GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Cellular Systems, PG_00067238		
Field of study	Electronics and Telecommunications		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2028/2029
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	4	Language of instruction	Polish
Semester of study	7	ECTS credits	4.0
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 hab. inż. Jarosław Sadowski	
	Teachers	dr hab. inż. Sławomir Ambroziak	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	0.0	15.0	0.0	45

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	45	4.0	51.0	100

Subject objectives

Familiarization with the functioning and design principles of radio networks based on the multiple use of the same radio resources, i.e. cellular networks, personal area networks (WPAN - Wireless Personal Area Networks) or networks operating within and in the immediate vicinity of the human body (WBAN - Wireless Body Area Networks).

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_K02] is ready to critically assess possessed knowledge and acknowledge the importance of knowledge in solving cognitive and practical problems	The student is able to evaluate the technical knowledge acquired in the field of the operation of cellular networks in the context of the impact of radio communications on the functioning of society.	[SK5] Assessment of ability to solve problems that arise in practice [SK4] Assessment of communication skills, including language correctness
[K6_W03] knows and understands, to an advanced 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 and principles of operation of wireless networks with a cellular structure and the basic physical phenomena in radio links that influence the way cellular networks are designed.	[SW1] Assessment of factual knowledge
[K6_U09] can carry out a critical analysis of the functioning of existing technical solutions and assess these solutions, as well as apply experience related to the maintenance of technical systems, devices and facilities typical for the field of studies, gained in the professional engineering environment	The student is able to design, implement and verify the operation of basic components of cellular network devices.	[SU1] Assessment of task fulfilment

Subject contents	Topics covered during the lecture: 1. Cellular networks and short-range radio networks - definitions of basic terms. 2. Radio link performance quality, communication range, and radio link budget. 3. Radio wave propagation mechanisms in short-range links. 4. Fading and the Doppler effect 5. Radio channel modeling, propagation environment profiles. 6. The impact of user equipment mobility on fading parameters. 7. Methods for reducing channel influence. Transmit and receive diversity. 8. Fundamentals of cellular network topology design. 9. Cell cluster analysis. 10. Spectral efficiency and capacity of cellular systems 11. Generations of cellular systems, basic parameters and characteristics. 12. Directions of cellular network development. 13. Short-range networks (WPAN, WBAN) - definitions, classification, frequency bands. 14. Specifics of communication within the human body antenna technology, specific solutions for the physical layer of the radio link. 15. Power sources for mobile devices. 16. Interaction of short-range radio devices with organisms, the definition of the absorption rate (SAR), and methods for its analysis and assessment. 17. Legal conditions regarding ultra-wideband (UWB) emissions, unlicensed bands (ISM), short-range devices, and radio devices for medical applications. 18. Standardization of WBAN networks. 19. Development trends and applications of WBAN networks. Project activities include: design and testing of basic modulator and demodulator circuits used in radio links of cellular networks and short-range networks, modeling the impact of the radio channel and its compensation in receiving devices, and implementation and testing of functional blocks responsible for implementing multiple access and securing transmission against unauthorized access.
Prerequisites and co-requisites	
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Reports on completed project tasks	50.0%	30.0%
Final exam	50.0%	70.0%

Recommended reading	Basic literature	1. Ambroziak S.J.: Kanał radiowy w sieciach WBAN, WKŁ, Warszawa, 2020 2. Wesołowski K.: Systemy radiokomunikacji ruchomej, WKŁ, Warszawa, 1998 3. Lee C.Y.: Wireless & Cellular Telecommunications, McGraw-Hill, 2006 3. J. Wang, Q. Wang, Body area communications, Wiley, 2013. 4. H.-B. Li, K.Y. Yazdandoost, B. Zhen, Wireless Body Area Network, River Publishers, 2010. 5. G.-Z. Yang, Body Sensor Networks, Springer, 2006. 6. IEEE, "IEEE standard for local and metropolitan area networks part 15.6: Wireless body area networks, IEEE Std 802.15.6-2012, February 2012. 7. R. Cavallari, F. Martelli, R. Rosini, C. Buratti, R. Verdone, A Survey on Wireless Body Area Networks: Technologies and Design Challenges, IEEE Communications Surveys & Tutorials, Vol. 16, No. 3, 2014. 8. Ambroziak S., "Radiowe sieci BAN", Przegląd Telekomunikacyjny i Wiadomości Telekomunikacyjne, Nr 2-3, ISSN: 1230-3496, Warszawa 2017, s. 36-50.

	Supplementary literature	1. S.J. Ambroziak, L.M. Correia, R.J Katulski, M. Mackowiak, C. Oliveira, J. Sadowski, K. Turbic, Off-Body Channel Model for Body Area Networks, IEEE Transactions on Antennas and Propagation, Vol. 64, No. 9, pp. 4022 - 4035, Sept. 2016. 2. Ambroziak S.J., "Measurement stand and methodology for research of the off-body and body-to-body radio channels in WBANs with different diversity schemes", International Journal of Antennas and Propagation, vol. 2019, Article ID 3837190. 3. K.Y. Yazdandoost, K. Sayrafian, Channel Model for Body Area Network (BAN), IEEE P802.15-08-0780-09-0006, 2009.
	eResources addresses	
Example issues/ example questions/ tasks being completed	Issues in line with the topic of the lecture.	
Work placement	Not applicable	

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