> Rector						
Name and surname of lecturer (lecturers)	Subject supervisor		dr Agnieszka Demby				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	30.0	0.0	0.0	0.0	60
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	60		2.0		63.0	125
Subject objectives	Supplementing and deepening knowledge and skills from secondary school by: defining and introducing new types of elementary functions, studying functions using various methods, computer visualization of selected issues, solving more difficult or unusual tasks, linking with other areas of science or life.						
	Deepening the student's theoretical awareness of functions, i.e. e.g. the ability to link techniques for solving problems from high school with the properties of functions, proving skills.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[MATMU2_U01] is able to construct mathematical reasoning: prove theorems, formulate, test and refute hypotheses by constructing and selecting counterexamples, choosing, if necessary, methods and tools from various areas of mathematics	Is able to construct mathematical reasoning: prove the properties of functions using definitions and theorems from the lecture; is able to solve various types of tasks concerning elementary functions, including tasks from the canon of the extended secondary school leaving examination in mathematics.	[SU1] oral statement/conversation/discussion [SU4] test/exam - oral or written
	[MATMU2_W02] knows and understands in depth the role and importance of the construction of mathematical reasoning	Knows and understands in an in-depth way the role and importance of the construction of mathematical reasoning related to the properties of elementary functions.	[SW4] test/exam - oral or written [SW2] presentation/project/paper/report
	[MATMU2_W01] knows and understands in depth the theory of selected areas of mathematics or related fields, the complex relationships between them and their development trends	Knows and understands in an in-depth way the theory related to elementary functions and their various subtypes; knows examples of non-elementary functions, including non-elementary integrals; knows the applications of elementary functions outside mathematics.	[SW4] test/exam - oral or written [SW2] presentation/project/paper/report
Subject contents	1. Recursive method of constructing a set of elementary functions (one real variable with real values). Proofs of elementary functions; examples of non-elementary functions. Algebraic and transcendental functions. 2. Review of algebraic functions - graphs, properties, applications outside mathematics. Selected theorems about polynomials, including solving polynomial equations by radicals. Solving rational and irrational equations and inequalities (referring to the properties of these functions). Parameter problems. 3. Power with a real exponent. Selected theorems about irrational numbers and powers. Power, exponential and logarithmic functions - graphs, properties, applications. 4. Trigonometric functions (including cotangent, secant and cosecant functions). Examples of approaches other than traditional ones, e.g. historical (segments related to the unit circle) or axiomatic. Graphs, properties, formulas, applications outside mathematics. Solving various types of trigonometric equations and inequalities. 5. Trigonometric functions - graphs, properties, formulas, applications. Examples of composition of trigonometric and trigonometric functions. 6. Elements of mathematical analysis: limit of elementary function, continuity (note about different definitions), derivative, differentiability, antiderivative (not necessarily elementary). Solving problems, including optimization and with a parameter. 7. Hyperbolic functions and area. Graphs, properties, formulas, applications outside mathematics. Analogies of formulas for trigonometric and hyperbolic functions, trigonometric functions and area, including formulas for derivatives. Formulas for calculating integrals containing the square root of x^2+1 or of x^2-1. 8. Examples of elementary functions of a real variable with complex values. Theorems defining certain classes of elementary and non-elementary integrals. Visualization of the shape and position of a graph and various issues related to the study of elementary functions using computer programs, especially GeoGebra.		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	exam	51.0%	30.0%
	activity	51.0%	15.0%
	observation of the student's attitude	51.0%	0.0%
	project	51.0%	25.0%
	test	51.0%	30.0%

Recommended reading	Basic literature	1. Internet materials showing applications of elementary functions outside mathematics and various other aspects of these functions, e.g. the website: Muleshkov, A. S. (Ph.D. Associate Professor of Mathematics, University of Nevada Las Vegas): Definition and Some Properties of Elementary Functions, 2006. 2. Marchisotto, E. A., Zakeri, G. A.: An Invitation to Integration in Finite Terms, The College Mathematics Journal, Mathematical Association of America, Vol.25, No.4 (Sep., 1994), pp. 295-307. 3. Sierpiński, W.: Zasady algebry wyższej. Z przypisem Andrzeja Mostowskiego: Zarys teorii Galois, in: Monografie Matematyczne - t.XI, Warszawa Wrocław, 1946 4. Internet materials introducing the possibilities of the GeoGebra computer program and applets of this program - visualization of various aspects of functions, especially from the website: www.geogebra.org. 5. Publications preparing for the advanced level matriculation exam in mathematics, advanced level matriculation exam task sheets.
	Supplementary literature	1. Fichtenholz, G. M.: Rachunek różniczkowy i całkowy - t.1, PWN, Warszawa, 1976. 2. Mostowski, A., Stark, M. : Elementy algebry wyższej, PWN, Warszawa, 1975. 3. Pobiega, E., Pobiega, K., Winkowska-Nowak, K.: Funkcje z GeoGebra, Fundacja AKCES, Warszawa 2019. 4. Textbooks for teaching advanced mathematics in high school (licem in Poland). 5. Books and articles of a popular science nature.
	eResources addresses	
Example issues/ example questions/ tasks being completed	Give 5 examples of practical applications of elementary functions. (This refers to functional dependencies with a variable argument, and not, for example, calculating the square root of a specific number or the length of a certain segment using a trigonometric function in a specific geometric figure.)	
Work placement	Not applicable	

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