COURSE DESCRIPTION CARD - SYLLABUS

Course name
Introduction to Satellite Technology [S1MiKC1>PTS]

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 operation of satellite and deep space communication systems.

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 orbit type and propagation phenomenas.
Knows the processing techniques for transmission and reception in satellite links.

Skills:
Can analyse link power budget and design a satellite radio link.
Is able to select a satellite system for a specific application.

Can evaluate the correlation between propagation conditions and link quality.

Social competences:
Is aware that satellite systems can provide to the user new services, not available in terrestrial systems.
Understands the importance of satellite communication for the evolution of information society and industry/economy 4.0.

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 discusses modern telecommunication technologies applied in satellite and deep space communication. It focuses on signal processing techniques as well as hardware and software solutions making the design and development of high quality radio links possible, taking into account long distance transmission and implementation of broad range of services, e.g. broadcasting, personal communication as well as broadband communication. Several existing systems together with their evolution are presented and analysed.
During the laboratory sessions, students will design and simulate radio links used in satellite systems, analyzing transmission parameters and the impact of interference on signal quality, as well as conducting tests on real communication modules, learning to configure and optimize the parameters of telecommunication systems used in space probes and satellites.

Course topics

Lecture:
Kepler laws. Orbit types and their parameters. (2h)
Design of the space segment - bus, subsystems and satellite payload. Design of the ground segment. (2h)
Antenna systems and mounts. (2h)
Parameters of radio links for satellite and deep space communication - transmission and reception techniques. Link quality vs transponder types. (6h)
Interference and signal distortion as a result of propagation phenomenas. (4h)
Radio noise sources. Calculating equivalent noise temperature. (4h)
Multiple access techniques and satellite system capacity. (2h)
Practical satellite communicatio systems - INMARSAT, Globalstar, Iridium, Orbcomm, StarLink. (4h)
Mission control. (4h)
Laboratory classes:
Radio link power budget anaysis. Modern signal processing techniques in satellite links. Configuration and testing of satellite communication modules. Adaptive transmission techniques in satellite communication. Application of TLE files to object tracking. Ground station operation.

Teaching methods

Lectures are conducted using multimedia presentations with elements of conversational lectures, including discussions and the analysis of practical examples. The format of the classes is flexible - they can be delivered in a stationary, hybrid, or remote mode.
Project-based classes are conducted using the Project-Based / Problem-Based Learning methodology, in which students carry out comprehensive projects based on real-world problems or simulated scenarios. Students work in small groups, allowing them to develop interpersonal skills, effective communication, and task distribution. Regular consultations with the instructor are held to monitor project progress, provide guidance for further work, and address encountered challenges

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	85	3,00
Classes requiring direct contact with the teacher	45	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50