

GDAŃSK UNIVERSITY

Subject card

Subject name and code	Optimization and Decision Support, PG_00056863								
Field of study	Automation, Robotics and Control Systems								
Date of commencement of studies	October 2023		Academic year of realisation of subject			2024/2025			
Education level	first-cycle studies		Subject group						
Mode of study	Full-time studies		Mode of delivery			at the university			
Year of study	2		Language of instruction			Polish			
Semester of study	4		ECTS credits			5.0			
Learning profile	general academic profile		Assessment form		exam				
Conducting unit	Department of Control Engineering -> Faculty of Electrical and Control Engineering								
Vame and surname Subject supervise		dr hab. Anna		Witkowska					
of lecturer (lecturers)	Teachers								
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project		Seminar	SUM	
	Number of study hours	30.0	24.0	6.0	0.0		0.0	60	
	E-learning hours included: 0.0								
	Additional information: Laboratory, lecture and excercise - stationary Lecture, exercises, laboratory - classes conducted in stationary form Exercises- blackboard classes, implementation of tasks, activating methods Lecture - presentation, discussion Computer laboratories - practical and independent implementation of tasks by students.								
Learning activity and number of study hours	Learning activity	Participation i classes incluc plan	n didactic led in study	Participation i consultation h	in nours	Self-st	udy	SUM	
	Number of study hours	60		8.0		57.0		125	
Subject objectives	The aim of the course support and preparate	e is to acquaint on for indepen	students with t dent solving ba	the basics of th asic optimizatio	ne theory	of opti ms.	mization and	decision	

Learning outcomes	Course outcome	Subject outcome	Method of verification				
	[K6_K05] can think and act in an entrepreneurial way	Based on the analysis of the optimization problem, it can classify and then formulate the optimization task, define target functions, decision variables and constraints. Evaluates and properly interprets the solution received.	[SK5] Assessment of ability to solve problems that arise in practice				
	[K6_U05] can use analytical and simulation methods to solve tasks in the field of automation and robotics and use various techniques to carry out engineering tasks related to automation and robotics devices and systems	He can choose and apply the appropriate method and algorithm to solve the task optimization for advanced problems in engineering practice (eg to choose the parameters of the regulator, allocate forces to an excess set of executive devices, determine the production volume that maximizes profit, minimize losses, to solve the transport problem and allocation).	[SU1] Assessment of task fulfilment				
	[K6_W01] has basic knowledge in the field of mathematics including algebra, geometry, mathematical analysis, probabilistics, numerical methods - necessary to describe and analyze automation and robotics systems	He knows and has a basic knowledge of analytical and numerical algorithms for solving basic tasks of linear and nonlinear optimization.	[SW1] Assessment of factual knowledge				
Subject contents	1. Formulation of the task of such	ation Otomoo of activity - the instantion	bolko Clossification of a timi-ti				
	 Portification of the task of optimization. Stages of solving optimization tasks. Classification of optimization tasks. Basic division of optimization tasks. Convex vs. non-convex optimization. Types of constraints in an optimization task. Formulation of a linear programming task in general form, in vector form. Stages of solving the ZPL by geometric method. Examples of linear programming tasks. Formulation of the mathematical model of the optimization task (selection of production mix, allocation of machines, mixing of raw materials, transportation task), dedicated algorithms. Formulation of the task of nonlinear (quadratic) optimization. The method of least squares. Necessary conditions for optimization of an unconstrained objective function (what is a hessian?). Necessary conditions for optimization of the objective function with equality constraints. The method of Lagrange multipliers for tasks with equality constraints. Relationship of the method of Lagrange multipliers to the necessary conditions for optimization of the objective function with inequality constraints. Kuchar Cuotitions for optimization of the objective function with inequality constraints. Kuchar Cuotitions for optimization of the objective function with inequality constraints. Kuchar Cuotitions for optimization of the objective function with inequality constraints. Kuchar Cuotitions for optimization in the direction for unconstrained tasks - general characteristics and general anethods of optimization in the direction for unconstrained tasks - general characteristics and general classification. Gradient-free methods of optimization in the direction. Gradient methods of optimization in the direction for unconstrained tasks - general characteristics and general classification. Gradient-free methods of optimization in the direction. Numerical methods of optimization task. Effi						
Prerequisites and co-requisites	Ability mathematical description of physical and technical processes. Knowledge of basic mathematic differential theory and numerical methods.						
Assessment methods	Subject passing criteria	Passing threshold	Percentage of the final grade				
and criteria	lecture	50.0%	40.0%				
	excercises	50.0%	40.0%				
	Pagia literatura	00.0%					
Recommended reading	Basic literature	 Amborski, Podstawy metod optymalizacji, Oficyna Wydawnicza Politechniki Warszawskiej, 2001 Arabas G.: Wyklad z algorytmow ewolucyjnych, PWN, Warszawa 2003. Optymalizacja. Wybrane metody z przykładami zastosowań. Kusiak Jan , Danielewska-Tułecka Anna , Oprocha Piotr . Wydawnictwo Naukowe PWN 2009. Marianna Jacyna. Wspomaganie decyzji w praktyce inżynierskiej. PWN. Warszawa 2022. 					
	Supplementary literature	 Rothlauf F. (2011) Optimization Methods. In: Design of Modern Heuristics. Natural Computing Series. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-540-72962-4_3 					
	eResources addresses	Adresy na platformie eNauczanie:					

Example issues/ example questions/ tasks being completed	Example 1. The electrical nodes there are receivers receiving currents shown on the drawing. How do I connect (which segments of he electrical web) the final receivers from the supply point to minimise the voltage drop between them	
	Example2. The company produces two products: W1 and W2 of three materials: S1, S2 and S3. For manufacturing of the product W1 needs 2 units of S1, one unit of S2, and 4 units of S3. To produce a product W2 respectively needs 2 units of S1, 2 units of S2. Daily limit is: 14 units of S1, 8 - S2 and 16 - S3. Product prices are as follows: 2 zł for W1 and 3 zł for W2. Find the production plan to maximize the benefits from the sale by using graphical method.	
	Example 3.	
	Application of numerical optimization algorithms to the tuning of PID controller parameters on the example of optimization of a ship's course control system with Nomoto first-order model.	
Work placement	Not applicable	