



Subject card

Subject name and code	Thermal Analysis, PG_00069348						
Field of study	Nanotechnology						
Date of commencement of studies	October 2024		Academic year of realisation of subject		2025/2026		
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	2		Language of instruction		Polish		
Semester of study	4		ECTS credits		2.0		
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 -> Wydział Politechniki Gdańskiej						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Aleksandra Mielewczyk-Gryń				
	Teachers		dr hab. inż. Aleksandra Mielewczyk-Gryń				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	6.0	0.0	0.0	9.0	0.0	15
	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	15		2.0		33.0	50
Subject objectives	The aim of the course is to introduce students to the fundamentals of techniques related to the thermal analysis of materials. Students will learn the principles of operation and the capabilities of various thermal analysis methods, including calorimetric and thermogravimetric techniques. The course enables students to understand how thermal studies allow for the assessment of the physicochemical properties of materials, the detection of phase transitions, and the analysis of the thermal stability of substances and nanomaterials.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[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.		The student knows the basic techniques of thermal analysis, including calorimetric methods (DSC, Calvet) and thermogravimetric methods (TGA), understands the principles of their operation and their applications in assessing material properties, and has knowledge of how to interpret thermal measurement results and their limitations.		[SW1] Assessment of factual knowledge		
	[K6_U02] can analyze and solve simple scientific and technical problems based on possessed knowledge, applying analytical, numerical, simulation and experimental methods.		The student is able to perform basic thermal measurements using available laboratory equipment, can analyze and interpret data obtained from thermal experiments, and is able to select the appropriate thermal analysis method depending on the type of material and the purpose of the study.		[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information		

Subject contents	<p>1. Introduction to Thermal Analysis</p> <ul style="list-style-type: none"> • Basic concepts and definitions • Classification of thermal analysis methods • Applications of thermal analysis in materials science <p>2. Thermal Analysis Techniques</p> <ul style="list-style-type: none"> • 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 <p>3. Equipment and Measurement Methods</p> <ul style="list-style-type: none"> • Description of the structure and operation of typical devices • Calibration and quality control of measurements • Experimental conditions <p>4. Examples of Thermal Analysis Applications</p> <ul style="list-style-type: none"> • Studies on polymers, ceramics, metals, and alloys • Phase characterization and thermal stability of materials • Thermal degradation and kinetic analysis of decomposition processes <p>5. Data Interpretation and Analysis</p> <ul style="list-style-type: none"> • Processing of thermal curves • Influence of experimental conditions on results • Computational methods and modeling of thermal processes <p>6. Practical Aspects of Thermal Analysis</p> <ul style="list-style-type: none"> • Planning and conducting experiments • Discussion of measurement errors and influencing factors • Comparison of different thermal analysis methods <p>7. Modern Developments in Thermal Analysis</p> <ul style="list-style-type: none"> • 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		

Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"> 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

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