COURSE DESCRIPTION CARD - SYLLABUS

Course name
DSP algorithms in wireless systems

Course

Field of study
Electronics and Telecommunications

Year/Semester
4/7

Area of study (specialization)
Mobile and Wireless Technologies

Profile of study
general academic

Level of study
First-cycle studies

Course offered in

Form of study
full-time

Requirements
elective

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
15	15	
Tutorials	Projects/seminars	

Number of credit points

3

Lecturers

Responsible for the course/lecturer:
Prof. dr hab. inż. Krzysztof Wesołowski

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Responsible for the course/lecturer:

Prerequisites

He/she knows the rule of operation of digital communication systems , including baseband transmission, digital modulations, signal transmission over transmission channels, methods of signal receptiuon, shaping of spectral properties of signals;

He/she has ordered and mathematically founded knowledge on foundations of telecommunications necessary for understanding, analysis and evaluation of functioning of analog and digital communication systems

He/she is able to solve basic problems in the area of electronics and telecommunications using mathematical tools from the area of mathematical analysis, algebra and probability

He/she is aware of necesity of professional approach to solution of stated technical problems and undertaking responsibility for the proposed technical solutions

Course objective

Getting knowledge on the most important methods of digital signal processing (DSP) in the physical layer of contemporary and future wireless communication systems

Course-related learning outcomes

Knowledge

He/she has ordered and mathematically founded knowledge on foundation of wireless systems, has basic knowledge in the area of architecture and functioning of 2G, 3G and 4G mobile networks; has basic knowledge in the area of construction and exploitation of wireless systems and functional blocks contained in ICT networks including wireless networks.

Skills

He/she is able to perform comparison of systems and standards of radio transmission and is able to make an appropriate choice of a transmission method or wireless standard taking into account transmission conditions and users' mobility

Social competences

He/she is aware of responsibility for designed electronic and communication systems and is aware of potential dangers resulting from their inappropriate utilizing to other people or societies

He/she is able to formulate opinions on basic challenges of contemporary radio communications; he/she is aware of influence of wireless systems and networks on functioning of information society go

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Written exam covering the topics of lectures and labs is organized using a special form in which students read the stated problems and write their solutions. The questionnaire contains four problems to be solved. Solution of each of them is evaluated in the range of 0 to 3 points. The exam is considered passed if a student has obtained at least 7 points. If the number of obtained points is between 5 and 6.5 the student participates in an additional meeting in which he/she solves two supplementary problems according to the same rules. The satisfactory grade is given for 7, 7.5 or 8 points. The grades increase by a subsequent value (3.5, 4, 4.5 and 5) after obtaining each additional point. Granularity of the evaluation is 0.5 point.

Programme content

Lectures:

1. DSP algorithms for determining the spectral properties of wireless signals (spectral properties of signals, mathematical apparatus associated with spectral properties, discrete signals in time domain andd their spectral properties, estimation of power spectral density of discrete signals)

2. DSP algorithms in multitone transmission on the example of IEEE 802.11a/g (overview of operation rules of 802.11a/g modems, basic DSP procedures in the receiver - packet start detection, coarse carrier

synchronization, precise carrier synchronization, timing synchronization, channel estimation, tracking of carrier synchronization on the basis of ppilots inside OFDM data symbols)

3. Radio channel estimtin and equalization algorithms operating in the time domain (baseband equivalent channel, systems with intersymbol interference, linear and decisin feedback equalizers channel impulse response estimators)

4. Foundations of adaptive antennas (idea of operation of adaprive antennas, elements of the theory of adaptive antennas, MIMO and massive MIMO systems)

Laboratory:

1. Estimation and spectral analysis of signals with emphasis on spectrum of wireless signals

2. Methods of reception for multitone transmission

3. Operation fo wireless channel equalizers

4. Multiantenna systems

Teaching methods

Lectures with activation of students by stating questions and discussion on the answers to them during lectures.

Laboratory with the application of radio devices (e.g. spectrum analyzers) and specializing software (e.g. Matlab).

Bibliography

Basic

T. Zieliński. Cyfrowe przetwarzanie sygnałów, Warszawa 2007, Wydawnictwa Komunikacji i Łączności WKŁ

red. T. Zieliński, Cyfrowe przetwarzanie sygnałów w telekomunikacji. Podstawy Multimedia Transmisja, Warszawa, 2014, Wydawnictwo Naukowe PWN

Additional

J. G. Proakis, D. K. Manolakis, Digital Signal Processing (4th Edition), Prentice Hall, 2006

M. Ibnkahla (ed.), Signal Processing for Mobile Communications Handbook, CRC Press, New York, Washington, D.C., 2005

K. Wesołowski, Systemy radiokomunikacji ruchomej, Wydawnictwa Komunikacji i Łączności WKŁ, Warszawa 2003

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	31	1,5
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	44	1,5

[1] delete or add other activities as appropriate