COURSE DESCRIPTION CARD - SYLLABUS

Course name
Satellite communication systems [S1MiKC1>SSK]

Course

Field of study
Microelectronics and digital communications

Year/Semester
4/7

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-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
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge of digital wireless systems, EM wave propagation and antennas.

Course objective

The course presents the theoretical background as well as design and practical implementation of satellite communication systems. Space communication is discussed as well.

Course-related learning outcomes

Knowledge:
Knows the principles of the design and operation of satellite communication systems as well as space communication systems.
Understands the limitations of satellite systems due to the propagation effects and orbit type.
Knows the digital signall processing methods applied to satellite communications.

Skills:
Can design a satellite link, based on a link power budget and required link capacity.
Is able to select a satellite system for a specific application.

Can analyse the correlation between propagation conditions and link quality.

Social competences:
Is aware of the evolution of satellite communication systems, new services and their availability to the user.
Understands the importance of satellite communication for the evolution of information society.

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 in modern satellite communications. It discusses important aspects of both, space and ground segments, concentrating on the specification and design of satellite radio links. Propagation effects, specific to satellite communication are analysed. Application of satellite systems to radio dyfusion, personal communication and broadband access, together with practical examples is also presented.
The aim of the laboratory classes is to acquire practical skills in designing and analyzing satellite radio links, considering both the space and ground segments. Students will become familiar with key transmission parameters, the impact of interference, and optimization methods for links used in broadcasting, personal communication, and broadband systems

Course topics

Lecture:
Kepler laws. Orbit types. (2h)
Satellite bus and payload. Satellite subsystems. (2h)
Satellite links. Power budget analysis. (4h)
Noise temperature. Radio link quality. (2h)
Estimation of the link quality in the uplink and the downlink. (2h)
Interference and signal distortion. Propagation effects. (2h)
Radio noise. Transponders. End-to-end link quality. (4h)
Multiple access in satellite systems and their capacity. (2h)
Antenna systems. Satellite and ground station antennas. (2h)
Mobile satellite systems. INMARSAT. Globalstar. Iridium. Orbcomm. StarLink. (4h)
Deep space communications. (4h)
Laboratory classes:
Radio link power budget anaysis. Capacity of satellite systems. Modeling and simulation of radio wave propagation in space. Dynamic transmission adaptation techniques in satellite communication systems. Application of TLE files to object tracking. Ground station operation.

Teaching methods

Lectures are delivered through multimedia presentations combined with interactive discussions and the analysis of practical cases. The course format is adaptable, allowing for on-site, hybrid, or fully remote participation.
Project-based learning is implemented using the Project-Based / Problem-Based Learning approach, where students work on comprehensive projects inspired by real-world challenges or simulated scenarios. They collaborate in small groups, fostering teamwork, communication skills, and effective task distribution. Regular consultations with the instructor help track progress, provide guidance on next steps, and address any difficulties encountered.

Bibliography

Basic:

L. J. Ippolito, Satellite Communications Systems Engineering, Wiley 2017
D. J. Bem, Radiodyfuzja satelitarna, WKiŁ 1990

Additional:
D. Roddy, Satellite Communications, 5th ed., Mc Graw Hill, 2024

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	45	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00