GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Fixed point theory, PG_00021051		
Field of study	Mathematics		
Date of commencement of studies	October 2022	Academic year of realisation of subject	2022/2023
Education level	second-cycle studies	Subject group	Optional subject group 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	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	prof. dr hab. Grzegorz Graff dr Adrian Myszkowski	

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
K7_W05	The student has a thorough knowledge of the Theory of fixed points: The student knows the most classical definitions and theorems and their proofs	[SW1] Assessment of factual knowledge
K7_U02	The student has the ability to validate inferences in the construction of formal proofs	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information
K7_W06	The student has a thorough knowledge of the Theory of fixed points: The student is able to understand the formulation of issues remaining at the research stage	[SW1] Assessment of factual knowledge
K7_K02	The student understands the need for a popular presentation of laymen selected higher mathematics achievement	[SK4] Assessment of communication skills, including language correctness

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 Invariant sets and their dynamics. 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
Activity	50.0%	25.0%
Exams	50.0%	70.0%
Homework	50.0%	5.0%

Recommended reading	Basic literature	1. J. Dugundji, A. Granas, *Fixed Point Theory*, vol. 1, PWN Warszawa, 1982. 2. J. Gulgowski, W. Marzantowicz, *Wstęp do analizy nieliniowej*, część I; Teoria stopnia, Wydawnictwo Naukowe UAM, Poznań 2003. 3. J. Jezierski, W. Marzantowicz, *Homotopy methods in topological fixed and periodic points* *theory*, Series: Topological Fixed Point Theory, Springer 2005.
	Supplementary literature	K. Goebel, W. A. Kirk, *Zagadnienia metrycznej teorii punktów stałych,* 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	