



## Subject card

Subject name and code	Functional analysis I , PG_00027634						
Field of study	Mathematics						
Date of commencement of studies	October 2022		Academic year of realisation of subject		2024/2025		
Education level	first-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		blended-learning		
Year of study	3		Language of instruction		Polish		
Semester of study	5		ECTS credits		5.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Nonlinear Analysis and Statistics -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. inż. Tomasz Szarek				
	Teachers		prof. dr hab. inż. Tomasz Szarek				
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: 28.0						
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	Basic knowledge of the subject						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	K6_W01		Is aware of the importance of mathematics		[SW3] Assessment of knowledge contained in written work and projects		
	K6_U09		Is able to interpret systems of equations, is fluent in applying objects as vector field, phase spaces, is able to define and apply in practice basic topological properties of topological subspaces and measurable functions		[SU1] Assessment of task fulfilment		
	K6_U08		knows basic concepts of linear algebra: vectors, linear transformations, matrices. Is able to determine basic algebraic structures in mathematics. Can count determinant and knows its basic properties. Is able to provide geometric interpretation of determinant and knows its connection to mathematical analysis.		[SU1] Assessment of task fulfilment		
	K6_U04		Is fluent in calculus. Is able to apply the definitions of limits and different concepts of convergence. Is able in dealing with the convergence of series.		[SU1] Assessment of task fulfilment		
	K6_K01		knows limits of his knowledge and needs for further education. Is able to search for required information in literature.		[SK2] Assessment of progress of work		

Subject contents	Basic notions of linear algebra (repetition) Basic notions from metric topology (repetition). Normed linear spaces. Banach spaces. Unitary and Hilbert spaces. Linear operators in normed spaces, continuity and boundedness. The space of linear operators. Linear functionals, adjoint space. Riesz theorem, Hahn - Banach theorem. Open mapping, inverse mapping theorems, and closed graph theorem. Orthogonal projections in Hilbert spaces. Orthonormal bases in Hilbert spaces, Bessel inequality. Spectrum and resolvent of a bounded operator in a Banach space. Exercises: Practical training associated with the lecture material, applications		
Prerequisites and co-requisites	Analysis I,II,III Linear algebra		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Midterm colloquium	50.0%	75.0%
	Written exam	50.0%	25.0%
Recommended reading	Basic literature	J. Musielak, Introduction to Functional Analysis, PWN 1976  J. Rusinek, Problems in functional analysis, W UKSW 2006	
	Supplementary literature	Gerald Teschl: Functional Analysis, <a href="http://www.univie.ac.at/~gerald/">http://www.univie.ac.at/~gerald/</a>	
	eResources addresses	Adresy na platformie eNauczanie:	
Example issues/ example questions/ tasks being completed			
Work placement	Not applicable		