

graphs and networks				Theory of graphs and networks				
SI_.....								
adernicki								
cjonalne								
rwszego stopnia								
owy								
7								
tr	(x egzamin, + zaliczenie, # projekt)						punkty ECTS	
	razem	wykłady	ćwiczenia	laboratoria	projekt	seminarium		
	30+	16	14+				1.5	
1		16	14				1.5	
przedmiotów kształcenia wprowadzających								
/ Kryptologia i cyberbezpieczeństwo / wszystkie specjalności								
ż. Zbigniew Tarapata								
s Research and Decision Support Division								
s supported by multimedia presentations, problem-solving classes, independent study of materials le via e-learning.								
Semestr II temat/tematyka zajęć				liczba godzin				
				wkt.	ćw.	lab.	prj.	sem.
efinition of a graph. Types and components of graphs nition of a graph. A graph as a system model. Characteristics graph and of the elements of its structure. Types of graphs. s of graphs, subgraphs and partial graphs.				2				
raph colouring Stable subsets of graph vertices. Graph bases. h chromatic properties. Graph-colouring models. Exact and roximate graph-colouring algorithms. Computational lexity of the algorithms discussed.				3	3			
alks, trails and paths in graphs Definitions of a walk, trail and . Connectivity and strong connectivity of a graph. omatic number and graph skeletons. Computational lexity of the algorithms discussed.				2	1			
erge graphs Definition and types of Berge graphs. Strongly ected components of digraphs. Leifman's algorithm. Paths in raphs. Layered representation of a digraph. Eulerian and iltonian paths in graphs. Computational complexity of the rithms discussed.				2	1			
etworks Definition of a network. Minimum-cost spanning s. Extremal paths in cyclic and acyclic networks. Network ods for the analysis of complex projects. Stochastic orks and the basic problems defined for them. putational complexity of the algorithms discussed.				3	3			
etwork flows Flow in a standard network. Separating cut and apacity. Maximum-flow algorithm. Edge connectivity and ex connectivity. Vertex-disjoint and edge-disjoint paths. ger's theorem. Minimum-cost feasible flow. Computational lexity of the algorithms discussed.				2	3			
ptimal assignments Definition of an assignment as a matching ipartite network. Hall's theorem. Algorithms for determining ximum-cardinality assignment and a maximum-cardinality um-cost assignment. Computational complexity of the rithms discussed.				2	3			
Razem				16	14			
wa:								
stel, Graph Theory, Springer-Verlag, New York, 2000.								
ord, D.R. Fulkerson. Flows in networks. 1969.								

	uzupełniająca:		
Efekty uczenia się	Symbol	Efekty kształcenia	odniesienie do efektów kształcenia dla kierunku
	W1	Knowledge of the principles of system modelling using graphs and networks	K_W02, K_W10, K_W07
	W2	Knowledge of various graph and network theory models	K_W02, K_W10, K_W07
	W3	Knowledge of methods for solving problems modelled using graphs and networks	K_W02, K_W10, K_W07
	U1	Ability to model real-world objects using graph and network models	K_U03, K_U17
	U2	Ability to distinguish between graph problems and network problems	K_U03, K_U17
	U3	Ability to apply specialised graph- and network-based methods to solve practical engineering problems	K_U03, K_U17
Metody i kryteria oceniania (sposób sprawdzania osiągnięcia przez studenta zakładanych efektów uczenia się)	The course is completed on the basis of: - a written knowledge test, - successful completion of the problem-solving classes. In the test, correct answers, unanswered questions and incorrect answers are assessed. The maximum number of points for a correct answer to a single test question is 1 point. No materials may be used during the test unless the lecturer decides otherwise and informs the students accordingly. Successful completion of the problem-solving classes is a prerequisite for admission to the written test. A necessary condition for passing the written test is obtaining more than half of the maximum total number of points available for the test questions. The problem-solving classes are assessed on the basis of: - two announced written tests - one covering the graph-theory section and the other covering the network-theory section, - unannounced short quizzes assessing students' preparation for current classes. The final grade for the classes is calculated as a weighted average of: - the grade from the first written test, - the grade from the second written test, - the average grade from the short quizzes, with each of these three components assigned a weight of 1/3. A necessary condition for successfully completing the classes is: - receiving a passing grade in each written test, and - obtaining an average quiz grade of at least 3.0. Students may be absent from up to two classes. In the event of a greater number of absences, separate assessments are conducted during consultation hours, or the student is assigned an individual task covering the material from the classes they missed. Learning outcomes W3, U1, U2 and U3 are assessed by means of the two announced written tests, unannounced quizzes and students' oral responses. Learning outcomes W1 and W2 are assessed by means of a written test and, where appropriate, an oral assessment.		
Bilans ECTS (nakład pracy studenta)	SEMESTR 2		
	Aktywność	Obciążenie studenta	
		Liczba godzin	Liczba ECTS
	Udział w wykładach	16	0.4
	Udział w laboratoriach		
	Udział w ćwiczeniach	14	0.8
	Udział w seminariach		
	Samodzielne studiowanie tematyki wykładów	10	0.3
	Samodzielne przygotowanie do laboratoriów		
	Samodzielne przygotowanie do ćwiczeń	8	
	Samodzielna realizacja projektu		
	Realizacja projektu		
	Udział w konsultacjach	2	
	Przygotowanie do egzaminu		
	Przygotowanie do zaliczenia		
	Udział w egzaminie / kolokwium		
	Sumaryczne obciążenie pracą studenta	52	1.5
	Zajęcia z udziałem nauczycieli	32	1.2
	Zajęcia powiązane z działalnością naukową	48	1.5
	Zajęcia o charakterze praktycznym	22	0.8
Zajęcia realizowane z wykorzystaniem metod i technik kształcenia na odległość	SEMESTR 2		
	Rygor	Liczba godzin	
		Liczba ECTS	
	Wykłady		
	Laboratoria		
	Ćwiczenia		
	Projekty		
	Seminaria		
	Razem		

autor

dr hab. inż. Zbigniew Tarapata
tytuł, stopień naukowy, imię, NAZWISKO, podpis

kierownik jednostki organizacyjnej
odpowiedzialnej za przedmiot

dr hab. inż. Nowicki Tadeusz
tytuł, stopień naukowy, imię, NAZWISKO, podpis