



Subject card

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|---|---|--|---|-------------------------------------|---------|--|-----|
| Subject name and code | Transmission and Switching Technology, PG_00055275 | | | | | | |
| Field of study | Electronics and Telecommunications | | | | | | |
| Date of commencement of studies | October 2024 | Academic year of realisation of subject | | | | 2026/2027 | |
| Education level | first-cycle studies | Subject group | | | | Optional subject group Subject group related to scientific research in the field of study | |
| Mode of study | Full-time studies | Mode of delivery | | | | at the university | |
| Year of study | 3 | Language of instruction | | | | Polish | |
| Semester of study | 5 | ECTS credits | | | | 3.0 | |
| Learning profile | general academic profile | Assessment form | | | | exam | |
| Conducting unit | Department of Teleinformation Networks -> Faculty of Electronics, Telecommunications and Informatics | | | | | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr inż. Maciej Sac | | | | | |
| | Teachers | dr inż. Maciej Sac | | | | | |
| Lesson types and methods of instruction | Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
| | Number of study hours | 30.0 | 0.0 | 0.0 | 0.0 | 0.0 | 30 |
| | E-learning hours included: 0.0 | | | | | | |
| Learning activity and number of study hours | Learning activity | Participation in didactic classes included in study plan | | Participation in consultation hours | | Self-study | SUM |
| | Number of study hours | 30 | | 4.0 | | 41.0 | 75 |
| Subject objectives | Transfer of knowledge on transmission and switching techniques used in telecommunications networks, including methods of circuit and packet switching, methods of spatial, optical and time-division switching, construction and properties of switching networks implemented in various technologies as well as techniques used in transmission of digital signals, transmission in copper and optical lines, methods of multiplexing digital signals and standards related to digital transmission. | | | | | | |
| Learning outcomes | Course outcome | | Subject outcome | | | Method of verification | |
| | [K6_W34] Knows the characteristics of telecommunications channels, methods of securing information, modulation systems, methods of access to the channel. | | Student knows the characteristics of digital channels, methods of encoding information, digital modulations, channel access methods | | | [SW1] Assessment of factual knowledge | |
| | [K6_W35] Knows the concepts of the technique of signal transmission, operation of telecommunications networks and multimedia services and the rules for providing them | | Student describes the principles of commutation of channels, packages, MPLS and optical channels and knows the solutions of switching fabrics, defines the parameters of switches and switching fabrics, explains the impact of parameters of switching fabrics on the quality of services rendered, describes the multiplication techniques and standards for transmission systems and techniques of sending signals in the physical layer, identifies phenomena affecting the transmission quality parameters | | | [SW1] Assessment of factual knowledge | |
| | [K6_U31] can identify telecommunications network architectures, differentiates their areas and functional elements, evaluates the quality of service delivery, calculates parameters of functional elements | | Student is able to identify telecommunications network architectures, distinguishes their areas and functional elements of transmission networks and switching nodes, calculates parameters of functional elements used in transmission and switching | | | [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information | |

| Subject contents | <p>Transmission techniques: Quality measures for an analog transmission channel, distortions, disruptions and noise, the effects of asymmetry and mismatch, quality measures for a digital channel. Properties of copper transmission lines. Transmission in optical fibers, linear and non-linear distortions and their influence on transmission of optical signals. Clock and frame synchronization in TDM systems, decisions in the synchronization process. Construction of a standard E1 signal frame, discretization and compression of telephone signals according to the A or μ characteristics. Multiplexing techniques for synchronous and plesiochronous signals, pulse stuffing. Synchronous transmission systems (SDH): mapping modes, header and pointer functions, container linking. Transmission protection in SDH and OTN networks, operation of optical rings and multi-ring networks. Requirements and properties for transmission codes used in copper and optical lines, code redundancy, element rate. Digital duplex transmission methods - TDD, FDD, echo cancellation. Transmission techniques for copper lines in xDSL access systems. Digital signal regeneration. Block diagram of a regenerative repeater (3R), timing signal extraction, decision errors. Phase fluctuations in digital links, phase jitter accumulation in cascade of regenerative repeaters. Methods of transmission quality assessment in digital systems: FAS, CRC-k, BIP-N errors. Interfaces between transmission and switching networks.</p> <p>Switching techniques: Place, tasks and features of the switching function in the telecommunications network. Network technologies and switching function. Criteria for classification of switching networks. Model of the switching network. Structure, selection type, control. A formal description of the connecting path. Basic structures of switching networks: Benes, Clos, Cantor. Other structures of switching networks. Selection types. Types of control. Transmission techniques and switching techniques. Switching network solutions: electrical (channels, cells, packets) and optical (packets, wavelengths). Elements of switching networks. Combinatorial properties of switching networks. Switching networks are non-blocking in the narrow and broad sense, rearrangeable, repackable. Clos' theorem. The SlepianDugid theorem. Close switching networks comparison. Costs optimization of switching networks. Control algorithms of switching networks. Basic algorithms: first free, quasi-random, Benes. Complexity comparison of control algorithms. Rearranging algorithms: Slepian, Paulla. Standard and priority rearranging. Mapping the state of the switching networks. Practical realizations of switching networks. S/T switch. T-T-T and T-S-T switching networks. Spatial equivalents. Packet-switched switching networks: TDS - shared memory, shared medium, SDS. Optical switching networks: MEMS 2D, MEMS 3D, waveguide, planar, bubble. OBS switching. Switching networks for EON. Elements and switching networks types for EON.</p> | | | | | | | | |
|--|--|--|--|--------------------------|-------------------|-------------------------------|---------------------|-------|--------|
| Prerequisites and co-requisites | | | | | | | | | |
| Assessment methods and criteria | <table border="1"> <thead> <tr> <th>Subject passing criteria</th> <th>Passing threshold</th> <th>Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Written examination</td> <td>50.0%</td> <td>100.0%</td> </tr> </tbody> </table> | | | Subject passing criteria | Passing threshold | Percentage of the final grade | Written examination | 50.0% | 100.0% |
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| Written examination | 50.0% | 100.0% | | | | | | | |
| Recommended reading | Basic literature | Materials prepared by the lecturer available in the electronic form (PDF files) and in the form of a photocopy (on request). | | | | | | | |
| | Supplementary literature | Not required. | | | | | | | |
| | eResources addresses | Adresy na platformie eNauzanie: | | | | | | | |
| Example issues/ example questions/ tasks being completed | | | | | | | | | |
| Work placement | Not applicable | | | | | | | | |