GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Next Generation Radio Communication Systems, PG_00047461		
Field of study	Electronics and Telecommunications		
Date of commencement of studies	February 2026	Academic year of realisation of subject	2026/2027
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	2	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department Of Radiocommunication Systems And Networks -> Faculty Of Electronics Telecommunications And Informatics -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Sławomir Gajewski	
	Teachers	dr inż. Sławomir Gajewski	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	0.0	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

The aim of the course is to familiarize students with problem issues and functioning rules relating to radio communication cellular systems of new generation.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[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 understands the principles of operation of individual components of radio communication systems. The student knows the principles of their design.	[SW1] Assessment of factual knowledge
[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 can analyse technical problems in radio communication systems. Understands the structure and operating principles of new generation cellular systems.	[SW1] Assessment of factual knowledge
[K7_K02] is ready to provide critical evaluation of received content and to acknowledge the importance of knowledge in solving cognitive and practical problems	The student can critically evaluate system solutions.	[SK5] Assessment of ability to solve problems that arise in practice

Subject contents	1) Development of cellular networks and ITU and 3GPP standardisation. 2) Basic requirements and frequency ranges for 4G, 5G and 6G cellular systems. 3) General characteristics of LTE-Advanced Pro and 5G NR systems, basic technical parameters and properties of 4G and 5G systems, and IoT components. 4) Multi-system and convergent cellular network - the process of network evolution and components' role from 2G to 6G. 5) Heterogeneous network, cellular structures in new generation systems. 6) 4G LTE and 5G NR network architectures, software architecture, and network functions. 7) Software-defined networks SDN and virtualisation of network functions (VNF). 8) Logical subnets implementation (Network Slicing) in the physical network. 9) Architecture of radio access networks RAN (4G) and NG RAN (5G). Access networks: open RAN, virtualised RAN, AI-based RAN, cloud RAN, centralised RAN. 10) General characteristics of the radio interface in 4G LTE and 5G NR systems, OFDM and SC-FDM transmission, modulation, channel coding, code-modulation schemes, and technical parameters. 11) Problems of physical resources management in 4G and 5G networks. 12) Frame formats, duplex modes, allocation of physical resources in 4G/5G systems, base services and teleservices. 13) The principle of modulation and implementation of OFDM multi-tone transmission in 4G/5G system, demodulation principle and reception procedures. 14) Signal processing in transport and physical channels in 4G/5G systems. 15) Radio protocols in 4G/5G networks. 16) PAPR problem in 4G/5G systems, OFDMA and SC FDMA multiple access techniques. 17) Fundamentals of radio communication channel modelling for simulation/emulation purposes for research and metrology. 18) System measurements in the 5G-NR/4G-LTE radio link and their relationship with the operation of the radio communication network, network parameters and signals measured in practice. 19) Network diagnostics and optimisation in practice. 20) CQI (channel quality indicator) in radio communication systems, modulation type and station range, MCS (code-modulation) schemes. 21) Throughput, quality and range characteristics of LTE networks. 22) Principles of designing 4G/5G radio interfaces based on OFDMA/SC-FDMA technique, configuration of system parameters, selection of link parameters.

	23) Efficiency of the OFDMA technique in new generation systems, link capacity, Shannon limit capacity. 24) Intercellular interference coordination techniques, data scheduling, and principles of reusing the band in cells in radio communication systems. 25) Modern techniques of reusing the frequency band in 4G/5G systems properties of selected techniques and their impact on the performance of the cellular network. 26) Selected techniques for increasing capacity, throughput and radio coverage in new generation systems general characteristics. 27) Resource management techniques and network performance. CoMP coordinated multipoint transmission techniques. 28) Diversity of transmission and reception, MIMO and massive-MIMO techniques. 29) 6G systems basic characteristics. 30) Communication in 6G - immersive, AI-integrated, digital twins, integrated sensor-based sensing.
Prerequisites and co-requisites	
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Written exam, 2 godz. Oral exam is possible when the number of students is small.	50.0%	100.0%

Recommended reading	Basic literature	1) Holma H., Toskala A., Nakamura T.(editors), 5G Technology. 3GPP Evolution to 5G-Advanced, Second Edition, Wiley 2024. 2) Holma H., Toskala A. (editors), WCDMA for UMTS , HSPA Evolution and LTE , 4th ed., Wiley Sons, 2007. 3) Holma H., Toskala A. (editors), LTE for UMTS , Evolution to LTE Advanced , 2nd ed. Wiley and Sons, 2011.
	Supplementary literature	1) Dahlman E., Parkvall S., Skold J.: 5G NR The Next Generation Wireless Access Technology , 2nd . ed., Elsevier, Academic Press, 2021.
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	

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