



Subject card

Subject name and code	Real and complex analysis , PG_00021033						
Field of study	Mathematics						
Date of commencement of studies	October 2023	Academic year of realisation of subject			2023/2024		
Education level	second-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			at the university		
Year of study	1	Language of instruction			Polish		
Semester of study	1	ECTS credits			5.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Department of Nonlinear Analysis and Statistics -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Marcin Styborski					
	Teachers	dr inż. Marcin Styborski					
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: 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	5.0		60.0	125	
Subject objectives	The aim of the course is to supplement the knowledge of real and complex analysis of topics that are not processed during the three-semester course of calculus and the course of complex functions at the undergraduate level. These are also topics with which students are already familiar (convergence of sequences of function, differentiation and integration of functional sequences, change the order of limits).						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_U09] Is able, at an advanced level and covering modern mathematics, to apply and present in speech and in writing the methods of at least one selected branch of mathematics: mathematical and functional analysis, theory of differential equations and dynamical systems, algebra and number theory, geometry and topology, calculus probability and statistics, discrete mathematics and graph theory, logic and set theory.	The student uses the methods of functional analysis and topology in the formulation of theses in the field of mathematical analysis.	[SU4] Assessment of ability to use methods and tools
	[K7_U03] Freely uses the tools of analysis, including differential and integral calculus (in particular, the curvilinear and surface integrals), elements of complex and Fourier analysis.	Student independently formulate assertions and verifies the importance of assumptions and their significance in the proof.	[SU3] Assessment of ability to use knowledge gained from the subject
	[K7_U02] Has the ability to check the correctness of conclusions in constructing formal proofs, sees formal structures related to the basic areas of mathematics in mathematical issues and understands the importance of their properties.	The student is able to verify proofs based on rule of inference and consciously uses elementary methods and reasoning.	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
	[K7_W02] Has good understanding of the role and importance of mathematical reasoning structure.	The student understands the importance of abstract theories and mathematical structures in resolving the issues formulated in engineering sciences (convergence of Fourier series, limit process in probability).	[SW1] Assessment of factual knowledge
	[K7_W01] Has enhanced knowledge of basic branches of mathematics.	The student is familiar with - Theorems about integration of functional sequences - Proof of the existence of a continuous function without derivative and topological properties of the set of such functions - Proof of the theorem about the divergence of Fourier series of continuous functions	[SW1] Assessment of factual knowledge
Subject contents	<ol style="list-style-type: none"> 1. Sequences and series of functions. Convergence. 2. The criteria for uniform convergence: Dini, Weierstrass, Dirichlet 3. Arzeli lemma and theorem of bounded convergence for the Riemann integral 4. Applications of the theorem of bounded convergence. The dominated convergence theorem for the improper Riemann integral. 5. Continuous function without derivative. 6. Baire theorem. The set of functions without derivative in Banach spaces of continuous functions 7. Arzeli-Ascoli and Weierstrass theorems. Stone's theorem and its consequences 8. Fourier series: the Riemann-Lebesgue Lemma, pointwise convergence, the principle of localization, Dirichlet and Fejer kernel; divergence of Fourier series of continuous functions; theorem of convergence in the L^2 space 9. Holomorphic functions. Power series, analyticity. 10. Index of the curve. Cauchy's theorem for a simply connected domain; consequences. 11. Homologous curves. Global Cauchy's theorem 		
Prerequisites and co-requisites	Familiarity with the: <ul style="list-style-type: none"> - primitive set theory - calculus. 		

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Midterm colloquium	51.0%	50.0%
	Activity in the classes	51.0%	10.0%
	Written exam	51.0%	40.0%
Recommended reading	Basic literature	1. W. Rudin, Principles of mathematical analysis, McGraw-Hill, 1976 2. W. Rudin, Real and complex analysis, McGraw-Hill, 1987 3. F. Leja, Funkcje zespolone, Wydawnictwo naukowe PWN 2006	
	Supplementary literature	1. J. Chądzyński, Wstęp do analizy zespolonej, Wydawnictwo Uniwersytetu Łódzkiego, 2008	
	eResources addresses	Adresy na platformie eNauczanie: Analiza Rzeczywista i Zespolona - Moodle ID: 34354 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=34354	
Example issues/ example questions/ tasks being completed	Check the pointwise/uniform convergence of a sequence of functions Calculate the sum of a series of functions Show examples of Baire theorem Expand a function in a Fourier series Calculate the index of the curve		
Work placement	Not applicable		