University of Gdańsk

Subject card

Subject name and code	Set theory, PG_00208670						
Field of study	Mathematics						
Date of commencement of studies	October 2024		Academic year of realisation of subject	2026/2027			
Education level	Bachelor's studies		Subject group	Obligatory subject group in the field of study Optional subject group			
Mode of study	full-time studies		Mode of delivery	at the university			
Year of study	3		Language of instruction	Polish			
Semester of study	5		ECTS credits	6.0			
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 hab. Andrzej Nowik				
	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	To learn the concepts and methods of set theory necessary for serious study of some other branches of mathematics such as set-theoretic topology, real functions, measure theory, and functional analysis.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[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	The student is ready to formulate questions precisely to dispel any doubts he may have on a given topic.	[SK1] oral statement/conversation/ discussion
[MATL3_W09] knows and understands the role and importance of proof in mathematics, as well as the concept of the importance of assumptions	The student knows and understands the theorems that are the subject of the lecture along with appropriate definitions, examples, and proofs.	[SW4] test/exam - oral or written
[MATL3_K01] is ready to accept the limitations of his/her own knowledge and understands the need for further education	The student is ready to understand his or her limitations and the need for further education.	[SK8] observation of student's independent or team work
[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	The student is able to present correct mathematical reasoning in an understandable manner, both orally and in writing.	[SU4] test/exam - oral or written
[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	The student is able to formulate and prove simple theorems.	[SU4] test/exam - oral or written
[MATL3_K06] is ready to formulate opinions on basic mathematical issues	The student is ready to formulate opinions on basic mathematical issues.	[SK1] oral statement/conversation/ discussion
[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	The student is ready to understand and appreciate the importance of intellectual honesty.	[SK8] observation of student's independent or team work

Subject contents

1. The axioms of ZFC set theory, explaining their role in capturing basic intuitive properties of sets. Various formulations of the axiom of choice with proofs of their equivalence (existence of choice functions, Zermello's theorem, Kuratowski-Zorn's lemma).
2. Definition of basic concepts of set theory based on axioms.
3. Properties of well-ordered sets. Transfinite induction. Definition by transfinite induction.
4. Von Neumann's ordinal numbers.
5. Von Neumann's cardinal numbers.
6. Arithmetic of cardinal numbers (product, power, sum). Some applications of the theorems to other branches of mathematics.
7. Cofinality of cardinal numbers. König's theorem.
8. Natural numbers in ZFC set theory.
9. Strongly and weakly inaccessible numbers.
10. Real and 0-1 measurable numbers. The Banach-Kuratowski theorem, the Ulam theorem. Ulam matrices.
11. Universally null sets and strongly null sets. The Luzin set.
12. Some basic set-theoretic constructions, including the existence of large families of independent sigma sets, families of almost disjoint sets. The sigma cardinality of a field generated by a family of sets.
13. The role of the axiom of choice and the continuum hypothesis in set theory.
14. Some consequences of Martin's axiom for measure theory and topology.

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
test	51.0%	50.0%
egzam	51.0%	50.0%
observation of the student's attitude	51.0%	0.0%

Recommended reading

Basic literature

1. W. Guzicki, P. Zakrzewski, *Wykłady ze wstępu do matematyki. Wprowadzenie do teorii mnogości*, WN PWN Warszawa 2005.
2. P. Halmos, *Naive set theory*, Princeton 1960, Springer Verlag 1974
3. K. Kunen, *Set Theory*, North Holland, Amsterdam 1980
4. K. Kuratowski, *Wstęp do teorii mnogości i topologii*, PWN 1980.
5. K. Kuratowski, A. Mostowski, *Teoria mnogości*, PWN 1966
6. Krzysztof Ciesielski, *Set theory for working mathematician*, Cambridge University Press, 1997.
7. Aleksander Błaszczyk, Sławomir Turek, *Teoria mnogości*, PWN 2007.

	Supplementary literature	not included
	eResources addresses	
Example issues/ example questions/ tasks being completed	not included	
Work placement	Not applicable	

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