



Subject card

Subject name and code	Microwave Engineering, PG_00048081						
Field of study	Electronics and Telecommunications						
Date of commencement of studies	October 2022	Academic year of realisation of subject			2024/2025		
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	3	Language of instruction			Polish		
Semester of study	6	ECTS credits			2.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Department of Microwave and Antenna Engineering -> Faculty of Electronics, Telecommunications and Informatics						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Rafał Lech					
	Teachers	dr inż. Małgorzata Warecka 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	2.0		18.0	50	
Subject objectives	Student acquainted with the basic operation principles, parameters and design methods of the waveguides and microwave circuits The guides include waveguides and transmission lines with TEM wave. Procedures for microwave circuit design, including lumped elements circuits, microwavel dividers, couplers , phase shifters and non-reciprocal ferrite devices are determined on the base of their scattering matrix.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K6_W34] Knows the characteristics of telecommunications channels, methods of securing information, modulation systems, methods of access to the channel.	student acquainted with the basic operation principles, parameters and design methods of the waveguides and microwave circuits The guides include waveguides and transmission lines with TEM wave. Procedures for microwave circuit design, including lumped elements circuits, microwavel dividers, couplers , phase shifters and non-reciprocal ferrite devices are determined on the base of their scattering matrix.			[SW1] Assessment of factual knowledge		
	[K6_U05] can plan and conduct experiments related to the field of study, including computer simulations and measurements; interpret obtained results and draw conclusions	Student acquainted with the basic operation principles, parameters and design methods of the waveguides and microwave circuits The guides include waveguides and transmission lines with TEM wave. Procedures for microwave circuit design, including lumped elements circuits, microwavel dividers, couplers , phase shifters and non-reciprocal ferrite devices are determined on the base of their scattering matrix.			[SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools		

Subject contents	<p>Lecture1. Waveguides and resonators: rectangular, cylindrical, ridge, dielectric, technology, equivalent circuits and their parameters, loop excitation, dipole2. Coaxial and strip lines and resonators, multi-conductor TEM lines, technology, equivalent circuit, higher types of field TM, TM, coaxial junctions3. Integrated lines and resonators; microstrip, slot, coplanar, equivalent circuits and wave parameters and natural frequencies of the basic type, surface waves, higher types of field4. Planar and layer-coupled strip lines, microstrip, slot; even and odd types, their equivalent circuits and wave parameters.5. Impedance matching methods - tuning devices6. Design of multi-section impedance transformers with maximally flat and Chebyshev characteristics7. Principles of designing non-uniform impedance transformers8. Discontinuities in waveguides, strip lines and microstrip lines and their equivalent circuitsLaboratory1. Measurement of single- and multi-port planar systems - The aim of the exercise is to familiarize yourself with the operation and measurement of passive planar systems parameters such as: antennas, branches, and crossed lines.2. Examination of filtering structures - The aim of the exercise is to familiarize yourself with the operation of filtering structures made in various technologies: resonators, filters and diplexers.3. Mutual and non-mutual multi-port systems - The aim of the exercise is to familiarize yourself with the operation of mutual multi-port systems (couplers made in various technologies) and non-mutual (three- and four-port circulators).4. Measurement of lumped constant elements using the high-frequency technique - The aim of the exercise is to become familiar with the behaviour of lumped constant elements connected to high-frequency signal sources.</p>											
Prerequisites and co-requisites	No requirements											
Assessment methods and criteria	<table border="1" data-bbox="451 573 1487 678"> <thead> <tr> <th data-bbox="451 573 794 607">Subject passing criteria</th> <th data-bbox="794 573 1137 607">Passing threshold</th> <th data-bbox="1137 573 1487 607">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="451 607 794 640">Laboratory exercises</td> <td data-bbox="794 607 1137 640">40.0%</td> <td data-bbox="1137 607 1487 640">40.0%</td> </tr> <tr> <td data-bbox="451 640 794 678">Assessment after the lecture</td> <td data-bbox="794 640 1137 678">60.0%</td> <td data-bbox="1137 640 1487 678">60.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Laboratory exercises	40.0%	40.0%	Assessment after the lecture	60.0%	60.0%
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Laboratory exercises	40.0%	40.0%										
Assessment after the lecture	60.0%	60.0%										
Recommended reading	Basic literature	<p>S. Rosłonec "Liniowe obwody mikrofalowe" WKŁ 1999 2.</p> <p>R. Lech - lectures material eNauczanie</p> <p>Kowalczyk P., Lech R., Mazur J., Technika wysokich częstotliwości w zadaniach, Wydawnictwo PG 2022</p> <p>D.M. Pozar "Microwave engineering" J. Willey&Sons, 1998</p>										
	Supplementary literature	No requirements										
	eResources addresses	<p>Adresy na platformie eNauczanie:</p> <p>Inżynieria Mikrofalowa - 24/25 - Moodle ID: 43899 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=43899</p>										
Example issues/ example questions/ tasks being completed	a list of sample questions for the exam can be found in the course on the eNauczanie platform											
Work placement	Not applicable											

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