University of Gdańsk

Subject card

Subject name and code	Introduction to set theory and logic, PG_00155208		
Field of study	Mathematics		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2025/2026
Education level	Bachelor's studies	Subject group	Obligatory subject group in the field of study
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	1	ECTS credits	6.0
Learning profile	academic	Assessment form	exam
Conducting unit	Division of Set Theory -> Institute of Mathematics -> Faculty of Mathematics, Physics and Informatics -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	dr Marta Kwela	
	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	10.0	80.0	150

Subject objectives	The aim is to teach the use of propositional and quantification calculus in reasoning, in particular in proving theorems, performing operations on sets and functions; interpreting issues known from other areas of mathematics in the language of set theory, understanding issues related to different types of infinity and orders in sets. These skills are needed to study most areas of mathematics.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[MATL3_W08] knows and understands the structure of mathematical theories, is able to use mathematical formalism to build and analyze simple mathematical models in other fields of science	knows some axioms of the ZFC set theory and other theorems that are the subject of the lecture, is able to indicate the relationships between axioms and theorems in set theory and interpret their significance in the context of theory construction	[SW4] test/exam - oral or written
[MATL3_K04] is ready to understand and appreciate the importance of intellectual honesty in one's own and other people's actions; is willing to act ethically	is able to indicate examples of unethical behavior in mathematical work (e.g. plagiarism, manipulation of proof) and explain their consequences	[SK8] observation of student's independent or team work
[MATL3_K02] is ready to precisely formulate questions to deepen his/her own understanding of a given topic or to find missing elements of reasoning	is able to ask questions leading to a deeper understanding of mathematical issues and initiate problem-solving discussions	[SK1] oral statement/conversation/discussion
[MATL3_W01] knows and understands the basic concepts, methods and theorems of mathematical logic and set theory, as well as basic examples illustrating specific concepts in these fields and enabling the refutation erroneous hypotheses or unauthorized reasoning	knows the elements of logic and set theory, in particular the theorems that are the subject of the lecture along with the appropriate definitions and proofs, is able to use examples illustrating these issues and use them to identify false hypotheses and incorrect reasoning	[SW4] test/exam - oral or written
[MATL3_W09] knows and understands the role and importance of proof in mathematics, as well as the concept of the importance of assumptions	Understands the significance of mathematical proof in theory building and can identify which assumptions are crucial for the correctness of theorems that are the subject of the lecture	[SW4] test/exam - oral or written
[MATL3_K06] is ready to formulate opinions on basic mathematical issues	is able to justify his/her position in a discussion on mathematical issues, referring to the concepts and methods learned	[SK1] oral statement/conversation/discussion
[MATL3_K01] is ready to accept the limitations of his/her own knowledge and understands the need for further education	knows the limitations of their own knowledge and understands the need for further education, is able to independently identify gaps in their knowledge and plan actions to fill them	[SK8] observation of student's independent or team work
[MATL3_U01] is able to correctly use the known concepts of mathematical logic and set theory, is able - at a simple and medium level of difficulty - to apply the known theorems and methods of these fields and is able to interpret the obtained results	is able to apply the theorems and proof methods learned during the lecture, use the ideas and techniques appearing in the proofs of theorems and in examples given during the lecture, provide applications of the theorems learned, solve exercises	[SU4] test/exam - oral or written
[MATL3_U08] is able to formulate definitions and theorems in an understandable way, both orally and in writing, and present correct mathematical reasoning regarding the acquired issues	is able to independently formulate definitions and theorems learned during the lecture and carry out reasoning related to them	[SU4] test/exam - oral or written
[MATL3_K09] is ready to critically evaluate arguments, find gaps in reasoning and constructively criticize other people's reasoning	is able to point out weaknesses in mathematical reasoning and propose constructive improvements, is ready to formulate opinions on basic mathematical issues	[SK1] oral statement/conversation/discussion
[MATL3_U09] is able to plan how to solve a specific problem and prepare a correct record of this solution, providing strict and precise justification for the correctness of his reasoning	is able to plan and carry out the solution of a mathematical problem in the context of new, previously undiscussed examples, documenting each stage of reasoning clearly and logically	[SU4] test/exam - oral or written

Subject contents	Propositional calculus. Valuation. Logically equivalent propositional forms and tautologies. The binary method and the shortened binary method. Propositional functions of several variables and the laws of quantifier calculus. Set algebra. The laws of set calculus. Venn diagrams. Review of the axioms of ZFC set theory. Proof of the nonexistence of the set of all sets. Natural numbers. The principle of minimum, the principle of induction, definitions by induction. Cartesian product of sets, relations, functions as relations. Bijections and surjections. Composition of functions. Inverse function. Sums and generalized products of sets. Indexed families of sets. Images and preimages of sets with respect to a function. Equivalence relations. The principle of abstraction. Construction of integers based on the set of natural numbers. Partially ordered sets. Distinguished elements, including maximal and minimal elements. Cardinalities of sets. Comparing cardinalities of sets. Proof using the Kuratowski-Zorn lemma about the possibility of comparing cardinality of sets. Equinumerous sets, countable sets, examples of uncountable sets, a power set. Cantor and Cantor-Bernstein theorems with proofs. Sets of cardinality continuum. Proof of the uncountability of the set of real numbers. Providing the subject-specific terminology in English.
Prerequisites and co-requisites	

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
written exam	51.0%	50.0%
written tests	51.0%	50.0%
observation of student's attitude	51.0%	0.0%

Recommended reading		
	Basic literature	W. Guzicki, P. Zakrzewski, Wykłady ze wstępu do matematyki. Wprowadzenie do teorii mnogości, WN PWN, Warszawa 2005. W. Guzicki, P. Zakrzewski, Wstęp do matematyki. Zbiór zadań, WN PWN, Warszawa 2005. J. Topp, Wstęp do matematyki, Wydawnictwo Uniwersytetu Gdańskiego, 2015. W. Marek, J. Onyszkiewicz, Elementy logiki i teorii mnogości w zadaniach, WN PWN, Warszawa 2005.
	Supplementary literature	K. Kuratowski, Wstęp do teorii mnogości i topologii, WN PWN, Warszawa 2004. A. Wojciechowska, Elementy logiki i teorii mnogości, WN PWN, Warszawa 1979.
	eResources addresses	
Example issues/ example questions/ tasks being completed	not applicable	
Work placement	Not applicable	

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