



## Subject card

Subject name and code	Multistage Decision Processes, PG_00049213						
Field of study	Automatic Control, Cybernetics and Robotics						
Date of commencement of studies	February 2023		Academic year of realisation of subject		2023/2024		
Education level	second-cycle studies		Subject group		Optional 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	2		Language of instruction		English		
Semester of study	3		ECTS credits		1.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Decision Systems and Robotics -> Faculty of Electronics, Telecommunications and Informatics						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Krystyna Rudzińska-Kormańska				
	Teachers		dr inż. Krystyna Rudzińska-Kormańska				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	0.0	0.0	15
	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	15		2.0		8.0	25
Subject objectives	Introduction to the theory of multistage decision making processes and its application in solving the problems of optimal control 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:n-appropriate selection of source information and its critical analysis, synthesis, creative interpretation and presentation,n-application of appropriate methods and toolsn		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		

Subject contents	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.		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	colloquium (80%) + activity (20%)	50.0%	100.0%
Recommended reading	Basic literature	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);	
	Supplementary literature	D. Kirk, Optimal Control Theory. An Introduction. ( Prentice Hall INC., 1970, and Dover Edition, 2004).	
	eResources addresses	Adresy na platformie eNauczanie:	
Example issues/ example questions/ tasks being completed			
Work placement	Not applicable		