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 2027	Academic year of realisation of subject	2026/2027
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	Department of Intelligent and Decision Support Systems -> Faculty of Electrical and Control Engineering -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Tomasz Rutkowski	
	Teachers		

Lesson types

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

The aim of the course is for the student to master knowledge in the area of selected advanced control structures and algorithms for objects pursuing complex control objectives. In addition, the student will learn selected issues from the area of decision support systems and advanced optimisation methods as synthesis tools.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W02] has a structured knowledge of the application of information systems to improve the reliability, efficiency, speed and mobility of control and management systems	Defines the characteristics of selected advanced control structures and algorithms. Selects advanced control methods for objects/processes based on their characteristics. Defines selected elements of advanced decision support methods.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
[K7_U11] is able to design and realise simple electrical circuits and control systems for a facility or industrial process using computer systems	Uses learned advanced control structures in projects. Implements selected advanced control algorithms. Implements simple decision support systems. Evaluates the quality of operation of applied control systems.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU5] Assessment of ability to present the results of task

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

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. 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.

Course content – project

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.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td></td></tr>
<tr><td>Assessment methods and criteria</td><td>
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<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Lecture Test</td><td>50.0%</td><td>50.0%</td></tr>
<tr><td>Projects Reports</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>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.</td></tr>
<tr><td>Supplementary literature</td><td>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.</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>- 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</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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