GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Antennas in Satellite Communication, PG_00065866		
Field of study	Anteny w komunikacji satelitarnej		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	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	2	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Microwave and Antenna 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. Włodzimierz Zieniutycz	
	Teachers	dr inż. Małgorzata Warecka prof. dr hab. inż. Włodzimierz Zieniutycz dr hab. inż. Rafał Lech	

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	30.0	15.0	0.0	75
	E-learning hours included: 0.0						
	eNauczanie source addresses: Moodle ID: 694 Anteny w komunikacji satelitarnej - TKiS 25/26 https://enauczanie.pg.edu.pl/2025/course/view.php?id=694						

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	75	10.0	40.0	125

Subject objectives	The aim of the course is to give the students the knowledge of theory, construction and measurement technique of antenna parameters taking into account the specifics the resulting from the applications in space and satellite technologies.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U07] Identifies and describes technical problems and is able to solve them choosing the relevant methods and tools. Is able to select and use the appropriate, also the advanced, IT solution for the specific problem in the field of space and satellite technologies.	He can measure the electric parameters (e.g. radiation pattern, gain) of selected antennas and arrays used in space application.	[SU1] Ocena realizacji zadania [SU2] Ocena umiejętności analizy informacji [SU4] Ocena umiejętności korzystania z metod i narzędzi
[K7_W04] Knows and understands, to an increased extent, processes occurring in the life cycle of equipment, objects and technical systems, including software systems.	Has knowledge on the space specifics and its influence on the design, technology and measurement methods of electric parameters of the antennas and arrays operating in space.	[SW1] Ocena wiedzy faktograficznej [SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym
[K7_W06] Has well-ordered and extended knowledge on ICT in space and satellite engineering. Has well-ordered and extended knowledge about potential, methods and application areas of satellite remote sensing and Earth observation as well as about the structure of individual segments, principles of operation and applications of satellite navigation systems.	Has knowledge on the specificity of the wireless channel used in space application	[SW1] Ocena wiedzy faktograficznej [SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym

Subject contents

Course content – lecture

1. Electrical and magnetic fields, basic laws of electromagnetism.
2. Wave guide: characteristic impedance, reflection coefficient, standing wave ratio.
3. Impedance matching techniques, Smith chart.
4. Wave guides and resonators.
5. Scattering matrix.
6. Electromagnetic frequency bands, basics of radiation theory and electromagnetic wave guiding, quantitative description of field phenomena.
7. Antenna parameters: radiation pattern, gain, effective antenna aperture, polarization parameters, noise parameters.
8. Theory of antenna array, the concept of array factor, , homogeneous and nonhomogeneous linear array, planar array, beam forming systems.
9. Overview of selected types of antennas: dipoles and their power supply systems, biconical, helical, spiral antennas,tubes, microstrip antennas, slot, reflector antennas.
10. Earthly space and space as a specific working environmentsfor antennas - factors determining the choice of material and the process of designing and antennas construction.
11. Antenna measurement: environmental measurements, antenna parameters measurement: radiation pattern, gain, ellipticity, reflection.
12. Final test.

Course content – laboratory

1. Measurement of WFS in a microstrip line; wavelength in a microstrip line; calculation of relative permittivity.
2. Impedance matching methods - impedance transformers. design and measurement of half- and quarter-wave transformers.
3. Getting to know with the PCAAD program, the concept of the impedance matching, reflection coefficient.
4. Numerical analysis of the properties of linear and planar antenna arrays and the dependence of amplitudes and phases of single radiators on the array radiation patterns.
5. Measuring lumped constant elements using very high frequency techniques. Getting to know the network analyzer operation.
6. Measurement of resonators and filters operating in the high frequency range.
7. Testing antenna parameters using a vector network analyzer.
8. Designing a rectangular microstrip antenna.
9. Designing a half-wave dipole.
10. Designing fabication and measurements of a 3dB branch coupler.

Course content – project

1. Analysis of transmitter and antenna connection via transmission line
2. Designing a branch coupler using the ADS MOMENTUM software.

Prerequisites and co-requisites

Basic of electromagnetics

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
project	50.0%	30.0%
written test from lecture	50.0%	40.0%
reports from laboratory	50.0%	30.0%

Recommended reading	Basic literature	1. P. Kowalczyk, R. Lech, W. Zieniutycz "Podstawy elektromagnetyzmu w zadaniach", Wydawnictwo Politechniki Gdanskiej, Gdansk 2007 (in Polish). 2. P. Kowalczyk, R. Lech, W. Zieniutycz "Pola i Fale Elektromagnetyczne w Zadaniach", Wydawnictwo Politechniki Gdanskiej, Gdansk 2015 (in Polish). 3. P. Kowalczyk, R. Lech, J. Mazur: "Technika Wysokich Częstotliwości w Zadaniach", Wydawnictwo Politechniki Gdanskiej, Gdansk 2022 (in Polish). 4. D. Pozar "Microwave engineering" J.Willey&Sons, 1998. 5. C. A. Balanis: Antenna Theory, Analysis and Design, John Wiley, 1982. 6. W. A. Imbriale, S. Gao, L. Boccia: Space Antenna handbook, J. Wiley, 2012. 7. W. Zieniutycz: Anteny - podstawy polowe, WKŁ, 2001 (in Polish).
	Supplementary literature	1. G. E. Evans: Antenna Measurement Techniques, Artech House, 1990.
	eResources addresses	
Example issues/ example questions/ tasks being completed	1. Present and discuss the law of Faraday 2. Reflection coefficient and standing wave ratio. 3. The characteristic impedance of the TEM line. 4. The cutoff frequency in the waveguide - single mode operation in waveguides. 5. Matching circuits: single-stub. 6. Define the gain of antenna. 7. The angular spectrum - discuss the application in antenna measurement. 8. Discuss the properties of biconical antenna. 9. Discuss the formula on reflector antenna directivity.	
Practical activites within the subject	Not applicable	

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