

Subject card

Subject name and code	Advanced Mathematical Analysis, PG_00155297						
Field of study	Mathematical Modeling and Data Analysis						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2025/2026		
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	Division of Real Functions -> Institute of Mathematics -> Faculty of Mathematics, Physics and Informatics -> Rector						
Name and surname of lecturer (lecturers)	Subject supervisor		dr Jacek Tryba				
	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 familiarize students with the concepts, theorems and methods of measure and Lebesgue integral theory.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[MMiADMU2_K05] is ready to independently search for information in literature, also in foreign languages	Student is ready to independently search for information related to the subject in the literature, also in English.	[SK1] oral statement/conversation/discussion [SK8] observation of student's independent or team work
	[MMiADMU2_W01] knows and understands in-depth the theory of selected areas of mathematics	The student knows and understands the concept of measure, measurable function, the construction of Lebesgue measure in Euclidean spaces; the construction of Lebesgue integral.	[SW4] test/exam - oral or written [SW1] oral statement/conversation/discussion
	[MMiADMU2_U01] can construct mathematical reasoning: prove theorems and disprove hypotheses by constructions and selecting counterexamples	The student is able to use the studied concepts, formulate and prove their properties, present correct mathematical reasoning, apply learned methods in order to solve exercises related to the subject.	[SU1] oral statement/conversation/discussion [SU4] test/exam - oral or written
	[MMiADMU2_K06] is ready to form an opinion on basic mathematical issues	Student is able to present opinions on various mathematical issues.	[SK1] oral statement/conversation/discussion [SK8] observation of student's independent or team work
	[MMiADMU2_W02] knows and understands well the role and importance of the construction of mathematical reasoning	The student knows and understands the concepts of measure theory and their connections with other branches of mathematical analysis and probability.	[SW4] test/exam - oral or written [SW1] oral statement/conversation/discussion
	[MMiADMU2_K01] is ready to recognize the limitations of his own knowledge and is ready to continue his education	The student understands the need to deepen their knowledge.	[SK1] oral statement/conversation/discussion [SK8] observation of student's independent or team work
	[MMiADMU2_K02] is ready to precisely formulate questions to deepen his own understanding of a given topic or to find missing elements of reasoning	The student is able to formulate questions in a precise manner.	[SK1] oral statement/conversation/discussion [SK8] observation of student's independent or team work
	[MMiADMU2_K04] is ready to understand and appreciate the importance of intellectual honesty in the actions of himself and others; is ready to act ethically	Student appreciates the importance of intellectual honesty and ethical conduct. in one's own and other people's actions.	[SK1] oral statement/conversation/discussion [SK8] observation of student's independent or team work
Subject contents	1. Fields and sigma-fields of sets. Borel sets. 2. Measure and its construction via outer measure. Theorem of Caratheodory. 3. Lebesgue measure in $\mathbb{R}^k$. Properties of measurable sets. 4. Measurable functions and their properties. 5. The construction of Lebesgue integral. Properties of integrable functions. Convergence theorems. 6. Fubini Theorem. Theorem on changing variables.		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	observation of student's attitude	100.0%	0.0%
	colloquia	51.0%	45.0%
	activity	0.0%	5.0%
	written/oral exam	51.0%	50.0%

Recommended reading	Basic literature	1. A. Birkholc, Analiza matematyczna. Funkcje wielu zmiennych. PWN Warsaw, 1995. 2. M. Balcerzak, Wykłady z teorii miary. Lodz University of Technology Publishing House, 2011. 3. P. Halmos, Measure Theory. Springer, 1974. 4. L. Górniewicz, R. Ingarden, Analiza matematyczna dla fizyków. UMK Publishing House, Toruń 1996. 5. W. Kaczor, M. Nowak, Zadania z Analizy Matematycznej. Całkowanie. PWN 2006.
	Supplementary literature	1. P. Billingsley, Probability and Measure, Wiley-Interscience, 1995
	eResources addresses	
Example issues/ example questions/ tasks being completed	1. Find all measurable sets with respect to a fixed outer measure. 2. Prove the measurability of a given function. 3. Present the construction of the Lebesgue measure in $\mathbb{R}^k$. 4. Present the construction of the Lebesgue integral. 5. Examine the integrability of a given function. Calculate the integral. 6. Formulate and prove Lebesgue's theorem on monotone convergence (Fatou's lemma, Lebesgue's theorem on bounded convergence).	
Work placement	Not applicable	

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