The syllabus of the discipline

Telecommunication transmission systems

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Field name	Detailed content, comments
Name of the faculty	Faculty of Infocommunications
Level of higher education	First (bachelor's)
Code and name of the specialty	172 Telecommunications and radio engineering
Type and name of educational program	EPP "Information and Network Engineering"
Name of the discipline	Telecommunication transmission systems
Number of ECTS credits	4
Discipline structure (distribution by types and hours of study)	24 hours - 12 lectures, 4 hours - 2 practical classes, 20 hours - 5 laboratory classes, 8 hours - 4 consultations, 64 hours - homework, **type of control**: exam
Schedule (terms) of studying the discipline	2nd year, III semester
Prerequisites for studying the discipline	Basic knowledge of: 1. Higher mathematics. 2. Theory of electric circuits and signals. 3. Theory of telecommunication. 4. Fundamentals of circuitry.
Competences, knowledge, skills, understanding, which is acquired by the applicant in higher education in the learning process	The discipline is used for formation the following competencies: FC-3. Ability to use basic methods, methods and means of obtaining, transmitting, processing and storing information; FC-8 Willingness to promote the introduction of advanced technologies and standards; FC-9 Ability to accept and develop new equipment in accordance with current regulations; FC-10 Ability to carry out installation, adjustment, adjustment, adjustment, pilot testing, testing and commissioning of telecommunications facilities, means and equipment and willingness to promote the introduction of advanced technologies and standards for new generation technologies; FC 15 Ability to perform calculations in the process of designing structures and means of information and telecommunication networks, telecommunication and radio systems, in accordance with the terms of reference using both standard and self-created methods, techniques and software automation designing.

The quality of the educational process	Educational-methodical and material-technical resource provision of the educational program, within the framework of which the discipline is studied, meets the licensing requirements and accreditation conditions of the educational activity of the university. Annual monitoring and revision of the curriculum of the discipline in accordance with the requirements and recommendations of the Ministry of Education and Science, state certification of acquired competencies of graduates, standards of cooperation with employers to ensure a competitive level of training. Adherence to the principles of academic integrity (https://lib.nure.ua/plagiat). Contains public information on the requirements, competencies, level of education within the current educational program.

Description and content of the discipline

The purpose of the discipline is to master the basic knowledge of construction and principles of technical means used in modern digital telecommunication transmission systems (DSP), methods of processing, conversion and transmission of signals in transmission system equipment, their mathematical justification, basics of digital linear path design.

Content

Content module 1. Basic principles of construction of digital telecommunication transmission systems.

Topic 1. Advantages of digital telecommunication transmission systems. Basic concepts and definitions. Classification of SPC. The principle of pulse-code modulation. Multi-channel telecommunication transmission system with time division of channels. Generalized block diagram

Topic 2. Problems related to the need to transmit digital signals in a channel with limited bandwidth. Transient effects. Channel noise and interference. Attenuation of the digital signal in the transmission clock. Regeneration of digital signals. Application of noise-tolerant coding

Topic 3. Sampling and quantization of analog signal. Methods of linear and nonlinear quantization. Methods and algorithms for digital signal compression. A- and μ-compression algorithms.

Content module 2. The principle of formation of information flow in a digital multi-channel transmission system.

Topic 1. Method of amplitude-pulse modulation (AIM). Temporal method of channel compression as the main creation of a group signal. A time-consistent method of presenting the channel signal of a digital transmission system. Features of the binary signal spectrum.

Topic 2. Generalized block diagram of digital transmission system. Assignment of the system of blocks and requirements to its characteristics. Methods of time grouping (multiplexing) in digital telecommunication transmission systems with PCM.

Topic 3. Methods of temporal grouping (multiplexing) in digital telecommunication transmission systems with PCM. Hierarchical way of constructing digital streams used in transmission systems.Isochronous, mesochronous, plesiosynchronous digital streams.

Content module 3. Fundamentals of digital hierarchy systems in digital communication networks.

