



Subject card

Subject name and code	Transmission and Switching Technology, PG_00055275						
Field of study	Electronics and Telecommunications						
Date of commencement of studies	October 2022	Academic year of realisation of subject				2024/2025	
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 concerning the transmission and switching techniques used in telecommunication networks, including channel-switching and packet-switching, methods of implementation of spatial and time switching, construction and properties of switching fabrics implemented in different technologies and techniques used for the transmission of digital signals, realization of transmission in the copper lines and fiber optics, methods of digital signal multiplexing 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 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>1. Classification of circuit, channel and packet switching techniques 2. Structure, working and control of homogenous time switches with RAM memory. Fast switches with RAM memory 3. Structure, working and control of matrix space switches 4. Structure, working and control of space-time switches 5. Switching networks: construction principles, parameters and structures, space equivalents space time of switching networks, graph of switching network. Tri-stage Clos switching network. Structure of switching networks built on time-space switches. 6. Switching network classification: non-blocked switching networks, rearrangeable networks, repacking networks, Clos, Cantor and Hwang theorems. Comparison of different class of switching networks 7. Switching networks optimization: criteria of optimization. Methods and algorithms of switching network control: sequential, quasi-random, Benes. Algorithms of connection paths rearrangement 8. Structure, working and control of packet switch. Input, output and switching fabrics functions 9. Characteristics of switching fabrics solutions in IP routers 10. Structure, working and control of ATM switch. ATM switching networks structures. 11. Classification and architecture review of ATM switches 12. Principles of optoelectronic switching: wave-guide switches. Switches and switching networks architecture characteristics 13. Switching networks with laser diodes. Wavelength division networks 14. Time division optical switching, Optical packet switching 15. Switching networks in transport networks, working and control principles Add-Drop Multiplexers ADM and Optical Cross-Connect DXC 16. Properties and quality measurement for analogue and digital channel, limiting factors for transmissions reach. 17. Transmission parameters, copper lines parameters, wave and work parameters, coupling properties, asymmetry and return loss consequence, telecommunications fiber-optics parameters 18. Frame structure for standard E1 and T1 signals, frame synchronization, insertion of speech samples and data, discretization and A or mi compression of telephone signals 19. Principles of multiplexing of plesiochronous signals (PDH), pulse stuffing, frame structure of multiplexed signal 20. Synchronous transmissions systems SDH, making of virtual containers and transport module STM-N principles, mapping modes 21. SDH system: function of path and section overheads, use of pointers, containers concatenation techniques 22. Transmission protection in SDH network, optical rings and multi-ring networks 23. Requirements and properties for line codes on copper lines and optical fibres, code redundancy 24. Transmissions principles for ISDN reference points U and S/T ISDN access, echo cancellation 25. Transmission techniques for copper lines in xDSL access systems, general frame structure, reach and bit rate maximization 26. Digital signal regeneration, Block scheme of regenerative repeater (3R), timing signal extraction. Decision field 27. Phase fluctuations in digital links, phase jitter accumulation in cascade of regenerative repeaters 28. Single- and multi-channel transmission in telecommunications optical fibres, linear and nonlinear distortions in fiber-optics and their optical signal receiving quality influence 29. Optical amplifiers EDFA and regenerative repeaters in optical links, amplifier noise and distortions influence, global noise on optical link, transmission reach without regeneration 30. Methods of transmission quality examination in digital systems: FAS errors, cyclic redundancy check CRC-k, bit interleaved parity BIP-N</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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Example issues/ example questions/ tasks being completed	<p>Relationship bit rates for tributaries and cumulative signals in PDH standard. Requirements for codes of fiber optic transmission. Methods of implementation of digital two-way transmission in the copper line. Sources of phase fluctuation in the regenerative repeaters. Techniques for realization of packets switches. The principle of operation of the spatial commutator of digital channels. Tasks performed by elements of architecture of the optical packet switching node. The data required to drive the switching field.</p>											
Work placement	Not applicable											