COURSE DESCRIPTION CARD - SYLLABUS

Course name
Cellular systems [S1MiKC1>SKOM]

Course

Field of study
Microelectronics and digital communications

Year/Semester
3/5

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
24

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

dr hab. inż. Rafał Krenz
rafal.krenz@put.poznan.pl

Lecturers

Prerequisites

Basic knowledge of 2G/3G cellular systems technology, with a mathematical background. Knowledge of important standards, architectures and wireless networks principles.

Course objective

The course presents the theoretical background as well as standards defining modern wireless systems, including 4G/5G cellular systems and broadband wireless access systems. Digital satellite systems for mobile communications are introduced as well.

Course-related learning outcomes

Knowledge:
Knows the fundamentals of 4G/5G cellular systems based on OFDM technique.
Is aware of phenomenas and problems related to EM waves propagation in wireless systems.
Understands the digital signal processing methods applied to wireless systems.

Skills:
Can analyse standardisation documents produced by working groups, e.g. belonging to 3GPP.

Knows the 3GPP standards related to NR and LTE systems.
Is able to evaluate satellite system characteristics.

Social competences:
Is aware of the impact of modern communication technologies on the society.
Understands the importance of communication standards in cellular communications and legal regulations.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: written/oral exam consisting of 5 or more questions, based on the list of 20-25 topics shared during the course duration. The assigned grade is based on the accuracy as well as student's understanding of the analysed topic. 50% of the total number of points necessary to pass.
Laboratory classes: exercise and project reports evaluated individually, the individual number of points must exceed 50% for all reports for student to pass

Programme content

The course introduces topics related to architecture, operation and services offered by modern cellular systems. It focuses on 4G - LTE and 5G NR systems, with special emphasis on Radio Access Network's aspects like radio protocol stack, physical layer operation and modern transmission techniques, including antenna arrays, relays as well as V2X communication.

Course topics

Lecture:
Brief history of digital cellular and satellite communication systems and the standards. (2h)
Signal propagation, interference, fading in communication channels - a recap. (2h)
4G/5G cellular systems architecture and operation, based on 3GPP Rel. 10-17. Radio protocol stack. Physical layer signal processing. Basic physical layer procedures. (8h)
OFDM, MIMO, Massive MIMO, multihop transmission, V2X communication techniques. (6h)
Satellite links - propagation, multiple access, ground stations. Satellite systems for personal and broadband communication - VSAT, Iridium, Globalstar, Starlink. (6h)
Evolution towards 6G. (6h)
Laboratory classes:
OFDM transmission technique for wireless communication. Application of antenna arrays and MIMO transmission. Radio link budget in cellular and satellite systems. Estimation of cellular system capacity for different multiple access technologies.

Teaching methods

Lecture: multimedia presentation, case study
Laboratory classes: computer simulation of physical layer, implementation of selected transmission techniques using Software Defined Radio, analysis of link power budget using spreadsheets

Bibliography

Basic:
K. Wesołowski, Systemy radiokomunikacji ruchomej, wyd. 3, WKiŁ, Warszawa, 2003
R. Zieliński, Systemy satelitarne, WNT, Warszawa, 2007

Additional:
C. Cox, An Introduction to LTE, 2nd ed., Wiley, 2014
D. H. Morais, Key 5G Physical Layer Technologies, 1st ed., Springer, 2021

Breakdown of average student's workload

	Hours	ECTS
Total workload	84	3,00
Classes requiring direct contact with the teacher	54	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00