Topic 1. The main digital channel of the digital transmission system. Base rate of binary characters. Plesiosynchronous Digital Hierarchy (PDH). Formation of streams E1, E2, E3, E4. Standardized methods of forming a group signal of the transmission system (European, North American, Japanese standards).

Topic 2. Synchronous Digital Hierarchy (SDH) and digital transport networks. SDH network link model. Synchronous transport modules (STM). STM-N frame structure. Self-recovery mechanisms and redundancy schemes. Linear protection. Ring protection. SDH network synchronization and management.

Topic 3. Self-healing mechanisms and redundancy schemes. Linear protection. Ring protection. SDH network synchronization and management

Content module 4. Digital transmission systems using information compression methods.

Topic 1. The principle of operation and block diagram of the digital difference transmission system. Differential pulse code modulation method. Block diagrams and advantages of DIKM codecs.

Topic 2. The principle of delta modulation. Block diagrams and advantages of delta codes. Adaptive delta modulation.

Topic 3. Digital transmission systems with band coding. Strip, formant, harmonic vocoders. Vocoders with linear prediction. Block diagrams. semi-encoders.

Learning outcomes of higher education

As a result of studying the discipline, students must:

- know: the principle of construction of digital transmission systems, methods of organization of group and linear paths in TSA and DSP, principles of automatic signal level control, types and methods of analog-to-digital signal conversion, principles of linear and nonlinear coding in DSP, combining and unification of digital flows in DSP, plesiosynchronous and synchronous hierarchy in DSP, issues of DSP synchronization, principles of construction of automated system of technical operation of transmission systems.

- be able to: independently design the main components of telecommunication transmission systems, digital linear path, measure the basic characteristics and parameters of the main components and units of transmission system equipment, solve problems of optimizing the length of amplifying sections, conduct technical operation of transmission systems.

- to own: PRN1. Knowledge of theories and methods of basic and general engineering sciences to the extent necessary to solve specialized problems and practical problems in the field of professional activity; PRN3. Ability to apply knowledge in the field of informatics and modern information technologies, computer and microprocessor technology and programming, software for solving specialized problems and practical problems in the field of professional activity; PRN4. Ability to participate in the creation of the application software for elements (modules, blocks, units) of telecommunication systems, infocommunication, telecommunication networks, radio engineering systems and television and radio broadcasting systems, etc.; PRN5. Ability to calculate elements of

telecommunication systems, infocommunication and telecommunication networks, radio systems and television and radio broadcasting systems, according to the terms of reference in accordance with international standards, using design automation tools, including created independently; PRN7. Ability to participate in the design of new (modernization of existing) telecommunication systems, infocommunication, telecommunication networks, radio systems and television and radio broadcasting systems, etc.; PRN8. Ability to apply modern achievements in the field of professional activity in order to build advanced telecommunication systems, infocommunication, telecommunication networks, radio systems and television and radio broadcasting systems, etc.; PRN9. Ability to administer telecommunication systems, infocommunication and telecommunication networks; PRN10. Ability to test telecommunication systems, infocommunication, telecommunication networks, radio systems and television and radio broadcasting systems in accordance with technical regulations and other regulations.

Assessment system according to each task for passing the test / exam

The combined exam is used as a form of final control for the discipline. With this type of control, the final grade Pp is calculated by the formula: Pp = 0.6×Qsem + 0.4×Qisp, where Qsem - grade for the semester in a 100-point system, Qisp - grade for the exam in a 100-point system.

The ticket for the exam consists of two theoretical questions and a task. Theoretical questions are evaluated at 30 points each, and the task - at 40 points (in total - 100 points).

Type of lesson / control measure	Rating
Lb № 1, 2, 3	(5…8)×3 = 15…24
Pr №1	(5…8)×2 = 10…16
Individual task №1	8…14
Check point 1	33…54
Lb № 4, 5	(5…8)×2 = 10…16
Pr № 2	(5…8)×2 = 10…16
Individual task №2	7…14
Check point 2	27…46
Total for the semester	60…100

Qualitative evaluation criteria in the national scale and ECTS

Satisfactory, D, E (60-74). Have a minimum of knowledge and skills. Work out and defend all laboratory work and PrW.

