GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Modelling and Basics of Identification, PG_00058307		
Field of study	Automation, Robotics and Control Systems		
Date of commencement of studies	October 2022	Academic year of realisation of subject	2024/2025
Education level	first-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	3	Language of instruction	Polish
Semester of study	5	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Faculty of Electrical and Control Engineering		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Michał Grochowski	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	30.0	0.0	0.0	60

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	60	8.0	32.0	100

Subject objectives

Presentation of modern methods of systems modeling and estimation of their parameters. Analytical, fuzzy and neural technology will be presented

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U07] can build and analyze models of systems and systems in the field related to control systems and automation	Student potrafi zaplanować przygotować i przeprowadzić eksperymenty, pomiary i symulacje komputerowe do oceny realizacji zadań z zakresu modelowania i identyfikacji systemów	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task
[K6_W07] has basic knowledge related to control and automation systems	- Students is able to build mathematical models of objects and dynamic processes - The student is able to study simulation and experimentally behaviour of of dynamic objects. - The student formulates and solves optimization problems with constraints.	[SW1] Assessment of factual knowledge

Subject contents

LECTURES

1. Deterministic signals - parametric and non parametric models of deterministic signals. Multiplexing, demultiplexing, sampling and extrapolating, A/C and C/A processing. Selected models of deterministic signals. Random signals.
2. System theory in modelling and identification: categories of the systems. Static and dynamic models. Linear and nonlinear models. Continuous and discrete models. Kinds of description. Linearization.
3. Parametric and nonparametric models. Fenomenological modelling, behavioral modelling and mixed modelling grey box modelling. Steps of modeling.
4. Phenomenological modelling: example of models - continuous and discrete, linear and nonlinear, stationary and nonstationary, deterministic and stochastic. Uncertainty modelling. Modelling with usage of fuzzy technology. Fuzzy reasoning systems. Structures of fuzzy models - Mamdani, Larsen, Takagi-Sugeno and Tsukamoto models.
5. Optimisation methods In identification: optimisation problems for parametric models. Criteria of optimisation. Optimisation methods with and without constraints. Fundamentals of usage of the genetic algorithms.
6. Behavioural models and identification: System identification - problems. Linear and nonlinear models considering the parameters. Least squares method. Modelling with usage of neural technologies; training of neural models.
7. Modelling with usage of hybrid techniques; example of advanced applications: neural - fuzzy models and their tuning. Examples of hybrid models .

EXERCISE

- Continuous systems - building of phenomenological models based on principle rules of conservation - Designing of analogue diagrams.
- Linearization.
- Continuous/discrete signals - differences, ways of conversions.
- Discrete systems - definitions, analysis.
- Selected optimisation problems.
- Fuzzy systems - definitions, properties, fuzzy reasoning.

LABORATORY

- Continuous systems - building of phenomenological models based on principle rules of conservation.
- Linearization.
- Modelling of discrete systems.
- Model parameter estimations, Least squares method.
- Fuzzy logic - fundamentals of reasoning.

Prerequisites and co-requisites

There are no requirements

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Laboratory	80.0%	15.0%
Exam	60.0%	70.0%
Exercises	70.0%	15.0%

Recommended reading

Basic literature	1. Roffel, B., Betlem, B. (2006). Process Dynamic and Control. Modelling for Control and Prediction. John Wiley & Sons, Ltd. 2. Hangos,K.M., Cameron,I.T. (2001). Process Modelling and Model Analysis. Academic Press, Ltd. 3. Englezos, P., Kalogerakis, N. (2001). Appled Parameter Estimation for Chemical Engineers. Marcel Dekker, Inc. 4. Ljung, L. (1999). System Identification. Theory for the User. Prentice Hall. 5. Söderström, T., Stoica, P. (1997). Identyfikacja systemów. PWN, Warszawa 1997
Supplementary literature	1. Ljung, L., Glad, T. (1994). Modelling of Dynamic Systems. Prentice Hall. 2. Wellstead, P.E. (2000). Introduction to Physical System Modelling. Academic Press Ltd.
eResources addresses	

Example issues/ example questions/ tasks being completed

- building a complex dynamic plant model in Matlab/Simulink software;
- dynamic model parameter estimation;
- process modeling using fuzzy sets;
- introduction to artificial neural networks.

Work placement

Not applicable