GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Numerical Methods & Optimization in Automatic Control, PG_00067429		
Field of study	Automatic Control, Cybernetics and Robotics		
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 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	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 Signals and Systems -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Piotr Fiertek	
	Teachers	dr inż. Piotr Fiertek	

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	2.0	18.0	50

Subject objectives

To familiarize students with the theoretical foundations of mathematical optimization methods for unconstrained and constrained problems. Furthermore, they will be introduced to computational analytical and numerical methods.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W01] knows and understands, to an advanced extent, mathematics necessary to formulate and solve simple issues related to the field of study	Has basic knowledge of static optimization.	[SW1] Assessment of factual knowledge
[K6_U01] can apply mathematical knowledge to formulate and solve complex and non-typical problems related to the field of study and perform tasks, in an innovative way, in not entirely predictable conditions, by:n- appropriate selection of sources and information obtained from them, assessment, critical analysis and synthesis of this information,n- selection and application of appropriate methods and toolsn	Can formulate an optimization problem in mathematical form and solve it using analytical or numerical methods.	[SU1] Assessment of task fulfilment

<table>
<tr><td>Subject contents</td><td>Course content – lecture
1. Introduction. Basic problems and terminology. Applications.
2. Mathematical notation of practical optimization problems.
3. Analytical methods for solving multivariable optimization problems without constraints.
4. Analytical methods for solving multivariable optimization problems with constraints.
5. Review of numerical methods for solving optimization problems:
a) gradient-free direct search methods;
b) gradient-free algorithms for improvement directions;
c) simple gradient methods (without directional minimization);
d) gradient algorithms for improvement directions.

Course content – laboratory
1. Mastering the computational environment (e.g., Matlab)
2. Implementing gradient and gradientless algorithms for finding the minimum of a function: Hooke-Jeeves algorithm, Symplex algorithm: Sample tasks: determining object model parameters based on a recorded step response.
3. Formulating the minimum of a function for constrained and unconstrained problems: Sample task: numerical tuning of PID controllers</td></tr>
<tr><td>Prerequisites and co-requisites</td><td></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>sprawdzian pisemny</td><td>50.0%</td><td>50.0%</td></tr>
<tr><td>wykonanie wszystkich zadań</td><td>50.0%</td><td>50.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>J.Seidler, A.Badach, W.Molisz, Metody rozwiązywania zadań optymalizacji, Podręczniki Akademickie eit, WNT 1980.
A.Stachurski, Wprowadzenie do optymalizacji , Politechnika Warszawska, 2009.</td></tr>
<tr><td>Supplementary literature</td><td>J.Nocedal, S.J.Wright, Numerical Optimization, Springer, 1999</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></td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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