COURSE DESCRIPTION CARD - SYLLABUS

Course name
Distribution of the time and reference frequency signal in networks [S1Teleinf1>DSCiCWwS]

Course

Field of study
Teleinformatics

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
elective

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

dr hab. inż. Jakub Nikonowicz
jakub.nikonowicz@put.poznan.pl

Lecturers

Prerequisites

The student attending this course should have systematized knowledge of mathematical analysis and probability theory, as well as the theory of one-dimensional signals. Should know the basic principles of operation of digital telecommunications systems. Should also have the ability to obtain information from indicated sources and analyze and interpret it. Should be able to solve common problems and problems related to signal analysis.

Course objective

1. Acquainting with the basic methods and functioning of the process of distribution of time and reference frequency signals in wired and wireless teleinformatic networks. 2. Shaping students' skills in acquiring knowledge about currently implemented solutions in the field of telecommunications and ICT.

Course-related learning outcomes

Knowledge:
Has an ordered, detailed knowledge of the functioning of the phase-locked loop, its elements, and their implementation. Knows the carrier synchronization processes, symbol synchronization, packet synchronization and the methods of their implementation necessary for understanding, analysis and

evaluation of the operation of time and frequency signal distribution methods in modern digital teleinformatic networks.

Skills:
Can define the basic parameters and properties of time and frequency signals. Can assess the quality of the synchronization signal in the system or telecommunications network with the distribution of the time and frequency signals in the physical layer or/and in the packet layer.

Social competences:
Notices changes resulting from technological progress and understands the need to learn about new standards of ICT networks. Has a sense of responsibility for the designed ICT systems and is aware of social risks in the event of inadequate design or implementation.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired during the lecture is verified by assessing the knowledge shown in the final test. Checking the knowledge consists in giving a written answer to 5 questions. Final topics, on the basis of which the questions are developed, are available to students using the university's remote learning platform. To receive a grade of 3.0, it is necessary to score at least half of the points.
In the laboratory, verification of the assumed learning outcomes is carried out by continuous assessment: oral answers to questions asked during the laboratory exercises, written reports on the exercises, and the assessment obtained from the test summarizing laboratory exercises.

Programme content

Lectures:
1. Introduction (2 hours).
2. Phase-locked loop for continuous and discrete signals (2h).
3. Sources of time and frequency signals (2h).
4. Mathematical model of the timing signal (2h).
5. Frequency distribution in the physical layer of the Ethernet network (2 hrs.).
6. Time and frequency distribution in the packet layer of the Ethernet network (2 hours).
7. Frequency distribution in mobile wireless networks (2 hours).
8. Final test (1 hour).

Lab:
1. Recovery of the frequency signal (4 hours).
2. Time and frequency signal sources (4 hours).
3. Measurement of the quality of time and frequency signals (6 hours).
4. Final test of the laboratory (1 hour).

Lectures:
1. Introduction (2 hours).
2. Phase-locked loop for continuous and discrete signals (2h).
3. Sources of time and frequency signals - GNSS, atomic clocks, optical clocks (2h).
4. Mathematical model of the timing signal (2h).
5. Frequency distribution in the physical layer of the Ethernet network - SyncE (2 hrs.).
6. Time and frequency distribution in the packet layer of the Ethernet network - PTP, White Rabbit (2 hours).
7. Reproducing frequencies in wireless networks - OTA (2 hours).
8. Final test (1 hour).

Lab:
1. Recovery of the frequency signal - digital phase-locked loop (4 hours).
2. Time and frequency signal sources - NTP, PTP, GNSS (4 hours).
3. Measurement of the quality of time and frequency signals - Alan deviation, time deviation, TE / TIE / MTIE (6 hours).
4. Final test of the laboratory (1 hour).

Course topics

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4. Final test of the laboratory (1 hour).

Teaching methods

Lecture: multimedia presentation, supplemented with current examples and additional explanations on the whiteboard.
Laboratory: solving tasks/problems with the active support of the teacher.

Bibliography

Basic:
A. Dobrogowski, Sygnał czasu, Wydawnictwo PP, Poznań, 2003.
Recommendations ITU-T G.810, ITU-T G.8261, ITU-T G.8262, ITU-T G.8264, ITU-T G.781.
Standards IEEE802.3, IEEE 1588-2008.

Additional:
Petar Popovski, Time and Frequency in Wireless Communications, in Wireless Connectivity: An Intuitive and Fundamental Guide , Wiley, 2020.

Breakdown of average student's workload

	Hours	ECTS
Total workload	56	3,00
Classes requiring direct contact with the teacher	30	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	26	1,00