

Subject card

Subject name and code	Mathematical Analysis III, PG_00155270						
Field of study	Mathematical Modeling and Data Analysis						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2026/2027		
Education level	Bachelor'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	2		Language of instruction		Polish		
Semester of study	3		ECTS credits		10.0		
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 Gulowski				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	60.0	60.0	0.0	0.0	0.0	120
	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	120		15.0		115.0	250
Subject objectives	The aim of the course is to familiarize students with the concepts, theorems and methods of differential and integral calculus of functions of many variables and the basics of the theory of differential equations.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[MMiADL3_K01] is ready to accept the limitations of his/her own knowledge and understands the need for further education	knows the limits of his own knowledge and is ready for further education	[SK8] observation of student's independent or team work
	[MMiADL3_W05] knows the basic concepts, methods and theorems of differential equations	knows the basic methods of solving ordinary differential equations and the theorem on the existence of solutions to the initial value problem	[SW4] test/exam - oral or written
	[MMiADL3_U05] correctly uses the concepts of differential equations, is able - at a simple and medium level of difficulty - to apply the learned theorems and methods in this field, and is able to interpret the results obtained	uses the acquired concepts of differential equations correctly, is able - at a simple and medium level of difficulty - to apply the known theorems and methods in this field and is able to interpret the obtained results	[SU4] test/exam - oral or written
	[MMiADL3_U07] can comprehensively, in speech and in writing, formulate definitions and theorems and present correct mathematical reasoning regarding the issues learned	can clearly formulate definitions and theorems of mathematical analysis of functions of many variables, both orally and in writing, and present correct mathematical reasoning regarding the acquired issues	[SU1] oral statement/conversation/discussion [SU4] test/exam - oral or written
	[MMiADL3_K06] is ready to formulate opinions on basic mathematical issues	is ready to formulate opinions on basic issues of mathematical analysis	[SK1] oral statement/conversation/discussion
	[MMiADL3_W07] knows and understands the construction of mathematical theories, can use mathematical formalism to build and analyse simple mathematical models in other fields of science	understands the structure of mathematical theories, is able to use the formalism of differential and integral calculus to build and analyze simple mathematical models in other fields of science	[SW4] test/exam - oral or written
	[MMiADL3_W08] knows and understands well the role and importance of proof in mathematics, as well as the concept of the significance of assumptions	understands well the role and importance of proof in mathematics, as well as the concept of the importance of assumptions	[SW4] test/exam - oral or written
	[MMiADL3_K02] is ready to precisely formulate questions to deepen his/her own understanding of a given topic or to find missing elements of reasoning	is ready to precisely formulate questions to deepen one's understanding of a given topic or find missing elements of reasoning	[SK1] oral statement/conversation/discussion
	[MMiADL3_U06] correctly uses the learned concepts of topology	correctly uses studied topology concepts	[SU4] test/exam - oral or written
	[MMiADL3_K09] is ready to critically evaluate arguments, find gaps in reasoning, and constructively criticize other people's reasoning	is ready to critically evaluate arguments, find gaps in reasoning and constructively criticize other people's reasoning	[SK1] oral statement/conversation/discussion [SK8] observation of student's independent or team work
	[MMiADL3_U08] is able to plan a way to solve a given problem and make a correct record of this solution, providing accurate and precise justifications for the correctness of their reasoning	is able to plan how to solve a specific problem and prepare a correct record of this solution, providing strict and precise justification for the correctness of his reasoning	[SU4] test/exam - oral or written
	[MMiADL3_U02] correctly uses the concepts of mathematical analysis, is able - on a simple and medium level of difficulty - to apply the learned theorems and methods in this field, and is able to interpret the results obtained	correctly uses the known concepts of mathematical analysis of functions of many variables, is able - at a simple and medium level of difficulty - to apply the known theorems and methods in this field and is able to interpret the obtained results	[SU4] test/exam - oral or written
	[MMiADL3_W01] knows the basic concepts, methods and theorems of mathematical logic and set theory	knows the basic concepts and selected methods and theorems of mathematical logic and set theory	[SW4] test/exam - oral or written
	[MMiADL3_K04] is ready to understand and appreciate the importance of intellectual honesty in own and other people's actions; is ready to act ethically	understands and appreciates the importance of intellectual honesty in one's own and other people's actions	[SK8] observation of student's independent or team work
	[MMiADL3_W06] knows the selected concepts, methods and theorems of topology	knows selected concepts, methods and theorems of topology	[SW4] test/exam - oral or written

	Course outcome	Subject outcome	Method of verification
	[MMiADL3_W02] knows the basic concepts, methods and theorems of mathematical analysis, and basic examples both illustrating specific concepts in this field, and allowing to refute incorrect hypotheses or unauthorized reasoning	knows the basic concepts, methods and theorems of mathematical analysis of functions of many variables and basic examples both illustrating specific concepts in this field and allowing to refute erroneous hypotheses or unauthorized reasoning	[SW4] test/exam - oral or written
	[MMiADL3_U01] correctly uses the learned concepts of mathematical logic and set theory	correctly uses the concepts of mathematical logic and set theory	[SU4] test/exam - oral or written
Subject contents	1. Derivatives of functions of many variables. Partial derivatives, directional derivative, derivative (differential) - relationships between these concepts. 2. Derivatives of higher orders, Schwartz theorem on the commutativity of partial differentiation. Taylor's formula, local extrema. 3. Maps R^n in R^m, Jacobian, diffeomorphism, local diffeomorphism theorem. Implicit function theorem. Conditional extremes. 4. Riemann integral in R^2 and R^3 (and R^k), theorem. on iterated integrals, theorem on the change of variables in a multiple integral. 5. Line integral. 1- and 2-forms. Integral of 1- and 2-forms. Green and Stokes theorems. 6. Linear differential and separated equations. Initial problem for ordinary differential equations.		
Prerequisites and co-requisites	Knowledge of differential and integral calculus of functions of one variable		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	tests	51.0%	50.0%
	student's attitude evaluation	100.0%	0.0%
	final exam	51.0%	50.0%
Recommended reading	Basic literature	1. A. Birkholc: Analiza matematyczna. Funkcje wielu zmiennych. PWN W-wa, 1995. 2. G.M. Fichtenholz, Rachunek różniczkowy i całkowy, tom I, II i III. Państwowe Wydawnictwo Naukowe, Warszawa 1978. 3. W. Kryszicki, L. Włodarski, Analiza matematyczna w zadaniach, część I i II, Państwowe Wydawnictwo Naukowe, Warszawa 1986.	
	Supplementary literature	not applicable	
	eResources addresses		
Example issues/ example questions/ tasks being completed	not applicable		
Work placement	Not applicable		

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