

Subject card

Subject name and code	Functional Analysis, PG_00206844						
Field of study	Mathematics						
Date of commencement of studies	October 2026		Academic year of realisation of subject		2026/2027		
Education level	Master'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		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 hab. Karolina Kropielnicka				
	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		3.0		62.0	125
Subject objectives	The aim of the course is to present the selected concepts and theorems of Functional Analysis.						
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		knows how to apply selected concepts and theorems of Functional Analysis in selected, classical functional and sequence spaces		[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		known and understands the selected concepts and theorems of Functional Analysis		[SW4] test/exam - oral or written		
	[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		known and understands the selected concepts and theorems of Functional Analysis		[SW4] test/exam - oral or written		

Subject contents	1. Normed spaces, Banach spaces and their properties. Examples of normed and Banach spaces. Lack of compactness of closed ball in infinitely dimensional normed spaces. 2. Linear maps between normed and Banach spaces. Boundedness and continuity of linear operator. The space of bounded linear operators, norm of the linear operator. 3. Classical theorems of functional analysis: open map theorem, bounded inverse theorem, closed graph theorem, Hahn-Banach theorem 4. Linear functionals on normed spaces. Dual space. The representation of linear and bounded functionals in l^p , $L^p(a,b)$. 5. Inner product spaces, Hilbert spaces. The basic properties of inner product spaces. Orthogonal decomposition theorem (orthogonal projection theorem). 6. Riesz representation theorem in Hilbert spaces. 7. Fourier series, Bessel inequality, complete orthonormal systems in Hilbert spaces.		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	evaluation of student's attitude	51.0%	10.0%
	final exam	51.0%	45.0%
	tests	51.0%	45.0%
Recommended reading	Basic literature	1. J. Musielak - Wstęp do analizy funkcjonalnej, PWN 1989.	
	Supplementary literature	1. A. Alexiewicz - Analiza funkcjonalna, PWN 1968. 2. W. Kołodziej - Wybrane rozdziały analizy matematycznej, PWN 1982.	
	eResources addresses		
Example issues/ example questions/ tasks being completed	not applicable		
Work placement	Not applicable		

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