GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Fuzzy Control, PG_00048425		
Field of study	Automatic Control, Cybernetics and Robotics		
Date of commencement of studies	February 2024	Academic year of realisation of subject	2024/2025
Education level	second-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	1.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Automatic Control -> Faculty of Electronics, Telecommunications and Informatics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Piotr Fiertek	
	Teachers	dr inż. Piotr Fiertek	

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	Students taking this course get acquainted with the basic elements of the theory of fuzzy sets and fuzzy logic, and learn how this theory can be applied to control of dynamic systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W08] Knows and understands, to an increased extent, the fundamental dilemmas of modern civilisation, the main development trends of scientific disciplines relevant to the field of education.	The student knows the principles of designing fuzzy drivers.	[SW1] Assessment of factual knowledge
[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.	Student has a basic knowledge of the fuzziness paradigm in control structured in the following two parts: (i) fundamental concepts of fuzzy sets theory, fuzzy logic and approximate reasoning, (ii) designing of the classical control systems. Student knows how to use the fuzzy systems approach to solving engineering problems in control.	[SW1] Assessment of factual knowledge
[K7_W06] Knows and understands, to an increased extent, the basic processes taking place in the life cycle of devices, facilities and technical systems.	The student knows the basic processes taking place in fuzzy drivers.	[SW1] Assessment of factual knowledge
[K7_W05] Knows and understands, to an increased extent, methods of process and function support, specific to the field of study.	Student has a basic knowledge of the fuzziness paradigm in control structured in the following two parts: (i) fundamental concepts of fuzzy sets theory, fuzzy logic and approximate reasoning, (ii) designing of the classical control systems. Student knows how to use the fuzzy systems approach to solving engineering problems in control.	[SW1] Assessment of factual knowledge

Subject contents

1. Fuzzy sets theory introduction, basic definitions and examples.
2. Operations of fuzzy sets. Fuzzy relations. The extension principle.
3. Approximate reasoning. Fuzzy propositions. Fuzzy inference rules.
4. Linguistic variables. Fuzzy if-then statements. Fuzzy knowledge based control principle.
5. Structure of fuzzy knowledge based controller: fuzzification module, knowledge base, inference engine, defuzzification module.
6. Mamdani and Takagi Sugeno models. PID-like fuzzy control.
7. MATLAB Fuzzy Logic toolbox.
8. Fuzzy models of dynamic systems. Identification of fuzzy models.
9. Stability in the sense of Lyapunov. An idea of adaptive fuzzy control.
10. Adaptive fuzzy control. Direct and indirect methods of adaptation.
11. Adaptive fuzzy control with a supervisor. Robustness of fuzzy control systems.
12. Internal model control (IMC) principle for fuzzy control.
13. Non-linear fuzzy control. Stability of fuzzy control systems.
14. Optimal fuzzy control systems. Expert systems with fuzzy logic. Process diagnostics based on fuzzy rules.
15. Examples of complex fuzzy control systems.

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Midterm colloquium	50.0%	100.0%

Recommended reading

Basic literature	1. A. Piegat: Modelowanie i sterowanie rozmyte, Exit, 1999. 2. L.-X. Wang: A Course in Fuzzy Systems and Control, Prentice Hall, 1997
Supplementary literature	Yager Ronald R.: *Podstawy modelowania i sterowania rozmytego*, Warszawa: Wydawnictwo Naukowo-Techniczne 1995
eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed

1. Give the definition and an interesting example of fuzzy set.
2. Draw the full functional diagram of a fuzzy inference system. Describe the meaning of each element of such system.
3. Describe the chosen method of defuzzification.
4. What is the T-norm? Give an example of such an operator.
5. What is the core and support (fuzzy set base) of fuzzy set?
6. Describe fuzzy controller based on the *Mamdani* scheme. (How its work? In a few sentences)

Work placement

Not applicable