

Subject card

Subject name and code	Graph and Network Theory, PG_00203628						
Field of study	Informatics						
Date of commencement of studies	October 2026		Academic year of realisation of subject			2026/2027	
Education level	Master's studies		Subject group			Obligatory subject group in the field of study Subject group related to scientific research in the field of study	
Mode of study	part-time studies		Mode of delivery			at the university	
Year of study	1		Language of instruction			Polish	
Semester of study	1		ECTS credits			5.0	
Learning profile	academic		Assessment form			exam	
Conducting unit							
Name and surname of lecturer (lecturers)	Subject supervisor		dr Hanna Furmańczyk				
	Teachers		dr Hanna Furmańczyk				
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	20.0	0.0	20.0	0.0	0.0	40
	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	40		0.0		85.0	125
Subject objectives	The aim of the course is to deepen students' knowledge of graph theory and network models, with a particular focus on advanced properties of graphs, graph algorithms, and optimization problems. The course prepares students to model and analyze complex computer science problems using methods from graph theory and to select appropriate algorithms and techniques for solving them.						
Learning outcomes	Course outcome		Subject outcome			Method of verification	
	[INFMU2_W09] knows and understands formal models of data representation and structures (e.g. graphs, relational and non-relational models), knows the applications of mathematical models and data structures in solving practical problems, understands the connections between theory (e.g. graphs) and practical data processing systems (e.g. databases, Big Data systems)		The student knows and understands advanced graph models and their application in modeling, analyzing, and solving computer science and networking problems.			[SW4] test/exam - oral or written [SW5] implementation of a problem task	
	[INFMU2_U01] is able to formulate, analyze and solve complex problems related to computer science by selecting and applying appropriate mathematical methods and tools		The student is able to model complex computer science problems using graphs and to select and apply appropriate algorithms and methods from graph theory to analyze and solve them.			[SU5] implementation of a problem task	
	[INFMU2_W01] has in-depth knowledge of the branches of mathematics necessary for the study of computer science; has a good understanding of the role and importance of the construction of mathematical reasoning		The student knows and understands the mathematical foundations of graph theory and the role of formal reasoning in the analysis of the properties of graphs, networks, and graph algorithms.			[SW4] test/exam - oral or written	

Subject contents	Review of Basic Concepts in Graph Theory		
	• classes of graphs, • graph representations, • basic properties and invariants of graphs.		
	Advanced Properties of Graphs		
	• network connectivity and resilience, • planar graphs, • spanning trees, • graph decompositions and their applications.		
	Graph Operations and Their Applications		
	• graph operations, • sums of graphs, • products of graphs (Cartesian, strong, tensor, lexicographic), • properties of products.		
	Flows and network problems		
	• maximum flow, • minimum cut, • the Max-Flow Min-Cut theorem, • applications in network design.		
	Advanced graph algorithms		
	• algorithms for shortest paths, • matchings in graphs, • reachability problems, • algorithms for directed graphs.		
Prerequisites and co-requisites	Graph Coloring and Related Problems		
	• vertex and edge coloring, • perfect graphs, • applications of graph coloring.		
	Optimization Problems on Graphs		
	• domination, • coverage, • independent sets, • cliques, • location problems.		
	Complexity of graph problems		
	• polynomial-time and NP-hard problems, • exact algorithms, • approximation algorithms, • heuristics and metaheuristics.		
Assessment methods and criteria			
	Subject passing criteria	Passing threshold	Percentage of the final grade
	laboratory project	51.0%	30.0%
	implementation tasks	51.0%	20.0%
	written assignment	51.0%	50.0%
Recommended reading	Basic literature	1. J. Wojciechowski, K. Pieńkosz, <i>Grafy i sieci</i>, PWN, Warszawa, 2014. 2. R. Diestel, <i>Graph Theory</i>, 6th ed., Springer, 2024. 3. J.A. Bondy, U.S.R. Murty, <i>Graph Theory</i>, Springer, 2008.	

	Supplementary literature	1. D.B. West, <i>Introduction to Graph Theory</i>, 2nd ed., Prentice Hall, 2001. 2. R.K. Ahuja, T.L. Magnanti, J.B. Orlin, <i>Network Flows: Theory, Algorithms, and Applications</i>, Prentice Hall, 1993. 3. Selected academic articles provided by the teacher.
	eResources addresses	
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	

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