



## Subject card

Subject name and code	Algebraic topology, PG_00021037						
Field of study	Mathematics						
Date of commencement of studies	October 2023		Academic year of realisation of subject		2024/2025		
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	2		Language of instruction		Polish		
Semester of study	3		ECTS credits		5.0		
Learning profile	general academic profile		Assessment form		exam		
Conducting unit	Division of Differential Equations and Applications of Mathematics -> Institute of Applied Mathematics -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. Grzegorz Graff				
	Teachers		dr inż. Marcin Styborski				
			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	0.0	0.0	0.0	30.0	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 familiarize students with the basic concepts and theorems in the field of algebraic topology.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_W03] Knows the most important theorems and hypotheses of main branches of mathematics.	Student: - gives examples of fundamental groups of elementary spaces, - can define a fundamental group, - gives examples of homology of basic spaces, - defines a topological degree and lists its applications.	[SW1] Assessment of factual knowledge
	[K7_U06] Has the ability to recognize topological structures in mathematical objects occurring, for example, in geometry or mathematical analysis; is able to use the basic topological properties of sets, functions and transformations, uses the language and methods of functional analysis in the problems of mathematical analysis and its applications, in particular uses the properties of classical Banach and Hilbert spaces.	Student: - gives examples of fundamental groups of elementary spaces, - can define a fundamental group, - gives examples of homology of basic spaces, - defines a topological degree and lists its applications.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject
	[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.	Student: - can independently prepare and present a presentation based on a scientific article related to the topic of the lecture - distinguishes between spaces with homotopic accuracy, - calculates the topological degree	[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject
Subject contents	Categories and functors. Operations on spaces. TCell complexes. opological invariants. Classification of surfaces. Homotopy of maps, homotopy equivalence. Homotopy of paths, fundamental group. Fundamental group of a circle. Covering spaces. Homotopy lifting. Deck transformation group. Relation between fundamental group and first homology group. Singular and simplicial homology. Exact sequences, Mayer-Vietoris sequence. Mapping degree and some applications. Cohomology rings. Applications of topological methods in other branches of mathematics as well as in physics, biology and in other fields of science.		
Prerequisites and co-requisites	Linear algebra. Algebra I. Algebra II. Topology.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Activity during classes	50.0%	20.0%
	Presentation	50.0%	40.0%
	Written exam	50.0%	40.0%
Recommended reading	Basic literature	C. Kosniowski, Wprowadzenie do topologii algebraicznej, Wydawnictwo UAM  R. Duda, Wprowadzenie do topologii tom II, PWN Warszawa 1986  A. Hatcher, Algebraic topology, Cambridge Univ.Press <a href="http://www.math.cornell.edu/hatcher">http://www.math.cornell.edu/hatcher</a>	
	Supplementary literature	1. Massey W.S., A Basic Course in Algebraic Topology, Springer-Verlag, 1991.	
	eResources addresses	Adresy na platformie eNauczanie: Topologia algebraiczna 2023/24 - Moodle ID: 30932 <a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=30932">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=30932</a>	
Example issues/ example questions/ tasks being completed	The definition of the primary group. Examples of homotopy and homology groups. Mathematical description of a Mobius strip.		
Work placement	Not applicable		

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