University of Gdańsk

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 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	Division of Real Functions -> Institute of Mathematics -> Faculty of Mathematics, Physics and Informatics -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Antoni Augustynowicz	
	Teachers	dr hab. Antoni Augustynowicz	

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_K06] is ready to form an opinion on basic mathematical issues	Student is ready to formulate opinions on basic mathematical issues.	[SK1] oral statement/conversation/ discussion [SK8] observation of student's independent or team work
	[MMiADMU2_U01] can construct mathematical reasoning: prove theorems and disprove hypotheses by constructions and selecting counterexamples	The student is able: 1. to prove basic properties of measure and outer measure; 2. to present the construction of Lebesgue outer measure in R^k; 3. to formulate a definition of a Lebesgue measurable set and prove some properties of measurable sets; 4. to prove besic properties of measurable functions; 5. to present a construction of Lebesgue integral and prove basic properties of integral and integrable functions; 6. to apply Fubini Theorem and Theorem on Change of Variables to calculate Lebesgue integrals; 7. establish connections between measure and integral theory and probability calculus.	[SU1] oral statement/conversation/ discussion [SU4] test/exam - oral or written
	[MMiADMU2_W01] knows and understands in-depth the theory of selected areas of mathematics	The student knows and understands the concept of measure; the construction of Lebesgue measure in Euclidean spaces; the construction of Lebesgue integral; properties of integral and integrable functions; connections of Lebesgue measure in R^k with Jordan measure, and the Lebesgue integral with the Riemman integral; the connection of measure theory with the probability.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion
	[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_K05] is ready to independently search for information in literature, also in foreign languages	Student is ready to independently search for information in the literature, also in English.	[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 in one's own and other people's actions; ethical conduct.	[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 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	45.0%	45.0%
activity	0.0%	5.0%
written/oral exam	50.0%	50.0%

Recommended reading

Basic literature	1. W. Rudin: Fundamentals of Mathematical Analysis. PWN Warsaw, 1998 2. A. Birkholc: Mathematical Analysis. Functions of Several Variables. PWN Warsaw, 1995. 3. W. Kołodziej: Mathematical Analysis. PWN Warsaw 1978. 4. L. Górniewicz, R. Ingarden. Mathematical Analysis for Physicists. UMK Publishing House, Toruń 1996. 5. W. Kaczor, M. Nowak, Tasks in Mathematical Analysis. Integration. PWN 2006.
Supplementary literature	1. P. Billingsley, Probability and Measure, PWN, 2009.
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 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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