Well, C (75-89). It is firm to have a minimum of knowledge and skills. Work out and defend all laboratory work and R / P. Be able comment on the basic tasks and principles of Windows administration.

Excellent, A, B (90-100). Firmly know all the topics. Navigate the official sources of information about Windows. Work out and defend all laboratory work and **PrW**. Thoroughly know the tasks, principles and tools of Windows administration. Be able to configure and administer Windows, including AD DS administration.

Assessment scale: national and ECTS

The sum of points for all types of educational activities	ECTS assessment	Score on a national scale	
		for exam, course project (work), practice	for offset
90 – 100	**A**	perfectly	credited
82-89	**B**	fine	
74-81	**C**		
64-73	**D**	satisfactorily	
60-63	**E**		
35-59	**FX**	unsatisfactory with the possibility of reassembly	not credited with the possibility of re-assembly
0-34	**F**	unsatisfactory with mandatory re-examination	not credited with compulsory re-study of the discipline

Methodical support

Basic literature

1.Baieva N.N., Mnohokanalnaia elektrosviaz y RRL [Tekst]. – M.: Radyo y sviaz, 1988. – 312 s.
2.Kyrylov V.Y. Mnohokanalnye systemy peredachy [Tekst]. – M.: OOO «Novoe znanye», 2003. – 751s.
3.Krukhmalev V.V., Hordyenko V.N., Mochenov A.D., Yvanov V.Y., Burdyn V.A., Krizhanovskyi A.V., Marykova L.A. Osnovy postroenyia telekommunykatsyonnykh system y setei [Tekst]. – M.: Horiachaia lynyia – Telekom , 2004. – 510 s.
4.Krukhmalev V.V., Hordyenko V.N., Mochenov A.D. Tsyfrovye systemy peredachy [Tekst]. – M.: Horiachaia lynyia – Telekom, 2007. – 352s.
5.Slepov N.N. Synkhronnye tsyfrovye sety SDH [Tekst]. – M.: EKO-TRENDZ, 1998. -148 s.
6.Zynherenko A.M., Baieva N.N., Tveretskyi M.S. Systemy mnohokanalnoi sviazy [Tekst]. – M.: Sviaz, 1980. – 440s.

Supporting literature

1. Hytlyts M.V., Lev A.Iu. Teoretycheskye osnovy mnohokanalnoi sviazy [Tekst]. – M.: Radyo y sviaz, 1985. – 248 s.
2. Byriukov N.L., Steklov V.K. Transportnye systemy y sety elektrosviazy. Systemy multypleksyrovanyia [Tekst]. – Kyev.: 2003. – 352s.
3. Lomovytskyi V.V., Mykhailov A.Y., Shestak K.V., Shchekotykhyn V.M. Osnovy postroenyia setei y system peredachy ynformatsyy [Tekst]. – M.: Horiachaia lynyia – Telekom, 2005. – 382 s.
4. Apparatura YKM-30 / Pod red. O.P. Yvanova y L.S. Levyna [Tekst]. – M.: Radyo y sviaz,1983. – 185 s.

Methodical instructions for different types of classes

1. Konspekt lektsii po kursu "Systemy peredachi v elektrozviazku zviazku";*
2. Slaid-lektsii po kursu "Systemy peredachi v elektrozviazku zviazku", ch. 2;
3. Metodychni vkazivky do praktychnykh zaniat i praktychnykh zaniat z dystsypliny «Systemy peredachi v elektrozviazku» dlia studentiv usikh form navchannia napriamu 6.050903 – Telekomunikatsii / Uporiad. D.V. Bondar.*
4. Metodychni vkazivky do laboratornykh robit i praktychnykh zaniat z dystsypliny «Systemy peredachi v elektrozviazku» dlia studentiv usikh form navchannia napriamu 6.050903 – Telekomunikatsii / Uporiad. D.V. Bondar, P.V. Lymarenko.*

Internet sources

1. Mathematical software package MathCad 2000 Pro.
2. Electronics WorkBench 5.12 Pro.