



## Subject card

Subject name and code	Functional analysis II, PG_00061292						
Field of study	Mathematics						
Date of commencement of studies	October 2023	Academic year of realisation of subject			2023/2024		
Education level	second-cycle 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	2	ECTS credits			5.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Department of Nonlinear Analysis and Statistics -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Maciej Starostka				
	Teachers		dr inż. Maciej Starostka				
Lesson types and methods of instruction	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		5.0		60.0	125
Subject objectives	Introduction to advanced topics of functional analysis and noncommutative normed algebras.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_U06] Has the ability to recognize topological structures in mathematical objects occurring, for example, in geometry or mathematical analysis; is able to use the basic topological properties of sets, functions and transformations, uses the language and methods of functional analysis in the problems of mathematical analysis and its applications, in particular uses the properties of classical Banach and Hilbert spaces.	Has a profound knowledge of topological linear spaces.	[SU2] Assessment of ability to analyse information
	[K7_W03] Knows the most important theorems and hypotheses of main branches of mathematics.	Explains the role of the set theory and von Neumann algebras in modern analysis.	[SW1] Assessment of factual knowledge
	[K7_W02] Has good understanding of the role and importance of mathematical reasoning structure.	Constructs models based on specific normed spaces.	[SW1] Assessment of factual knowledge
[K7_U09] Is able, at an advanced level and covering modern mathematics, to apply and present in speech and in writing the methods of at least one selected branch of mathematics: mathematical and functional analysis, theory of differential equations and dynamical systems, algebra and number theory, geometry and topology, calculus probability and statistics, discrete mathematics and graph theory, logic and set theory.	Synthesis measure theory, functional analysis and noncommutative algebras.	[SU4] Assessment of ability to use methods and tools	
Subject contents	Introduction to notation, basic definitions and revision of selected topics on set theory. Classical Banach spaces. The axiom of choice, Kuratowski - Zorn lemma, Hahn - Banach theorem. Characterization of compactness in specific Banach spaces. Stone - Weierstrass theorem. Dual operations. Weak and *weak topologies. Banach - Alaoglu theorem. Reflexivity. Banach algebras. Gelfand transform. $C^*$ -algebras. Spectral theorem and spectral measures. Strong and weak operator topologies. Basics of von Neumann algebras.		
Prerequisites and co-requisites	Courses completed: Functional Analysis I (MAT1016)		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Projects	51.0%	40.0%
	Exam	51.0%	50.0%
	Activity	51.0%	10.0%
Recommended reading	Basic literature	W.Rudin, Analiza funkcjonalna, PWN, 2001.  J.Musielak, Wstęp do analizy funkcjonalnej, PWN, 1989.  J.Górniak, T.Pytlik, Analiza funkcjonalna w zadaniach, Wyd. PWr, 1992.  K.Zhu, An Introduction to Operator Algebras, CRC Press, 2000.	
	Supplementary literature	R.V.Kadison, J.R.Ringrose, Fundamentals of the Theory of Operator Algebras, vol. I, III, AMS, 1997.  F.Albiac, N.J.Kalton, Topics in Banach Space Theory, Springer, 2006.  S.Prus, A.Stachura, Analiza funkcjonalna w zadaniach, PWN, 2007.	

	eResources addresses	Adresy na platformie eNauczenie: Analiza funkcjonalna 2 - Moodle ID: 36348 <a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=36348">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=36348</a>
Example issues/ example questions/ tasks being completed	Identify dual spaces. Investigate compactness of subsets of continuous functions on compact spaces. Find closures of specific subsets of Banach spaces. Investigate metrizable weak and $w^*$ topologies. Investigate whether specific algebras are Banach algebras, $C^*$ -algebras. Compare different operator topologies.	
Work placement	Not applicable	