



Subject card

Subject name and code	Electrical Methods of Material Characterisation, PG_00070177						
Field of study	Hydrogen Technologies and Electromobility						
Date of commencement of studies	February 2026	Academic year of realisation of subject	2025/2026				
Education level	second-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	1	Language of instruction	Polish				
Semester of study	1	ECTS credits	3.0				
Learning profile	general academic profile	Assessment form	exam				
Conducting unit	Department of Functional Materials Engineering -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Piotr Jasiński					
	Teachers	prof. dr hab. inż. Piotr Jasiński mgr inż. Bartłomiej Lemieszek mgr inż. Justyna Ignaczak dr inż. Maciej Haras					
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	15.0	0.0	0.0	45
	E-learning hours included: 0.0						
	eNauczanie source addresses: Moodle ID: 5612 Elektryczne metody charakteryzacji materiałów https://enauzanie.pg.edu.pl/2025/course/view.php?id=5612						
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	45	3.0	27.0	75		
Subject objectives	The aim of the course is to provide in-depth knowledge of the electrical methods of materials characterisation and to develop the ability to apply them in practice. Students learn DC and AC conductivity measurement techniques, methods for measuring sheet and contact resistance, as well as thermoelectric phenomena and the determination of transport numbers. In the laboratory they perform measurements independently, select the method appropriate to the material studied, and interpret the results. The course prepares students for materials characterisation in research.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_U02] can perform tasks related to the field of hydrogen technologies and electromobility as well as formulate and solve problems applying recent knowledge of physics and other areas of science	The student is able to solve measurement problems in the electrical characterisation of materials, applying knowledge of solid-state physics and electrochemistry, select an appropriate technique to determine a given property, and assess the limitations and sources of error of the method used.	[SU2] Assessment of ability to analyse information
	[K7_W01] knows and understands, to an increased extent, mathematics to the extent necessary to formulate and solve complex issues related to the field of hydrogen technologies and electromobility	The student knows and understands the mathematical foundations for describing the electrical properties of materials, including the functional relationships of the characteristics, fitting models to measured data, and uncertainty analysis, necessary for the quantitative interpretation of characterisation results.	[SW2] Assessment of knowledge contained in presentation
	[K7_U12] is able, to an increased extent, to analyze the operation of components and systems related to the field of hydrogen technologies and electromobility, as well as to measure their parameters and study their technical characteristics, and to plan and carry out experiments related to the field of hydrogen technologies and electromobility, including computer simulations, interpret the obtained results and draw conclusions	The student is able to plan and perform measurements of the electrical properties of materials (DC and AC conductivity, current-voltage characteristics, temperature dependences), select the measurement method and geometry appropriate to the material studied, and interpret the obtained results and draw conclusions about the electrical properties of the examined systems.	[SU4] Assessment of ability to use methods and tools
	[K7_W02] knows and understands, to an increased extent, selected laws of physics and physical phenomena, as well as methods and theories explaining the complex relationships between them, constituting advanced general knowledge in the field of technical sciences related to the hydrogen devices, systems, installations, and automation systems	The student knows and understands the physical phenomena underlying the electrical methods of materials characterisation (electronic and ionic conduction, dielectric polarisation, charge transport phenomena), as well as the operating principles, range of applicability and limitations of the measurement techniques used.	[SW1] Assessment of factual knowledge
Subject contents	<p>Course content – lecture</p> <p>W1 – Fundamentals of electrical conduction. DC methods of conductivity measurement: two- and four-point configurations.</p> <p>W2 – Advanced DC measurements: measurement configurations, contact and sheet resistance, the van der Pauw method, sources of error.</p> <p>W3 – AC measurement methods: conductometry, electrode polarisation, fundamentals of impedance spectroscopy in materials characterisation.</p> <p>W4 – Reference electrode: types, operating principle and correct potential measurement in electrochemical systems.</p> <p>W5 – Thermoelectric effect: history, physics and measurement of the Seebeck coefficient.</p> <p>W6 – Transport numbers: separation of ionic and electronic conduction, methods of determination.</p> <p>Course content – laboratory</p> <p>L1 – Resistance measurement by two- and four-point methods; elimination of contact resistance, determination of resistivity and conductivity.</p> <p>L2 – Conductometry of aqueous solutions: AC conductivity measurement, polarisation effects, 2- and 4-electrode cells.</p> <p>L3 – Resistivity and conductivity measurement by the van der Pauw method; effect of geometry and contacts on accuracy.</p> <p>L4 – Sheet resistance measurement with a four-point probe; geometric correction factors.</p> <p>L5 – Contact resistance (ASR) measurement by DC and single-frequency EIS; temperature dependence and the nature of conduction in the layers.</p>		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	test	50.0%	60.0%
	laboratory (reports)	50.0%	40.0%
Recommended reading	Basic literature	D.K. Schroder, Semiconductor Material and Device Characterization, Wiley, Hoboken, 2006.	

	Supplementary literature	E. Barsoukov, J.R. Macdonald, Impedance Spectroscopy: Theory, Experiment, and Applications, Wiley, Hoboken, 2018. L.J. van der Pauw, A method of measuring specific resistivity and Hall effect of discs of arbitrary shape, Philips Research Reports, 1958.
	eResources addresses	
Example issues/ example questions/ tasks being completed	Differences between two- and four-point methods; principle of the van der Pauw method; measurement and interpretation of sheet resistance; ASR measurement by DC and EIS and distinguishing metallic from semiconducting conduction; physics and measurement of the Seebeck coefficient; transport numbers.	
Practical activities within the subject	Not applicable	

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