GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Diagnostics of nanoscale structural changes, PG_00071214		
Field of study	Nanotechnology		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2026/2027
Education level	second-cycle studies	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	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Marek Chmielewski	
	Teachers	dr inż. Marek Chmielewski	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	6.0	0.0	24.0	0.0	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	1.0	44.0	75

Subject objectives

The aim of the course is to present the possibilities of using non-destructive and destructive diagnostic techniques, based mainly on magnetomechanical phenomena, for the purpose of monitoring structural changes at the domain boundary level and stress changes of all types. The experimental part of the course will involve the use of, among other things, the acoustic Barkhausen effect and the mechanical Barkhausen effect.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U04] is able to formulate hypotheses, plan and conduct experimental research, critically analyze results, verify hypotheses, draw conclusions, and formulate well-founded opinions within nanotechnology and related physical and natural sciences. Recognizes economic and non-technical aspects of the activities performed	In carrying out tasks related to the topics of laboratory student will know the correct methods of carrying out the experiment, will be able to realize and understand the need for multi-track analysis of the results. Properly provide calibration procedures, and effectively uses these results to determine the unknown parameters of the measured elements	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools
[K7_U06] is able to apply acquired specialist knowledge to problems in other physical, natural, or technical sciences and to critically analyze and evaluate the functioning of the adopted solutions	The student presents and defends their analysis of measurement results. They learn to use complementary techniques to confirm their results and conclusions derived from their analysis.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information

Subject contents

Course content – lecture
Discussion of ways to use the magnetic properties of ferromagnetic materials to study mechanical properties, structural changes, and stress effects. Analysis of phenomena related to reversible and irreversible magnetization processes in ferromagnetic materials.

Course content – laboratory
All effects discussed during the lectures will be experimentally verified during the laboratory sessions. Systems will be used to measure voltage pulses of the classic Barkhausen effect, the acoustic Barkhausen effect, and the mechanical variant of the phenomenon, with the latter additionally utilizing adaptive techniques and measurement software elements.

Prerequisites and co-requisites

Basics of programming measuring devices. Basics of LabVIEW, Python

<table>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Test on lecture topics</td><td>60.0%</td><td>40.0%</td></tr>
<tr><td>Evaluation of laboratory reports</td><td>100.0%</td><td>60.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>"Physics of Ferromagnetism"; by Soshin Chikazumi (Author), C. D. Graham (Editor); Clarendon Press; International Series of Monographs on Physics (49 books), 1997

"Barkhausen Noise Analysis and Ferromagnetic Materials"; by Douglas J. Strand (Author); PN 1989</td></tr>
<tr><td>Supplementary literature</td><td>None</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">Magnetic domain, domain boundaries

Energy losses in magnetization processes

Faraday effect in measuring systems, eddy currents</td></tr>
<tr><td>Practical activites within the subject</td><td colspan="2">Not applicable</td></tr>
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