GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Control and Decision Support Systems, PG_00057478		
Field of study	Automation, Robotics and Control Systems		
Date of commencement of studies	February 2022	Academic year of realisation of subject	2021/2022
Education level	second-cycle studies	Subject group	
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	1	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Katedra Inteligentnych Systemów Sterowania i Wspomagania Decyzji -> Faculty of Electrical and Control Engineering		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Tomasz Rutkowski	
	Teachers	dr inż. Tomasz Rutkowski dr inż. Tomasz Zubowicz dr hab. inż. Kazimierz Duzinkiewicz	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	0.0	15.0	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 advanced structures and algorithms of control systems that implement complex control objectives. Introduction to decision support systems and advanced optimisation methods as tools for their synthesis purposes.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K7_U11	Knowledge of advanced control methods. Knowledge of advanced decision support methods.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
K7_W02	Knowledge of the implementation of control algorithms. Knowledge of the decision support system implementation. Knowledge of the evaluation of the performance quality of the control systems.	[SW1] Assessment of factual knowledge

Subject contents	LECTURES: Aspects of modelling dynamics systems: linear and nonlinear with distributed and concentrated dynamics, continuous and discrete, mixed and event dynamics. Uncertainty modelling methods: stochastic, interval deterministic and mixed. Control and decision support structures: centralized and decentralized, with information exchange, with negotiation and consensus mechanisms, hierarchical with coordination. Trajectory tracking control in the cascade control structure. Problems of direct adaptive control based on the DMRAC model (Direct Model Reference Adaptive Control). Decision support systems as control systems. Issues of decision support with multi-criteria decisions problems: multi-attribute and multi-objective. Problems of multi-criteria linear programming, Pareto optimality. Introduction to optimizing MPC (Model Predictive Control) control, aspects of taking into account changes in process operating conditions (soft switching), robustness's mechanisms. The classical genetic algorithm as a method for solving optimization problems. PROJECT: The project classes are based on the Matlab/Simulink software with prepared utility tools (scripts, models), and its scope includes the content presented during lectures such as: - synthesis of a trajectory tracking cascade control system for the vertical inclination of the radar bowl, taking into account the presence of friction forces and measurement noise (LuGre friction model, PI regulator with adapted parameters: fuzzy logic, Mamdani inference), - synthesis of the oxygen concentration control system in a biological reactor using Direct Model Reference Adaptive Control (DMRAC), - synthesis of predictive control with a linear object model in a multivariate, nonlinear chemical reactor with a continuous flow of components (CSTR), - the classic Genetic Algorithm (GA) as a tool for solving optimization problems, - decision support problem based on the example of Portfolio optimization of the investment portfolio of an individual investor.
Prerequisites and co-requisites	Knowledge of the contents of the subjects related to control systems engineering, which were realized within the standard curriculum of a bachelor's degree in Automatics.
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Lecture Test	50.0%	50.0%
Projects Reports	50.0%	50.0%

Recommended reading	Basic literature	1. Slotine Jean Jacques E., W. Li: Applied Nonlinear Control. Prentice Hall, Englewood Cliffs, New Jersey 07632, 1991. 2. Brdys Mietek A., P. Tatjewski: Iterative Algorithms for Multilayer Optimizing Control, Imperial College Press, World Scientific Publishing Co. Pte. Ltd., 2005. 3. Rawlings J.B., D.Q. Mayne: Model Predictive Control: Theory and Design. Nob-Hill Publishing, 1st edition, 2009. 4. A.P. Wierzbicki, M. Makowski, J. Wessels: Model-Based Decision Support Methodology with Environmental Applications, Series: Mathematical Modeling and Applications. Kluwer Academic, Dordrecht, 2000. 5. J. Branke, K. Deb, K. Miettinen, R. Slowinski: Multiobjective Optimization: Interactive and Evolutionary Approaches, 2008.
	Supplementary literature	1. Hassan K. Khail: Nonlinear Systems. Prentice Hall, Englewood Cliffs, New Jersey 07632, 2002. 2. J. M. Maciejowski: Multivariable Feedback Design. Addison Wesley, 1989 3. Byrski W.: Obserwacja i Sterowanie w Systemach Dynamicznych. Uczelniane Wydawnictwa Naukowo Dydaktyczne Akademii Górniczo Hutniczej w Krakowie, 2007 4. Tatjewski P.: Sterowanie Zaawansowane Obiektów Przemysłowych struktury i algorytmy. Warszawa, Akad. Oficyna Wyd. EXIT, 2002.
	eResources addresses	
Example issues/ example questions/ tasks being completed	- Synthesis of a trajectory tracking cascade control system for the vertical inclination of the radar bowl, taking into account the presence of friction forces and measurement noise (LuGre friction model, PI regulator with adapted parameters: fuzzy logic, Mamdani inference) - Synthesis of the oxygen concentration control system in a biological reactor using Direct Model Reference Adaptive Control (DMRAC) - Synthesis of predictive control with a linear object model in a multivariate, nonlinear chemical reactor with a continuous flow of components (CSTR) - Classic Genetic Algorithm (GA) as a tool for solving optimization problems - Decision support problem based on the example of Portfolio optimization of the investment portfolio of an individual investor	
Work placement	Not applicable	