University of Gdańsk

Subject card

Subject name and code	Introduction to Set Theory and Logic, PG_00204249						
Field of study	Mathematics						
Date of commencement of studies	October 2026		Academic year of realisation of subject	2026/2027			
Education level	Bachelor's studies		Subject group	Obligatory subject group in the field of study 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	1		Language of instruction	Polish			
Semester of study	1		ECTS credits	11.0			
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	60.0	60.0	0.0	0.0	0.0	120
	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	120	5.0	150.0	275

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. Additionally, the course aims to develop students' skills in abstract understanding of problems and general mathematical culture.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[MATL3_W01] knows and understands at an advanced level selected concepts, methods and theorems of mathematical logic, set theory and metric topology, as well as basic examples both illustrating specific concepts from these fields and allowing to refute false hypotheses or invalid 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_U01] is able to correctly use the concepts of mathematical logic, set theory and metric topology, is able to apply the 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_U06] can formulate definitions and theorems in an understandable manner, both orally and in writing, and present correct mathematical reasoning on the learned topics	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_U07] is able to plan a way to solve a complex problem and prepare a correct record of this solution, providing strict and precise justification for the correctness of his/her 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
	[MATL3_W07] knows and understands at an advanced level 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

Subject contents

Properties of elementary functions (linear and quadratic functions, absolute value, polynomials, rational functions and their domain, power function (rational exponent), trigonometric and cyclometric functions, exponential and logarithmic functions). Determining properties of functions from their graphs. Solving equations and inequalities from the graph of a function.

Elements of mathematical logic. 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. Methods of proving theorems.

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.

Cartesian product of sets, relations, functions as relations. Bijections and surjections. Composition of functions. Inverse function. Properties of functions.

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

<table>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>written exam</td><td>51.0%</td><td>50.0%</td></tr>
<tr><td>written tests</td><td>51.0%</td><td>50.0%</td></tr>
<tr><td>observation of student's attitude</td><td>51.0%</td><td>0.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>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.

Hammack R., Book of Proof, Third eition, 2018

Bryński M., Dróbka N., Szymański K., Matematyka dla zerowego roku studiów, Wydawnictwo WNT, 2012;

Leksiński W., Macukow B., Żakowski W., Matematyka dla maturzystów, Wydawnictwo WNT;

Kowalczyk R., Niedziałomski K., Obczyński C., Matematyka dla studentów i kandydatów na wyższe uczelnie. Repetytorium, Warszawa, 2022.</td></tr>
<tr><td>Supplementary literature</td><td>K. Kuratowski, Wstęp do teorii mnogości i topologii, WN PWN, Warszawa 2004.

A. Wojciechowska, Elementy logiki i teorii mnogości, WN PWN, Warszawa 1979.

Uryga J., Nowa matura. Matematyka. Rozwiązywanie zadań, Wydawnictwo Szkolne PWN, 2010;

Karolak T., Repetytorium z matematyki, Skrypt, 2004;

Kurlyandchik L., Matematyka elementarna w zadaniach Tom I i II, Aksjomat Toruń, 2005.</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">not applicable</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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