GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Thermal Analysis, PG_00069348		
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	Division of Ceramics -> 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. Aleksandra Mielewczyk-Gryń	
	Teachers	dr hab. inż. Aleksandra Mielewczyk-Gryń	

Lesson types

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_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.	[SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools
[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

Subject contents

Course content – lecture

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
laboratories	0.0%	50.0%
final test	50.0%	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	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?
Practical activites within the subject	Not applicable

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