COURSE DESCRIPTION CARD - SYLLABUS

Course name
Communication between mobile terminals [S2EiT1-TMiB>KMTR]

Course

Field of study
Electronics and Telecommunications

Year/Semester
1/2

Area of study (specialization)
Mobile and Wireless Technologies

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
30

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
15

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

The student starting the course should have knowledge of the operation of mobile radiocommunication systems and of wireless signal propagation between fast-moving devices. The student should also have knowledge of the most important standards, architecture and operation of wireless local networks, 3G and 4G cellular systems and radio access methods. The student should also know the basic methods of computer simulation. The student should be able to evaluate the parameters determining the quality of digital signal transmission in radio channels, as well as to compare the systems and standards of radio transmission and select the appropriate transmission method in specific transmission conditions with high user mobility.The ability to use measuring devices and object-oriented programming with the use of languages such as C ++, C # or Java are also required. The student should be able to find solutions to problems using various sources, and be ready to cooperate as part of a team. Student should be aware of his skills, limitations, and the need for continuous education. Should also understand the importance of a professional approach to the task being performed and responsibility for the solutions developed.

Course objective

The aim of the course is to provide students with knowledge about the principles of operation of communication systems used for intelligent transport systems (ITS) and for communication systems with unmanned aerial vehicles (UAS). The course provides information on the theoretical foundations and standards describing the principles of operation of ITS and UAS systems as well as advanced simulation research methods for communication systems between vehicles.

Course-related learning outcomes

Knowledge:
1. Has structured knowledge of the operation of communication systems between vehicles (V2X) and communication with drones (UAS).
2. Knows the principles of operation of ITS and UAS systems.
3. Has an established knowledge of communication problems between mobile devices.
4. Knows the rules of simulating communication systems.

Skills:
1. Can analyze the standards of modern radio communication systems in English.
2. Can identify the characteristics of V2X communication systems defined in standards.
3. Can evaluate and compare the operation of communication systems between mobile devices.

Social competences:
1. Is aware of his knowledge and skills, as well as the limitations related to them. Understands the necessity of further education related to the rapid aging of knowledge and skills in the field of ITS and UAS systems.
2. Understands the importance of radio communication standards in the operation of ITS and UAS systems.
3. Has a sense of responsibility for the implementation of the project of a communication system between vehicles or with drones and its importance for the environment and man.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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The knowledge acquired during the lectures is verified during the exam, which may be written or oral. The written exam consists of 6-10 questions (test and / or open) that can be scored differently. The pass mark for the written exam is 45% of the available points. The oral exam consists of 3 questions related to the subject of the lectures, which are assessed on a scale of 2-5, taking into account the understanding of the issue by the student, as well as the detailed answers. The pass mark for the oral exam is 50% of positively assessed answers to the questions.
The skills acquired during the laboratory are verified during the implementation of 4-7 practical exercises consisting in examining and assessing the operation of the communication system between mobile devices (taking measurements) or simulating selected issues of communication systems between mobile devices. The tasks are carried out in groups, and both the involvement of students during the classes and the prepared report (partial reports on the conducted research or the final report summarizing all conducted research) are assessed. The final grade consists of points obtained by students during the classes (activity and commitment) and points for the prepared report / reports. The pass mark is to obtain a minimum of 50% of possible points.
The skills and competences acquired during the implementation of project activities are assessed on the basis of the implementation of an extensive task - project - on the subject agreed with the students. The tasks are performed in groups and concern the design and implementation of a communication system between mobile devices, which is an example of UAS or ITS. The final evaluation of the project, on a scale of 2-5, depends on the degree of complexity of the task, completed stages / functionalities, as well as the student"s involvement in the project

Programme content

The course covers the following issues:
- Introduction to ITS and UAS systems - architecture and principles of operation.
- Propagation phenomena occurring in communication between mobile devices.

- Communication technologies used in ITS systems.
- Existing standards and current standardization work for V2X and UAS communication.
- Modelling of communication systems between mobile devices.

Course topics

The lectures cover the following issues:
- Introduction to ITS and UAS systems. Architecture and principles of operation of these systems.
- Propagation phenomena occurring in communication between mobile devices and methods of their modeling for V2X and UAS systems.
- Technologies used in ITS systems (driver assistance systems) - in particular wired and wireless communication systems inside vehicles.
- Existing standards and current standardization work for V2X and UAS communication.
- Advanced methods for simulating communication systems between mobile devices, in particular V2X systems.

The subject of the laboratory is as follows:
- Compilation and configuration of the wireless communication system between mobile devices.
- Measurement of selected physical quantities in terms of communication between mobile devices.
- Analysis of the obtained measurement results and optimization of system parameters.
- Implementation of simulation of selected elements of communication between mobile devices.

The subject of the project includes the design, construction and implementation of a communication system between mobile devices - UAS or V2X. As part of the project, it is possible, for example, to develop a drone communication system with a ground station or build a V2X system enabling autonomous vehicle movement in a convoy.

Teaching methods

Lectures: multimedia presentation with elements of a seminar lecture - discussion on various problems and solutions.
Laboratory: practical exercises with laboratory and measuring elements, using communication devices or computer simulation methods - research and analysis of communication between moving devices.
Project: Implementation of a project task - group work - development and construction of a communication system with an unmanned aerial vehicle or development and implementation of a communication system between vehicles (e.g. for the needs of convoy traffic).

Bibliography

Basic
Christoph Sommer, Falko Dressler, "Vehicular networking", Cambridge University Press, 2015
Krzysztof Wesołowski, "Systemy radiokomunikacji ruchomej", Wydawnictwa Komunikacji i Łączności, 1999
Additional
M. Mueck, I. Karls, "Networking vehicles to everything", De|G Press; 2017
A. Paul, N. Chilamkurti, A. Daniel, S. Rho, "Intelligent Vehicular Networks and Communications: Fundamentals, Architectures and Solutions", Elsevier, 2016
X. Cheng, R. Zhang, L. Yang, "5G-Enabled Vehicular Communications and Networking", Springer International Publishing, 2019

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	75	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	25	1,00