



Subject card

Subject name and code	Applied mathematics, PG_00068133						
Field of study	Spatial Development						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2026/2027		
Education level	first-cycle studies		Subject group		Obligatory subject group 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		2.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Visual Arts -> Faculty of Architecture -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr Lech Kujawski				
	Teachers		dr Lech Kujawski				
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	15.0	0.0	0.0	0.0	30
	E-learning hours included: 0.0						
	eNauczanie source address: https://enauczenie.pg.edu.pl/2025/course/view.php?id=8020						
	Moodle ID: 8020 WA - GP sem.3 - Matematyka stosowana w planowaniu przestrzennym 2026/27 (L.Kujawski) https://enauczenie.pg.edu.pl/2025/course/view.php?id=8020						
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	30		4.0		16.0	50
Subject objectives	Increasing knowledge and develop skills for making three-dimensional space						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K6_W03] has knowledge in the field of mathematics and physics relating to issues related to space management, including the basic mathematical methods used in urban design, as well as analytical and design methods using information technology used in planning processes of settlement structures		He knows the graphic methods of space projection and their application in solving engineering problems.		[SW1] Assessment of factual knowledge		
	[K6_U04] prepares analyses of spatial assumptions on an agglomeration, city and district scale; demonstrates the ability to correctly interpret and assess the existing condition based on data from various sources; formulates guidelines for urban and architectural design and develops concepts for the transformation of urbanized structures		Can freely determine the surface topography of land, and plan simple engineering tasks.				
	[K6_U01] has the ability to abstractly understand technical problems; applies basic mathematical and simulation methods in urban planning and spatial planning		He can attractively present the effects of his work in the form of perspective sketches and digital visualizations.		[SU5] Assessment of ability to present the results of task [SU1] Assessment of task fulfilment		

Subject contents	Course content – lecture 1. Basic Concepts of Mathematical Logic: logical propositions; truth values; negation; conjunction; disjunction; implication; equivalence; exclusive disjunction; truth tables for compound propositions. 2. Laws of Propositional Calculus: tautology; laws of propositional calculus; De Morgan's laws. 3. Quantifiers: quantified propositions; order of quantifiers; De Morgan's laws for quantifiers. 4. Sets and Set Operations: concept of a set; element and subset; empty set; power set; cardinality of a set; finite and infinite sets; set operations: union, intersection, difference, complement, symmetric difference; De Morgan's laws. 5. Cartesian Product of Sets: ordered pairs; Cartesian product; relation between sets. 6. Matrix Algebra: concept of a matrix; types of matrices; matrix operations. 7. Matrix Determinants: concept of a determinant; properties of determinants; inverse matrix. 8. Basic Concepts of Graph Theory: concept of a graph; directed and undirected graphs; simple graph; complete graph; empty graph. 9. Paths and Cycles: walk; path; cycle; distance; paths in directed graphs. 10. Applications of Graph Theory: Ford–Fulkerson algorithm. 11. Applications of Graph Theory: CPA model (Critical Path Analysis). 12. Applications of Graph Theory: CPM model (Critical Path Method). 13. Fundamentals of Spatial Data: concept of spatial data; point, line and polygon data; spatial units; adjacency matrices; spatial distance and neighbourhood. 14. Exploratory Spatial Data Analysis: descriptive statistics; measures of location and variability; distributions of spatial variables; identification of outliers. 15. Spatial Dependence: concept of spatial autocorrelation; positive and negative spatial autocorrelation; spatial weights matrix; definition of neighbourhood; distance-based neighbourhood; Moran's statistic and testing its statistical significance. Course content – exercises 1. Basic Concepts of Mathematical Logic: logical propositions; truth values; negation; conjunction; disjunction; implication; equivalence; exclusive disjunction; truth tables for compound propositions. 2. Laws of Propositional Calculus: tautology; laws of propositional calculus; De Morgan's laws. 3. Quantifiers: quantified propositions; order of quantifiers; De Morgan's laws for quantifiers. 4. Sets and Set Operations: concept of a set; element and subset; empty set; power set; cardinality of a set; finite and infinite sets; set operations: union, intersection, difference, complement, symmetric difference; De Morgan's laws. 5. Cartesian Product of Sets: ordered pairs; Cartesian product; relation between sets. 6. Matrix Algebra: concept of a matrix; types of matrices; matrix operations.
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Prerequisites and co-requisites	Completion of the mathematics course in the first and second semesters of study.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Examination	50.0%	50.0%
	Mid-semester test	50.0%	40.0%
	Class participation	50.0%	10.0%
Recommended reading	Basic literature		
	Supplementary literature		
	eResources addresses		
Example issues/ example questions/ tasks being completed	1. Determine whether the logical proposition ... is a tautology. 2. Find the union, intersection, and complement of the sets ... in the plane. 3. Discuss the solvability of the system of equations ... and, if the system is consistent, solve it. 4. Determine the minimum cost of transporting $\setminus(n)$ units of a homogeneous commodity to $\setminus(k)$ suppliers. 5. Determine and test the significance of spatial autocorrelation among $\setminus(n)$ spatial units.		
Practical activites within the subject	Not applicable		

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