GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Process Diagnostics, PG_00064546		
Field of study	Automatic Control, Cybernetics and Robotics		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2026/2027
Education level	second-cycle studies	Subject group	Optional subject group Specialty 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	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 Decision Systems and Robotics -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Marek Tatara	
	Teachers	dr inż. Marek Tatara mgr inż. Marek Grzegorek	

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	Familiarization with modern methods of diagnostics of industrial processes

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W11] knows and understands, to an increased extent, the general principles of creation and development of forms of individual entrepreneurship and the economic, legal and other conditions of various types of activities related to the awarded qualification, including the principles of protection of industrial property and copyright law	Knows the industrial justification and conditions associated with the implementation of diagnostic systems in industry.	[SW1] Assessment of factual knowledge
[K7_U04] can apply knowledge of programming methods and techniques as well as select and apply appropriate programming methods and tools in computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study, making assessment and critical analysis of the prepared software as well as a synthesis and creative interpretation of information presented with it	Is able to select and apply programming tools (e.g., neural networks, fuzzy logic) to develop fault detection and isolation systems.	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
[K7_U12] is able, to an increased extent, to analyze the operation of components and systems related to the field of study, as well as to measure their parameters and study their technical characteristics, and to plan and carry out experiments related to the field of study, including computer simulations, interpret the obtained results and draw conclusions	Is able to analyze process signals, plan diagnostic experiments, and interpret results obtained from diagnostic models and observers.	[SU1] Assessment of task fulfilment [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 and understands the structure of diagnostic systems, fault detection methods (modelbased, statistical), and symptomfault relationships.	[SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge

Subject contents

Course content – lecture

Fault detection methods: the control of process parameters, examination of limitations (credibility, alarm limits, trends), analysis of signals; control compounds (redundancy, feedback, deterministic and statistical compounds) modeling methods, quality models, fuzzy and neural; Methods and tools for fault location: elements of description of the object and diagnosing system (state of an object, process variables, diagnostic signals, relationship fault-symptoms, binary matrices, arrays of states, isolability, diagnosis), redundancy in hardware, logic, observers (diagnostic systems/banks, observation with unknown inputs, systems robustness), equations and spaces parity (residua, directivity, parity/balance equations), pattern recognition (classical methods of classification, neural classifiers), binary diagnostic matrix (expert knowledge, reasoning, serial, diagnostic trees, contradiction symptoms, parallel reasoning) , Bayesian theory (conditional probability, probabilistic inference) Information System (relationship-damaging symptoms, assessment of multivalent, distinctness, reasoning parallel and serial, reduced systems), fuzzy logic (evaluation of residues, fuzzy inference, fuzzy relationship Diagnostic, fuzzy neural networks).

Course content – project

1. Development of project assumptions: defining the diagnostic object, identifying a set of potential faults, and selecting measurable process signals.
2. Development of the Fault-Symptom Relation (FSR) matrix: formalizing knowledge about the object in the form of a binary or multi-valued diagnostic matrix.
3. Modeling of the diagnostic system: designing residuals, diagnostic equations, or building classification models based on artificial intelligence (e.g., neural networks, fuzzy logic).
4. Software implementation: creating a fault detection and isolation algorithm in a selected programming environment.
5. Evaluation and testing: verification of the system's performance, analysis of fault distinguishability, and robustness to false alarms.
6. Preparation of the final report: developing technical documentation including a description of the methodology, implementation process, and interpretation of the results.

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="3">Knowledge of core and direction subjects for Automation and Robotic s is sufficient.</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="3"><table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><tr><td>Project and project report</td><td>50.0%</td><td>100.0%</td></tr></table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td colspan="2">J.M. Kościelny: Diagnostyka Zautomatyzowanych Procesów Przemysłowych, Akademicka Oficyna Wydawnicza EXIT, Warszawa 2001.
J. Korbicz, J.M. Kościelny, Z. Kowalczuk, W. Cholewa: Fault Diagnosis: Models, Artificial Intelligence, Applications, Springer, Berlin 2004.</td></tr>
<tr><td>Supplementary literature</td><td colspan="2">B.D.O. Andersson, J.B. Moore: Optimal Filtering, Prentice-Hall, Englewood Cliffs 1979.
B.C. Kuo: Automatic Control Systems. Prentice-Hall, Englewood Cliffs 1987.</td></tr>
<tr><td>eResources addresses</td><td colspan="2"></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="3">Research within the scope of fault detection methods: the control of process parameters, examination of limitations (credibility, alarm limits, trends), analysis of signals; control compounds (redundancy, feedback, deterministic and statistical compounds) modeling methods, quality models, fuzzy and neural; Methods and tools for fault location: elements of description of the object and diagnosing system (state of an object, process variables, diagnostic signals, relationship fault-symptoms, binary matrices, arrays of states, isolability, diagnosis), redundancy in hardware, logic, observers (diagnostic systems/banks, observation with unknown inputs, systems robustness), equations and spaces parity (residua, directivity, parity/balance equations), pattern recognition (classical methods of classification, neural classifiers), binary diagnostic matrix (expert knowledge, reasoning, serial, diagnostic trees, contradiction symptoms, parallel reasoning) , Bayesian theory (conditional probability, probabilistic inference) Information System (relationship-damaging symptoms, assessment of multivalent, distinctness, reasoning parallel and serial, reduced systems), fuzzy logic (evaluation of residues, fuzzy inference, fuzzy relationship Diagnostic, fuzzy neural networks).</td></tr>
<tr><td>Practical activites within the subject</td><td colspan="3">Not applicable</td></tr>
</table>

Document generated electronically. Does not require a seal or signature.