GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Structural optimisation in robotics, PG_00056135		
Field of study	Mechatronics		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2026/2027
Education level	first-cycle studies	Subject group	
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	3	Language of instruction	Polish
Semester of study	6	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Institute of Mechanics and Machine Design -> Faculty of Mechanical Engineering and Ship Technology -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Szymon Grymek	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	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	0.0	0.0	30

Subject objectives

Understanding the basics of optimization and polyoptimization as applied to design and control in robotics.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W08] knows and understands design and production processes of elements and simple mechatronic devices	Student knows the methods of applying optimization in the design of mechatronic devices.	[SW1] Assessment of factual knowledge
[K6_W10] has knowledge about development trends in the field of engineering and technology sciences and scientific disciplines: Mechanical Engineering, Automation, Electronics, Electrical Engineering and Space Technologies, adequate for Mechatronics curse	Student knows the ways of using artificial intelligence methods in optimization.	[SW1] Assessment of factual knowledge
[K6_W11] has knowledge about the life cycle of mechatronic systems and objects	Student knows the evaluation criteria used in the design of mechatronic systems.	[SW1] Assessment of factual knowledge
[K6_U05] is able to use properly chosen tools to compare design solutions of elements and mechatronics systems according to given application and economic criteria (e.g. power demand, speed, costs)	Student is able to choose the methods and means necessary for the effective solution of the given optimization task.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
[K6_U06] is able to identify and formulate specification of simple, practical engineering tasks, distinctive for mechatronics	Student is able to define a robotics-specific optimization task.	[SU1] Assessment of task fulfilment

<table>
<tr><td>Subject contents</td><td>Course content – lecture
LECTURE
Optimization and selection. Criteria and decision variables. Polyoptimization. Criteria weights. Utility function. Objective function. Inequality, equality and cube constraints. Linear and nonlinear programming. Gradient and non-gradient methods of minimizing the objective function. Artificial neural networks in optimization. Evolutionary algorithms in optimization.

LABORATORY
Demonstration of defining and solving the selection task.
Demonstration of the definition and solution of the poly-optimization task.
Demonstration of the use of artificial neural networks in optimization.
Demonstration of the use of an evolutionary algorithm in optimization.
Student independently defines and solves the task of poly-optimization.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Basics of matrix and differential calculus.Fundamentals of mechanics, robotics, automation, strength of materials and thermodynamics.Basic knowledge of Matlab / Octave / Scilab.</td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Colloquium</td><td>50.0%</td><td>60.0%</td></tr>
<tr><td>Task of poly-optimization</td><td>50.0%</td><td>40.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>Tarnowski W.: optymalizacja i polioptymalizacja w mechatronice. Wydawnictwo Uczelniane Politechniki Koszalińskiej, 2009
Findeisen W., Szymanowski J., Wierzbicki A.: Teoria i metody obliczeniowe optymalizacji. PWN Warszawa 1972
Hertz J., Krogh A., Palmer R.G.: Wstęp do obliczeń neuronowych. WNT Warszawa 1993
Goldberg D.E.: Algorytmy genetyczne i ich zastosowania.</td></tr>
<tr><td>Supplementary literature</td><td>Osiński Z., Wróbel j.: Teoria konstrukcji maszyn. Seria PKM. PWN Warszawa 1992Tarnowski W.: Podstawy projektowania technicznego. WNT Warszawa 1997Milkiewicz F.: Podstawy optymalizacji. Skrypt PG. Gdańsk 1995Fortuna Z., Macukow B., Wąsowski J.: Metody numeryczne. WNT Warszawa 1982 Pająk E., Wieczorowski K.: Podstawy optymalizacji operacji technologicznych w przykładach. PWN Warszawa 1982</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>Find the fastest route from point A to point B through 3 centers of different traffic resistance.Determine the design features of a bending spring minimizing material consumption.</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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