

The syllabus of the discipline
Alarm and synchronization in communication networks

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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	Alarm and synchronization in communication networks
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: credit
Schedule (terms) of studying the discipline	3rd year, V semester
Prerequisites for studying the discipline	Basic knowledge of: 1. Fundamentals of circuitry 2. Digital signal processing 3. Technologies of TCRT means 4. Fundamentals of information and communication technologies
Competences, knowledge, skills, understanding, which is acquired by the applicant in higher education in the learning process	The discipline is used to form the following competencies: 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; PRN4. Be able to use modern computer simulation tools to study the means of telecommunications and radio systems and networks; 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 promising telecommunication systems, infocommunication, telecommunication networks, radio engineering systems and television and radio broadcasting systems, etc.; PRN10. Ability to test telecommunication systems, infocommunication, telecommunication networks, radio systems and television and radio broadcasting systems in compliance with technical regulations and other regulations; PRN13. Skills to ensure reliable and quality work information and communication networks, telecommunication and radio systems.

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
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Description and content of the discipline

The purpose of the discipline is to provide students with knowledge, skills and abilities on the principles of construction, architecture, methods, structures and tools of modern alarm systems and synchronization for various purposes.

The discipline considers: general information about alarm systems and their classification, description languages and methods of analysis; digital alarm systems on dedicated signal channels; digital common channel signaling system (SCS) №7, digital signaling systems IP-telephony. Attention is also paid to: the principles of synchronization in digital communication networks, which include the main tasks of network synchronization, characteristics of sources of clock signals, slippage and modes of operation of synchronization systems, their quality indicators; architectural concept of BITS synchronization with systems of internodal synchronization, intranodal synchronization, control and management of quality of synchronization, hardware and software means of formation of synchronized signals (TSG).

Content

Content module 1. Alarm systems.

Topic 1. Introduction. Development, brief description and general features of signaling and synchronization systems in communication networks.

Basic principles and classification of alarm systems. Types and methods of signal generation in analog and digital networks. Protocol specifications alarm. SDL and MSC languages. Analysis of the characteristics of signaling protocols by the method of probability-time graphs.

Topic 2. Alarm systems for digital compacted connecting lines of telephone networks.

Characteristics of digital compacted connecting lines of telephone networks. Procedures, SDL - diagrams and MSC - scenarios of signal exchange on digitally allocated signal channels (VSK) at local and long-distance connections.

Topic 3. Common channel signaling systems in digital integrated service networks (ISDN) with circuit switching.

Principles of construction and architecture of the system of inter-station joint channel signaling (SCS) №7. Basic SCS №7 subsystems (MTP messaging, SCCP signaling connection management and TCAP transaction capabilities). SCS №7 application subsystems (ISUP for users of digital integrated service networks; users of NMT - MUP cellular networks for roaming and HUP for handover; users of GSM - MAP cellular

networks for roaming and handover and BSSAP to ensure the interaction of MSC switching centers with BSC base station controllers, INAP for intelligent network users, OMAR for operation and maintenance).

Topic 4. Alarm systems in packet-switched networks.

Elements of IP-telephony networks. H.323 signaling protocols, initiation of SIP communication sessions, control of MGCP, MEGACO / H.248 gateways. Sigtran signaling protocols for convergence of communication networks.

Content module 2. Synchronization systems

Topic 5. Principles of synchronization in digital communication networks.

The main tasks of network synchronization. Sources of clock signals. Causes of instability of clock signals. Slippage and modes of operation of synchronization systems. Quality indicators of synchronization systems. Characteristics of SDH network synchronization systems

Topic 6. Architecture of synchronization systems.

BITS concept for synchronization systems architecture. Internodal synchronization system. Intra-node synchronization system. Unified clock generators (TSG). Synchronization quality control and management system.

Topic 7. Methods and structures of internodal clock synchronization systems.

Principles of construction of internode clock synchronization (SMTS) systems in SDH networks. SMTS topology. Features of SMTS in networks with ring and cell topologies.

Topic 8. Methods and structures of intra-node clock synchronization systems.

Principles of construction of intra-node clock synchronization (SVTS) systems. Open SVTS. Closed SVTS. Use of phase frequency tuning (PLL).

Learning outcomes of higher education

As a result of studying the discipline, students must:

KNOW:

- principles of construction and implementation, architecture and protocols of modern alarm systems; methods of their description, analysis and design;
- principles of construction, architecture, methods and means of implementation of modern synchronization systems.

BE ABLE:

- analyze the quality of alarm systems; to develop hardware and software of alarm systems;
- to analyze the quality indicators of synchronization systems; develop topologies and hardware and software of synchronization systems.

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

To evaluate the student's work during the semester, the total rating Q_{sem} calculated as the sum of grades for different types of classes and tests measures in accordance with the table below.

