GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Magnetic Properties of Materials and Nanomaterials, PG_00069349		
Field of study	Nanotechnology		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2026/2027
Education level	first-cycle studies	Subject group	
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish
Semester of study	4	ECTS credits	2.0
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 hab. inż. Leszek Piotrowski	
	Teachers	dr hab. inż. Leszek Piotrowski	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	21.0	0.0	9.0	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	3.0	17.0	50

Subject objectives

The aim of the course is to introduce the practical aspects of magnetism of materials . Volumetric materials with a classical division into diamagnets , paramagnetics and ferromagnets will be discussed . The second part will discuss the magnetism of nanomaterials and the basics of spintronics , with particular emphasis on the practical applications of nanometer sized materials .

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U04] can plan and conduct experiments, critically analyze their results, draw conclusions and formulate opinions. Has laboratory experience.	The student has a practical ability to measure the basic magnetic properties of bulk materials	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject
[K6_W09] Has knowledge of the structure and operation of scientific instruments, measuring and test equipment and in the field of planning and conducting a physical experiment and critical analysis of its results.	He has knowledge of measurement methods used in the case of thin films and nanoparticles.	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture
Lecture content

1 . Basic magnetic quantities 2 . Magnetism in solids , types of magnetic materials (dia - para - and ferromagnetics) 4 . Ferromagnetism , domain structure , coercive mechanisms . Applications of bulk materials permanent magnets , electromagnets . 5 . Magnetism of small particles , monodomain particles (Wohlfarth Stoner model). 8 Experimental techniques for determining properties magnetic and magnetic . Visualization and analysis of the domain structure . 6 . Thin Layers 7 . Magnetic Recording 8 Nano Magnetic Particles and Superparamgneticism . 9 Applications of magnetic nanoparticles in medicine .
Laboratory tasks : 1 . Hysteresis loop measurements 2 . Effect of demagnetization on magnetization of materials 3 . Effect of heat treatment on hysteresis loop parameters

Prerequisites and co-requisites

<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>Lab reports</td><td>50.0%</td><td>30.0%</td></tr>
<tr><td>Written exam</td><td>50.0%</td><td>70.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>J. Stohr, H.C. Siegmann; Magnetism From Fundamentals toNanoscale Dynamics; Springer, 2006</td></tr>
<tr><td>Supplementary literature</td><td>1. Handbook of Spin Transport and Magnetism; Ed. E.Y. Tsymbal, I.Žutić; CRC Press 2012.</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">What is the difference between electromagnet core material and permanent magnet material ?
What is the effect of temperature on ferromagnetic materials ?
What are the causes of magnetocrystalline anisotropy ?
Discuss how to write to your hard drive What is spin - orbit coupling ?
How does a spin valve work ? Give examples of applications of magnetic materials in medicine .</td></tr>
<tr><td>Practical activites within the subject</td><td colspan="2">Not applicable</td></tr>
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