GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Wireless Intelligent Systems, PG_00063998		
Field of study	Electronics and Telecommunications		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2027/2028
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	3.0
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	dr hab. inż. Łukasz Kulas	
	Teachers	dr hab. inż. Łukasz Kulas	

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	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	6.0	24.0	75

Subject objectives	The aim of the course is to introduce practical issues important from the point of view of creating wireless solutions for so-called intelligent environments - e.g. a smart home using IoT devices, a smart factory operating within the Industry 4.0 paradigm, or autonomous vehicles. Within this course, possibilities of increasing the intelligence of systems by using RF (radio frequency) signal processing techniques will be discussed. It will allow to provide the required functionalities in wireless embedded systems - e.g. reconfigurable wireless communication link for drones, wireless localization of RFID/BLE tags within an intelligent environment, systems for increasing the situational awareness of unmanned vehicles based on inexpensive miniature radar front-ends, etc.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[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	Knowledge of wireless embedded device development relying on radio frequency (RF) signals processing in order to provide wireless communication and environment monitoring.	[SW1] Assessment of factual knowledge
[K7_U12] is able, to an increased extent, to analyze the operation of components and systems related to the field of study, as well as to measure their parameters and study their technical characteristics, and to plan and carry out experiments related to the field of study, including computer simulations, interpret the obtained results and draw conclusions	Ability to analyze operation of a wireless embedded device relying on radio frequency (RF) signals processing.	[SU4] Assessment of ability to use methods and tools
[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	Knowledge of differences in operation and maintenance of wireless embedded devices relying on radio frequency (RF) signals processing in analogue and software-defined radio approaches.	[SW1] Assessment of factual knowledge
[K7_U03] can design, according to required specifications, and make a complex device, facility, system or carry out a process, specific to the field of study, using suitable methods, techniques, tools and materials, following engineering standards and norms, applying technologies specific to the field of study and experience gained in the professional engineering environment	Ability to develop wireless embedded device relying on radio frequency (RF) signals processing.	[SU1] Assessment of task fulfilment

Subject contents

Course content – lecture

1. Introduction to the course
2. Introduction to tools used during the course (laboratory)
3. Introduction to signal processing in radio-communication and radar systems
4. Signals, discretization, aliasing, decibels
5. Convolution, correlation, DFT, FFT, STFT transformations
6. Simulations of simple radar for environment monitoring (laboratory)
7. Noise, ADC and DAC conventers and their parameters
8. IQ signals, decimation and interpolation, time windows
9. Sampling parameters, zero padding, processing gain
10. Introduction to SDR (ang. software-defined radio) technique
11. Introduction to SDR (ang. software-defined radio) technique (laboratory)
12. Doppler radar in SDR technique
13. Filtration, analogue and digital circuits, transformations, filters parameters
14. Wireless embedded device in SDR technique (laboratory)
15. Case study - automotive radar

Prerequisites and co-requisites

Basic knowledge of embedded systems, including wireless systems. Student schould have knowledge of the following courses: Wireless Devices Design, Programming Communication Micromodules.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Laboratory score	50.0%	30.0%
Final test	50.0%	50.0%
Project	50.0%	20.0%

Recommended reading

Basic literature	1. T. P. Zieliński, "Cyfrowe przetwarzanie sygnałów" 2. Edgar H. Callaway Jr., Wireless Sensor Networks: Architectures and Protocols 3. Paul R. Hoole, "Smart Antennas and Signal Processing : for Communications, Biomedical and Radar Systems" 4. Lecture slides
Supplementary literature	1. Edgar H. Callaway Jr., Wireless Sensor Networks: Architectures and Protocols 2. Satyen Mukherjee, AmIware: Hardware Technology Drivers of Ambient Intelligence 3. Werner Weber, Ambient Intelligence
eResources addresses	

Example issues/ example questions/ tasks being completed	
Practical activites within the subject	Not applicable

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