



Subject card

Subject name and code	Fixed point theory, PG_00021051						
Field of study	Mathematics						
Date of commencement of studies	October 2024		Academic year of realisation of subject		2024/2025		
Education level	second-cycle studies		Subject group				
Mode of study	Full-time studies		Mode of delivery		at the university		
Year of study	1		Language of instruction		Polish		
Semester of study	2		ECTS credits		4.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Differential Equations and Mathematical Applications -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. Grzegorz Graff				
	Teachers		Patrik Topór prof. dr hab. Grzegorz Graff				
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		35.0	100
Subject objectives	The aim of the course is to introduce the student to issues related to the theory of fixed points. Listeners will be familiar with the classical theorems on the existence of fixed points. The related issues are also on the occurrence of periodic points. The lecture will be shown compounds fixed point theory with different areas of mathematics, particularly topology and the theory of dynamical systems, as well as applications in other fields of science.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
Subject contents	1 Reminder basic information on the topological concepts. 2 Retracts, absolute retracts, homotopy and their properties. 3 Sperner Lemma, Brouwer fixed point Theorem. 4 Kakutani Theorem . 5 Spaces having the fixed point property. 6 Banach fixed point theorem and its consequences. 7 Kuratowski's measure of non-compactness, Kuratowski's and Sadowski's theorem . 8 Borsuk theorem for antipodal and its consequences. 9 Theorem Badger-Lusternik-Schnirelman and Borsuk Ulam theorem. 10 Fixed point index and its properties. 11 Hairy ball theorem. 12 The existence of periodic points. 13 Methods for detection of invariant sets. 14 Applications of fixed point theory in other areas of mathematics. 15 Review of non-mathematic applications of fixed point theory.						

Prerequisites and co-requisites	Algebra		
	Mathematical analysis		
	Topology		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Exam	50.0%	40.0%
	Exam	50.0%	30.0%
	Activity	50.0%	30.0%
Recommended reading	Basic literature	1. J. Dugundji, A. Granas, <i>Fixed Point Theory</i> , vol. 1, PWN Warszawa, 1982. 2. J. Gulowski, W. Marzantowicz, <i>Wstęp do analizy nieliniowej</i> , część I; Teoria stopnia, Wydawnictwo Naukowe UAM, Poznań 2003. 3. J. Jezierski, W. Marzantowicz, <i>Homotopy methods in topological fixed and periodic points theory</i> , Series: Topological Fixed Point Theory, Springer 2005.	
	Supplementary literature	K. Goebel, W. A. Kirk, <i>Zagadnienia metrycznej teorii punktów stałych</i> , Wydawnictwo UMCS 1999.	
	eResources addresses	Adresy na platformie eNauczanie:	
	Example issues/ example questions/ tasks being completed	1) Prove that there is no retraction ball $(n + 1)$ -dimensional at its edge, ie dimensional sphere. Explain what is the relationship of this fact with the theory of fixed points. 2) What is the index of the fixed point for the sink, and for the source for mapping the plane?	
Work placement	Not applicable		

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