University of Gdańsk

Subject card

Subject name and code	Functional Analysis, PG_00155369						
Field of study	Mathematics						
Date of commencement of studies	October 2024		Academic year of realisation of subject	2024/2025			
Education level	Master's studies		Subject group	Obligatory subject group 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	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. inż. Jacek Gulgowski					
	Teachers	dr hab. inż. Jacek Gulgowski					
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	The aim of the course is to present the basic concepts and theorems of Functional Analysis.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[MATMU2_U01] can construct mathematical reasoning: prove theorems and refute hypotheses through construction and selection of counterexamples	knows how to apply basic concepts and theorems of Functional Analysis is selected, classical functional and sequence spaces	[SU1] oral statement/conversation/ discussion [SU4] test/exam - oral or written
[MATMU2_W02] knows and understands well the role and importance of the construction of mathematical reasoning	knows and understands the basic concepts and theorems of Functional Analysis	[SW4] test/exam - oral or written
[MATMU2_U02] can express mathematical content in speech and writing, in mathematical texts of various nature	knows how to apply basic concepts and theorems of Functional Analysis is selected, classical functional and sequence spaces	[SU1] oral statement/conversation/ discussion [SU4] test/exam - oral or written [SU8] observation of student's independent or team work
[MATMU2_K05] is ready to independently search for information in literature, also in foreign languages	searches for information in the literature	[SK1] oral statement/conversation/ discussion [SK8] observation of student's independent or team work
[MATMU2_K02] is ready to precisely formulate questions to deepen his/her understanding of a given topic or find missing elements of reasoning	is able to precisely formulate questions to deepen understanding of a given topic	[SK1] oral statement/conversation/ discussion
[MATMU2_W01] knows and understands in-depth the theory of selected areas of mathematics	known and understands the basic concepts and theorems of Functional Analysis	[SW4] test/exam - oral or written
[MATMU2_K06] is ready to formulate opinions on basic mathematical issues	can formulate opinions on mathematical issues	[SK1] oral statement/conversation/ discussion
[MATMU2_K01] is willing to acknowledge the limitations of his or her own knowledge and is willing to pursue further education	knows the limits of his or her own knowledge and shows readiness for further education	[SK8] observation of student's independent or team work
[MATMU2_K04] is ready to understand and appreciate the importance of intellectual honesty in one's own and other people's actions; ethical conduct	understands and appreciates the importance of intellectual honesty	[SK8] observation of student's independent or team work

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 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 represention 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. Fouriera series, Bessel inequality, complete orthonormal systems in Hilbert spaces.

Prerequisites and co-requisites

no requirements

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
tests	50.0%	45.0%
final exam	50.0%	45.0%
activity during classes	0.0%	10.0%

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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