Type of lesson / control measure	Rating
Lc № 1 - 6	3 ... 6
Lb № 1, 2, 3	(4 ... 6)x3 12 ... 18
Pr № 1	4 ... 6
Control test 1	13...23
Control point 1	
Lc № 7 - 12	3 ... 6
Lb № 4, 5	(4 ... 6)x2 8 ... 12
Pr № 2	4 ... 6
Control test 2	13...23
Control point 1	
Total for the semester	60...100

Qualitative evaluation criteria in the national scale and ECTS

Satisfactory, D, E (60-74). Show the required minimum of theoretical knowledge. Know the ways and methods of solving practical problems and be able to use them in practice.

Well, C (75-89). Firmly know a minimum of theoretical knowledge. Demonstrate the ability to solve a practical problem and justify all stages of the proposed solution.

Excellent, A, B (90-100). Show complete knowledge of basic and additional theoretical material. Unmistakably solve a practical problem, explain and justify the chosen method of solution.

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	satisfactorily	
64-73	D		
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. Bezruk V.M., Bidnyi Yu.M., Koltun Yu.N. ta in.. Informatsiini merezhi zviazku. Ch. 2. Telekomunikatsiini tekhnolohii statsionarykh merezh zviazku: Navch. posibnyk. – Kharkiv: KhNURE, 2011.
2. Steklov V. K., Berkman L. N. Telekomunikatsiini merezhi. - K.: Tekhnika, 2001, 1998 s.
3. Holdshtein B.S., Pynchuk A.V., Sukhovyt'skyi A.L. IP-telefoniya. – M.: Radyo y sviaz, 2001.
4. Breny S. Synkhronyzatsyia tsyfrovyykh setei sviazy. - M.: Myr. – 2003.
5. Baklanov Y. H. Tekhnolohyia yzmerenyi pervychnoi sety. Ch. 2. Systemy synkhronyzatsyy, B-ISDN, ATM. – M.: Eko – Trendz, 2000.
6. Sukhman S. M., Bernov A.V., Shevkoplias B.V. Synkhronyzatsyia v telekommunikatsyionnykh systemakh. Analiz ynzhenerykh reshenyi. – M.: Eko – Trendz, 2003.

Supporting literature

1. Melyk-Shakhnazarov H.V., Saparyn Yu.V., Sazer A.Y. Syhnyalizatsyia na mezhdunarodnykh, mezhdunarodnykh y mestnykh setiakh sviazy. – M.: MS RF, 1997.
2. Rosliakov A.V. Obshchekanalnaia systema syhnyalizatsyy №7. - M.: Eko – Trendz, 1999.
3. Rosliakov A.V., Samsonov M.Iu., Shybaeva Y.V. IP-telefoniya. – M.: Eko-Trendz, 2003.
4. Vasylev V.Y., Burkyn A.P., Svyrydenko V.A. Systemy sviazy. – M.: Vysshaiia shkola, 1985.
5. Slepov N.N. Synkhronnye tsyfrovye sety SDH. – M.: Eko – Trendz, 1999.
6. Davydkyn P.N., Koltunov M.N., Ryzhkov A.V. Taktovaia setevaia synkhronyzatsyia. - M.: Eko – Trendz, 2004.
7. Shakhlydian V.V. Systemy fazovoi synkhronyzatsyy s elementamy dyskretyzatsyy - M.: Radyo y sviaz. - 1989.

Methodical instructions for different classes

1. Metodychni vказivky do samostiinoi roboty ta praktychnykh zaniat z dystsypliny „Cynhnyalizatsiia v merezhakh zviazku” dlia studentiv usikh form navchannia napriamu 6.050903 "Telekomunikatsii"/ Uporiad.: Yu.M. Bidnyi – Kharkiv: KhNURE, 2013.
2. Metodychni vказivky do laboratornykh robit z dystsypliny „Cynkhronizatsiia v tsyfrovyykh merezhakh zviazku” dlia studentiv usikh form navchannia spetsialnosti 7.092402 IMZ / Uporiad.: Yu.M. Bidnyi – Kharkiv: KhNURE, 2009.
3. Metodychni vказivky do praktychnykh zaniat z dystsypliny „Cynkhronizatsiia v tsyfrovyykh merezhakh zviazku” dlia studentiv usikh form navchannia spetsialnosti 7.092402 IMZ / Uporiad.: Yu.M. Bidnyi – Kharkiv: KhNURE, 2009.
4. Metodychni vказivky do samostiinoi roboty z dystsypliny „Cynkhronizatsiia v tsyfrovyykh merezhakh zviazku” dlia studentiv usikh form navchannia spetsialnosti 7.092402 IMZ / Uporiad.: Yu.M. Bidnyi – Kharkiv: KhNURE, 2009.

Information support

1. Cinderella SDL 1.0 software package.
2. Electronics Workbench software package.