

。 GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Modelling and optimisation for transportation systems, PG_00064980							
Field of study	Transport and Logistics							
Date of commencement of studies	February 2025		Academic year of realisation of subject			2024/2025		
Education level	second-cycle 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	Full-time studies		Mode of delivery			at the university		
Year of study	1		Language of instruction		Polish polish			
Semester of study	1		ECTS credits		3.0			
Learning profile	general academic profile		Assessment form		exam			
Conducting unit	Zakład Hydromechaniki i Projektowania Okrętu -> Institute of Ocean Engineering and Ship Technology -> Faculty of Mechanical Engineering and Ship Technology							
Name and surname	Subject supervisor		dr inż. Marcin Życzkowski					
of lecturer (lecturers)	Teachers dr inż. Marcin Życzkowski							
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Projec	t	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	15.0 0.0		0.0	30
	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	30		10.0		35.0		75
Subject objectives	The aim of the course is to present selected transport processes using a mathematical description, particularly employing methods from discrete mathematics and graph theory. The modeling will focus on maritime transport, with special attention to issues related to ship trajectories and their dependence on dynamically changing hydrometeorological conditions.							

Learning outcomes	Course outcome	Subject outcome	Method of verification			
	[K7_U02] formulates and tests hypotheses concerning problems od transport systems and processes, as well as simple research problems	Is able to interpret modeling and optimization results in the context of real operational conditions.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU5] Assessment of ability to present the results of task			
	[K7_W01] explains and describes, based on general knowledge in the field of scientific disciplines forming the theoretical foundations of Transport and Logistics, the construction and principles of operation of transport systems, processes and their components, as well as methods and means of their integration	Demonstrates a well-structured and theoretically grounded knowledge of key topics in Transport and Logistics, enabling the modeling and analysis of transport systems and processes.	[SW2] Assessment of knowledge contained in presentation			
	[K7_U01] utilizes acquired methods, tools and mathematical models for analysis and evaluation of transport systems and processes	Applies the Python programming language to implement route optimization algorithms in maritime transport. Understands fundamental methods for modeling transport processes using discrete mathematics and graph theory.	[SU1] Assessment of task fulfilment			
	[K7_W02] demonstrates structured and theory supported knowledge encompassing key issues in the field of Transport and Logistics, enabling modeling and analysis of transport systems and processes	Has knowledge of tools and data analysis techniques used in maritime transport.	[SW2] Assessment of knowledge contained in presentation			
Subject contents	1. Introduction to Programming in	Python				
	 Introduction to the Anaconda environment and basic data analysis tools Summary of Python programming fundamentals: data types, operators, control structures, functions Basic Python libraries used in transport analysis (NumPy, Pandas, Matplotlib) 					
	2. Mathematical Methods in Transport Modeling					
	 Graph models in transport transport networks, nodes, and edges Grid and discretization of the maritime environment The concept of a grid in maritime transport modeling Discretization of the maritime environment description and representation in Python Various grid representation methods: rectangular grids, hexagonal grids, irregular grids Navigation-related concepts Geographical coordinates: latitude and longitude Measurement units in navigation: nautical mile, knot Representation of geographical coordinates in route modeling in Python Shortest paths in transport models Route computation algorithms: Dijkstras, Bellman-Ford, A* Flow problems in transport networks 					
	3. Ship Trajectory Modeling in Maritime Transport					
	 Characteristics of ship movement and the impact of hydrometeorological conditions Trajectory prediction methods and their applications Optimization of shipping routes considering variable environmental conditions 					
	4. Data Modeling and Analysis in Maritime Transport					
	 Application of data analysis in transport historical AIS data analysis Processing hydrometeorological data and its impact on ship trajectories Use of GIS systems in maritime transport analysis 					
Let me know if you need any modifications!						

Prerequisites and co-requisites	 Mathematics fundamentals of algebra, discrete mathematics, graph theory, and optimization methods. Programming basic proficiency in Python, including data structures, loops, functions, and fundamental libraries for data analysis (e.g., NumPy, Pandas). Basics of Transport and Logistics general understanding of transport systems, including maritime transport. 					
Assessment methods	Subject passing criteria	Passing threshold	Percentage of the final grade			
and criteria	Project	50.0%	100.0%			
Recommended reading	Basic literature Supplementary literature	 McKinney, W. Python for Data Analysis (O'Reilly, 201) Processing transport data using Pandas and NumPy IMO (International Maritime Organization) <i>E-navigation</i> Strategy Implementation Plan (IMO, 2014) E-navigation strategies and maritime route optimiza Dijkstra, E. W. A Discipline of Programming (Prentice 1976) A classical approach to graph algorithms, including shortest path algorithm. any e-course for Python 				
	eResources addresses	Adresy na platformie eNauczanie: Modelowanie i optymalizacja w transporcie - Moodle ID: 44117 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=44117				
Example issues/ example questions/ tasks being completed	For a given area, retrieve data describing marine conditions related to wave height and direction. Then, create an algorithm that avoids waves higher than 6 meters.					
Work placement	Not applicable					

Document generated electronically. Does not require a seal or signature.