GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Fixed point theory, PG_00070305		
Field of study	Mathematics		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	Subject group	Specialty 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	Divison of Differential Equations and Applications of Mathematics -> Institute of Applied Mathematics -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. Grzegorz Graff	
	Teachers	prof. dr hab. Grzegorz Graff dr inż. Marcin Styborski	

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

eNauczanie source address: https://enauczanie.pg.edu.pl/moodle/course/view.php?id=37824

Moodle ID: 37824 Teoria punktów stałych [2025/2026] (Matematyka, WFTiMS) https://enauczanie.pg.edu.pl/moodle/course/view.php?id=37824

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_W01] has enhanced knowledge of basic branches of mathematics,demonstrates knowledge theorem and hypotheses, has understanding of the role and importance of mathematical reasoning structure.	The student has an in-depth knowledge of Fixed Point Theory: he knows most of the classical definitions and theorems and their proofs, he is able to understand the formulations of issues remaining in the research stage, he knows the connections of Fixed Point Theory with other branches of theoretical and applied mathematics.	[SW1] Assessment of factual knowledge
	[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 and understands the importance of their properties.	The student has the ability to construct reasoning mathematical reasoning of the Theory of Fixed Points: proving theorems, as well as refuting hypotheses related to Fixed Point Theory through the construction and selection of counterexamples.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information
	[K7_U04] applies the concepts of measure theory in typical theoretical and practical problems	The student has the ability to construct reasoning mathematical reasoning of the Theory of Fixed Points: proving theorems, as well as refuting hypotheses related to Fixed Point Theory through the construction and selection of counterexamples.	[SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment

Subject contents	Course content – lecture 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. Course content – exercises 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	Algerba Mathematical analysis Topology

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Exam	50.0%	30.0%
Exam	50.0%	40.0%
Activity	50.0%	30.0%

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	
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?	
Practical activites within the subject	Not applicable	

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