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	October 2023	Academic year of realisation of subject	2024/2025
Education level	second-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	2	Language of instruction	English
Semester of study	3	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		
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 relating to radio communication systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_K02] is ready to provide critical evaluation of received content and to acknowledge the importance of knowledge in solving cognitive and practical problems	Can critically evaluate system solutions	[SK5] Assessment of ability to solve problems that arise in practice
[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 is able to analyze technical problems in radiocommunication systems. He knows the methodology of dimensioning of radiocommunication networks, including estimating capacity, throughput and range.	[SW1] Assessment of factual knowledge
[K7_W05] Knows and understands, to an increased extent, methods of process and function support, specific to the field of study.	The student knows the simulation methods and the construction of programming tools used to design and maintain the network.	[SW1] Assessment of factual knowledge
[K7_W06] Knows and understands, to an increased extent, the basic processes taking place in the life cycle of devices, facilities and technical systems.	The student knows the factors determining the development of radio networks of subsequent generations and their maintenance, and understands the evolutionary processes taking place in the networks.	[SW1] Assessment of factual knowledge

Subject contents	Basic requirements for cellular systems of next generation. Capacity-coverage characteristics in UMTS. The load of the WCDMA radio interface. Capacity reallocation between cells. The range and capacity of a cellular system in downlink and uplink – differences and their effect on the work of a cellular network. Modern techniques of design and planning of radio communication network on the basis of UMTS. Modern techniques of design and planning of radio communication network on the basis of LTE. Wideband properties of radio communication channel, fading coherence bandwidth, coherence time, correlation time. Non-stationary radio communication channel. Fundamentals of radio communication channel modelling. Analysis of propagation environment properties on the basis of distributions of average channel pulse response power. The orthogonality of transmission in the WCDMA interface. Orthogonality factor in various propagation environments. Orthogonality gain. Orthogonality of transmission and network capacity in UMTS. Relation between uplink and downlink capacity. Radio resource management in UMTS. UMTS network admission management, load and congestion control. Hard handover in radio communication systems on the basis of GSM and LTE. Soft handover in UMTS. Handover and network capacity. Measurements in a radio link of LTE and UMTS and their relationship with the operation of a radio network. Network parameters and signals measured in practise. Network diagnostics and optimisation in practise – drive tests. General principles of frequency reuse in cells. Principles of frequency band partitioning. Cluster size in GSM, UMTS, and LTE. Modern techniques of frequency reuse in GSM, UMTS and LTE. Properties of selected techniques and their effect on cellular network efficiency. Micro and macro-diversity in the UMTS system. Effect of diversity combining on the capacity of the UMTS cellular network. Correlation properties of pseudo-noise sequences for DS CDMA systems. Methods of generation of pseudo-noise sequences, m-sequences, preferred sequences, Gold sequences. Properties of orthogonal sequences. Orthogonal sequences of variable spreading factor in UMTS.

	The WCDMA and OFDMA techniques – comparison, advantages and disadvantages. The LTE-Advanced system – system characteristics. Selected techniques of capacity, throughput and coverage increasing in systems of the new generation – general characteristics. Handover and network efficiency. Techniques of resource management and network efficiency. The CoMP technique. Transmit diversity and receive diversity. The MIMO technique in LTE and UMTS/HSPA. The CQI - channel quality indicator in radio communication systems. the modulation and range of a station. Throughput, quality and coverage characteristics of the LTE network. Systems of the next generation – objectives and challenges.
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.Halonen T, Romero J, Melero J.: GSM, GPRS and EDGE Performance – Evolution Towards 3G/UMTS, Wiley 2003. 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	Sesia S. et al. .: LTE – The UMTS Long Term Evolution, John Wiley and Sons, 2009
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	