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 2026 | Academic year of realisation of subject | 2026/2027 |
| Education level | second-cycle studies | Subject group | Optional subject group<br>Specialty subject group<br>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 -> Wydziały Politechniki Gdańskiej | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr hab. inż. Łukasz Kulas | |
| | Teachers | dr hab. inż. Łukasz Kulas | |

| Lesson types and methods of instruction | 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_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 |
| [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_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_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 |

## Subject contents

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 |
|---|---|---|
| Project | 50.0% | 20.0% |
| Final test | 50.0% | 50.0% |
| Laboratory score | 50.0% | 30.0% |

## Recommended reading

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

| | |
|---|---|
| Example issues/ example questions/ tasks being completed | |
| Work placement | Not applicable |

Document generated electronically. Does not require a seal or signature.