GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	High Frequency Measurement Automation , PG_00048663						
Field of study	Electronics and Telecommunications						
Date of commencement of studies	February 2026		Academic year of realisation of subject	2025/2026			
Education level	second-cycle studies		Subject group	Optional subject group Specialty 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	1		Language of instruction	Polish			
Semester of study	1		ECTS credits	2.0			
Learning profile	general academic profile		Assessment form	exam			
Conducting unit	Department Of Microwave And Antenna Engineering -> Faculty Of Electronics Telecommunications And Informatics -> Wydziały Politechniki Gdańskiej						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Rafał Lech					
	Teachers	dr hab. inż. Rafał Lech					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	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		4.0	16.0		50
Subject objectives	Familiarizing yourself with the measurements methods and techniques of basic parameters which are necessary, from a practical point of view, to evaluate the performance of the RF devices and systems.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W03] knows and understands, to an increased extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum	The student knows the structure of the spectrum analyzer and network analyzer in the full version as well as its simplified implementations and on this basis selects the appropriate calibration method to calibrate the microwave analyzer in the high frequency range and carry out measurements of the basic parameters of RF elements.	[SW1] Assessment of factual knowledge
[K7_W04] knows and understands, to an increased extent, the principles, methods and techniques of programming and the principles of computer software development or programming devices or controllers using microprocessors or other elements or programmable devices specific to the field of study, and organization of work of systems using computers or such devices	The student is able to interpret and process measurement results. The student knows the embedding and de-embedding methods that allow the measured object to be embedded into a network of virtually existing systems, or to remove unwanted parts of the measured object from the measurement results.	[SW1] Assessment of factual knowledge
[K7_U12] is able, to an increased extent, to analyze the operation of components and systems related to the field of study, as well as to measure their parameters and study their technical characteristics, and to plan and carry out experiments related to the field of study, including computer simulations, interpret the obtained results and draw conclusions	The student measures the parameters of single- or multi-port RF systems using a network analyzer, spectrum analyzer or reflectometer and evaluates the performance of the measured system based on the obtained results. The student is able to select the appropriate network analyzer calibration method, is able to calibrate a microwave analyzer in the high-frequency range and perform measurements of basic parameters of RF components and systems.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
[K7_W10] knows and understands, to an increased extent, the basic processes occurring in the life cycle of equipment, objects and technical systems, as well as methods of supporting processes and functions, specific to the field of study	The student knows the structure of a spectrum analyzer and a network analyzer, which allows understanding the principle of their operation and selecting appropriate calibration methods	[SW1] Assessment of factual knowledge

Subject contents

Lecture1. Specifics of microwave measurement, matrix description of electronic systems, attenuation measurement, multipoint methods of measuring dispersion parameters, frequency reflectometry, time reflectometry2. Vector network analyzer: Fundamentals of measurements of RF systems, construction of a vector network analyzer, error model, measurement procedure, setting parameters, simplified VNA implementations.3. Vector network analyzer: Correction of random measurement errors, correction of systematic errors, calibration standards, calibration techniques, calibration verification.4. Vector network analyzer: Description of measurements using VNA.5. Spectrum analyzers: measurement capabilities, construction, signal sampling techniques, detector selection. Laboratory1. Reflectometric measurements of RF systems in the frequency domain - The aim of the exercise is to learn the principle of reflectometric measurements of RF system parameters in the frequency domain.2. Frequency and time domain measurements of RF systems - The aim of the exercise is to learn about different methods of measuring and presenting RF system results using an automatic microwave network analyzer.3. Time domain measurements of RF systems - The aim of the exercise is to learn about different methods of measuring RF components and systems using time domain reflectometry.4. Spectrum analyzer - The aim of the exercise is to learn about basic settings and perform basic measurements using a spectrum analyzer.5. Calibration of a vector network analyzer - The aim of the exercise is to learn about methods of calibrating a vector network analyzer to measure systems in the very high frequency range.

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Exam	50.0%	50.0%
Lab. reports	50.0%	50.0%

Recommended reading

Basic literature	1) Christoph Rauscher: "Fundamentals of Spectrum Analysis", Rohde & Schwarz GmbH & Co. KG, 5th Ed., Monachium, 2007 2) Michael Hiebel: "Fundamentals of Vector Network Analysis", Rohde & Schwarz GmbH & Co.KG, 1st Ed., Monachium, 2007
Supplementary literature	brak
eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	1. Briefly compare the advantages and disadvantages of hardware and software reflectometry 2. Time reflectometry in RF measurements 3. Briefly compare electronic and mechanical calibration of vector network analyzer 4. Reflectometric measurement method for measuring reflection parameters. 5. Block diagram of the reflectometer for measuring the modules of reflection and transmission parameters. 6. Calibration techniques of vector network analyzer. 7. Discuss selected reflectometric system to measure reflection parameter. 8. Block diagram and operation of the vector network analyzer. 9. Discuss the selected implementations of simplified vector network analyzer.
Work placement	Not applicable

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