



## Subject card

Subject name and code	, PG_00052285						
Field of study	Mathematics						
Date of commencement of studies	October 2022	Academic year of realisation of subject			2023/2024		
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			blended-learning		
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	Zakład Analizy Nieliniowej -> Instytut Matematyki Stosowanej -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Karol Wroński				
	Teachers		dr inż. Karol Wroński				
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: 30.0						
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	Introduce basic concepts and understand the main facts of differential topology, and discuss its potential applications in other mathematical fields.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	K7_U09		The ability to independently determine various topological properties of smooth manifolds		[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task		
	K7_W03		Understand the definitions and main theorems of differential topology.		[SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge		
	K7_K01		Understanding the complexity of problems such as, for example, the classification of smooth manifolds.		[SK2] Assessment of progress of work		
Subject contents	Definition of manifolds and their mappings. Manifolds with a border, submanifolds. Homotopy. Sard theorem and Morse functions. Immersion into Euclidean space. Intersections of manifolds and transversality. Riemann's manifolds. Euler characteristics and triangulation. External algebra and differential forms. Integration on manifolds.						
Prerequisites and co-requisites	Knowledge of mathematical analysis with particular emphasis on the functions of several variables. General knowledge of linear algebra. Basics of topology. Basic knowledge of ordinary differential equations.						
Assessment methods and criteria	Subject passing criteria		Passing threshold		Percentage of the final grade		
	Test		50.0%		50.0%		
	Presentation		50.0%		50.0%		

Recommended reading	Basic literature	<p>J. W. Milnor: Topologia z różniczkowego punktu widzenia, PWN, Warszawa 1969.</p> <p>J. Lee, Introduction to topological manifolds, Springer Science &amp; Business Media, 2010</p> <p>M. Hirsch. Differential Topology. Springer-Verlag 1997.</p>
	Supplementary literature	<p>V. Guillemin, Alan Pollack: Differential topology, Prentice-Hall, Inc, Englewood Cliffs, New Jersey, 1974.</p> <p>J. Gancarzewicz, Geometria różniczkowa, PWN, Warszawa, 1987.</p>
	eResources addresses	<p>Adresy na platformie eNauczanie:  Topologia Różniczkowa - Moodle ID: 29596  <a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29596">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29596</a></p>
Example issues/ example questions/ tasks being completed	<p>Check whether the given manifolds are diffeomorphic.</p> <p>Find and describe the critical points of Morse functions.</p>	
Work placement	Not applicable	