GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Multistage Decision Processes, PG_00064256		
Field of study	Automatic Control, Cybernetics and Robotics		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2027/2028
Education level	second-cycle studies	Subject group	Optional subject group Specialty subject group 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
Semester of study	2	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Decision Systems and Robotics -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr Krzysztof Topolski	
	Teachers	dr Krzysztof Topolski	

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

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

Introduction to the theory of multi-stage decision-making processes and its applications in solving optimal control problems for continuous and discrete dynamic systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U01] can apply mathematical knowledge to formulate and solve complex and non-typical problems related to the field of study by: - appropriate selection of source information and its critical analysis, synthesis, creative interpretation and presentation, - application of appropriate methods and tools	Creates a mathematical description of discrete processes in production and transport systems, designs automation systems, applies game theory to assess the performance of autonomous systems.	[SU2] Assessment of ability to analyse information
[K7_W03] knows and understands, to an increased extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum	Knows calculation algorithms for optimal control of discrete processes in industry, classic optimization methods and numerical methods of predictive control of dynamic processes.	[SW1] Assessment of factual knowledge

<table>
<tr><td>Subject contents</td><td>Course content – lecture

1. Introduction – multistage processes, decision systems and optimization.
2. Classification of multistage processes. Practical examples from various domains.
3. Dynamic Optimization (DO) problems – mathematical formulation. DO problems in economic and engineering domains, described by differential and finite difference equations.
4. Introduction to Calculus of Variations. Euler – Lagrange equation.
5. DO – continuous. Necessary conditions of optimal control in the problems with constraints imposed on boundary state trajectory values.
6. DO – continuous problems with constrained control function. Necessary condition for optimal solution. Hamilton function. Minimum Principle.
7. Optimal Decision Model based on conditions from subjects 5 and 6.
8. Parameter vector tuning in the multistage optimization process.
9. DO – discrete. Dynamic programming. Bellman Principle. Forward and backward recurrence.
10. DO – discrete. Algorithm for determination of optimal strategy for the processes described by finite difference equation
11. Resources management problem - DP application.
12. Allocation problem - DP application.</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>colloquium (80%) + activity (20%)</td><td>50.0%</td><td>100.0%</td></tr></table></td></tr>
<tr><td>Recommended reading</td><td><table><tr><td>Basic literature</td><td>1. I.M. Gelfand and S. V. Fomin, Calculus of Variations, (Dover, New York, 2000);
2. M. Athans and P. Falb, Optimal Control: An Introduction to the Theory and Its Applications. (New York McGraw-Hill Book Company, 1966);- accessible also in Polish.
3. G. Monahan, Management Decision Making. (Cambridge University Press, 2000);</td></tr><tr><td>Supplementary literature</td><td>D. Kirk, Optimal Control Theory. An Introduction. (Prentice Hall INC., 1970, and Dover Edition, 2004).</td></tr><tr><td>eResources addresses</td><td></td></tr></table></td></tr>
<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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