GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00066146					
Field of study	Materials Engineering					
Date of commencement of studies	October 2023		Academic year of realisation of subject		2024/2025	
Education level	first-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	4		ECTS credits		1.0	
Learning profile	general academic profile		Assessment form		assessment	
Conducting unit	Division of Ceramics -> Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics					
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Aleksandra Mielewczyk-Gryń				
	Teachers	dr hab. inż. Aleksandra Mielewczyk-Gryń				
		mgr inż. Piotr Okoczuk				

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	7.0	0.0	6.0	0.0	0.0	13
	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	13	2.0	15.0	30

Subject objectives	The aim of the course is to present the fundamentals of techniques related to thermal analysis.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_W02] has knowledge of physics and chemistry, useful for formulating and solving simple problems within the scope of materials science	Has knowledge in physics and chemistry useful for formulating and solving basic problems in materials science related to thermal analysis.	[SW1] Assessment of factual knowledge
	[K6_W06] Knows selected methods, techniques, tools and materials used in solving simple engineering problems within the scope of materials engineering.	Has knowledge of selected methods, techniques, tools, and materials used to solve basic engineering problems in the field of materials engineering using thermal analysis methods.	[SW1] Assessment of factual knowledge
	[K6_U02] Can operate typical laboratory equipment and analyze material tests	Is capable of operating standard laboratory equipment and conducting material analyses using thermal analysis methods.	[SU5] Assessment of ability to present the results of task [SU2] Assessment of ability to analyse information

Subject contents	
	1. Introduction to Thermal Analysis • Basic concepts and definitions • Classification of thermal analysis methods • Applications of thermal analysis in materials science **2. Thermal Analysis Techniques** • Thermogravimetry (TG) fundamentals, equipment, result interpretation • Differential Scanning Calorimetry (DSC) operating principles, thermal effects analysis • Dynamic Mechanical Analysis (DMA) measurement of mechanical properties as a function of temperature • Differential Thermal Analysis (DTA) characteristics and applications • Thermomechanical Analysis (TMA) study of thermal expansion of materials **3. Equipment and Measurement Methods** • Description of the structure and operation of typical devices • Calibration and quality control of measurements • Experimental conditions **4. Examples of Thermal Analysis Applications** • Studies on polymers, ceramics, metals, and alloys • Phase characterization and thermal stability of materials • Thermal degradation and kinetic analysis of decomposition processes **5. Data Interpretation and Analysis** • Processing of thermal curves • Influence of experimental conditions on results • Computational methods and modeling of thermal processes **6. Practical Aspects of Thermal Analysis** • Planning and conducting experiments • Discussion of measurement errors and influencing factors • Comparison of different thermal analysis methods **7. Modern Developments in Thermal Analysis** • Integration of thermal analysis with other research techniques (e.g., FTIR spectroscopy, XRD) • Application of artificial intelligence and big data analysis in result interpretation • Innovative materials and technologies in thermal studies

Prerequisites and co-requisites	

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
final test	50.0%	50.0%
laboratories	0.0%	50.0%

Recommended reading

Basic literature	"Thermal Analysis: Fundamentals and Applications to Polymer Science" Autor: Jean-Baptiste
Supplementary literature	Principles of Thermal Analysis and Calorimetry" by Peter O'Neill
eResources addresses	Podstawowe https://gateformme.files.wordpress.com/2017/04/principles-and-applications-of-thermal-analysis.pdf - Applications of thermal analysis / edited by Paul Gabbott Adresy na platformie eNauczanie: Analiza termiczna - moduł 2024/2025 - Moodle ID: 44376 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=44376

Example issues/ example questions/ tasks being completed	1. **Definition of Thermal Analysis** What is thermal analysis? What are its basic methods?
	2. **Types of Thermal Analyses** Name and briefly describe the basic thermal analysis techniques (e.g., DSC, TGA, DTA, TMA).
	3. **Temperature Measurement in Thermal Analysis** What temperature measurement methods are used in thermal analyses?
	4. **Thermal Expansion Phenomenon** What is the thermal expansion of a material, and how is it measured using TMA?
	5. **DSC (Differential Scanning Calorimetry)** Describe the working principle of a DSC device and its applications. What information can be obtained using this method?
	6. **TGA (Thermogravimetric Analysis)** Explain the working principle of the TGA method and provide examples of its applications in material studies.
	7. **Phase Transition Phenomenon** What is a phase transition? What are examples of phase transitions detected in thermal analysis?
	8. **Material Degradation** How can thermal analysis help in studying material degradation processes? Provide examples.
	9. **Differential Calorimetry (DSC)** What types of processes can be measured using DSC (e.g., melting, crystallization, exothermic reactions)?
	10. **Calculations in Thermal Analysis** What calculations can be performed based on the results from thermal analysis (e.g., mass change, reaction energy)?
	11. **Applications of Thermal Analysis in Industry** How is thermal analysis used in various industries, such as the chemical, food, and materials industries?
Work placement	Not applicable

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