

# **Syllabus**

Course Program



# **MULTISERVICE TECHNOLOGY**

## **Specialty**

172 Electronic communications and radio engineering

#### Educational program

Network technologies and telecommunications

#### **Educational level**

Master's degree

#### Semester

2

#### Institute

Institute of Computer Modeling, Applied Physics and Mathematics

#### Department

Information systems named after V.O. Kravets (169)

#### Course type

Free choice of specialized training

#### Language of teaching

English

# Lecturers and course developers



## **Maksym Tolkachov**

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Associate professor of NTU "KhPI", associate professor of the department "Information systems named after V. O. Kravets " NTU "KhPI". Work experience - 23 years. Author of more than 30 scientific and educational and methodological works. Leading lecturer in the disciplines: "Computer and telecommunication networks", "Design and administration of computer networks", "Technologies of transport networks", "System software of information communication systems"

Learn more about the teacher on the department's website

# general information

## Abstract

The discipline is focused on acquiring theoretical knowledge and practical skills in the design and operation of current telecommunication technologies and the smart use of current telecommunication technologies when calling multiservice telecommunications high-quality measures for ensuring the maintenance of various types of electrical services with a given level of service quality.

#### Purpose and goals disciplines

The goals and objectives of the educational discipline are the acquisition by learners of knowledge to solve the tasks of implementing multi-service networks, using various telecommunication technologies and taking into account the size of the network, bandwidth, type of network and communication channels between segments, load distribution, types of network protocols; under the leadership of a leading specialist, performing calculations of the necessary parameters and characteristics of multi-service networks in order to achieve the normative quality of service provision, using technical, scientific and reference literature, computer technology, knowledge of the principles of operation of multi-service network equipment, mathematical calculation methods; the ability to ensure the effective functioning of a multi-service network, as well as network operation planning with the analysis of information flows.

#### Format of classes

Lectures, laboratory work, independent work, consultations. The final control is an exam.

#### **Competences**

- GC1. Ability to abstract thinking, analysis and synthesis.
- GC3. Knowledge and understanding of the subject area and understanding of professional activity.
- GC2. Ability to apply knowledge in practical situations.
- SC1. Ability to apply scientific facts, concepts, theories, principles and methodologies of scientific research.
- SC4. The ability to solve problems of ensuring reliability, survivability, immunity, information security and bandwidth of electronic communication and radio technical systems, taking into account economic, legal, security and other aspects.

#### **Learning outcomes**

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m LO~3}$  – to develop and implement modern and promising telecommunication and radio engineering systems, complexes, technologies, devices and their components

LO10 - to ensure reliability, survivability, immunity, information security and bandwidth of electronic communication and radio technical systems

## Scope of the discipline

The total volume of the discipline is 1 2 0 hours. (4 credits ECTS): lectures – 32 hours, laboratory work – 16 hours, independent work – 72 hours.

## Prerequisites for studying the discipline (prerequisites)

To successfully complete the course, you must have knowledge and practical skills in the following disciplines: "Telecommunications and information networks", "Theory of information and coding", "Security of information in vehicles".

## Features of the discipline, methods and technologies of education

Lectures are conducted interactively using multimedia technologies. In practical classes, a project approach to learning is used, attention is focused on the application of information technologies. Study materials are available to students on the department's website

# Program of educational discipline

## **Topics of lectures**

Topic 1. Introduction. Ways of development of modern telecommunication networks.

Evolution of the concept of communication systems.

Model of multiservice networks.

Architecture of multiservice networks.

Topic 2. Concepts of the theory and practice of telecommunication networks

Principles of building multiservice networks

Dynamics of development of network technologies

The role of services in the development of network technologies

Topic 3. Evaluation of the efficiency of multiservice networks

General characteristics of multimedia traffic

Multimedia traffic quality of service parameters

Services of multi-service communication networks

Quality of telecommunication services

Topic 4. Real-time traffic transmission in multi-service networks

Real-time transport protocol

Description of the RTSR protocol

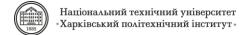
Real-time traffic transfer process

Topic 5. Technologies of access networks

General principles of building access networks

Convergence of networks

Trends in the development of access networks



City Ethernet networks

VSAT satellite radio access systems

Topic 6. Broadband access over analog telephone lines

xDSL broadband access technology

ADSL digital information transmission system

Topic 7. Optical access networks

Architecture and technologies of optical access networks

Passive optical networks (PON)

A-PON technology

Topic 8. Technologies of radio access networks

General characteristics of radio access networks

LTE broadband access networks

Organization of the physical level, channels and types of system information

Topic 9. Means of combining transport networks of different operators

Packet switching layer technologies

Routing in transport networks

Routing protocols of heterogeneous networks

External gateway protocols

Topic 10. Group broadcasting

Ways of organizing group broadcasting

IGMP protocol

Multicast routing protocols

Protocol of independent group broadcasting

Topic 11. Basic technologies of transport networks

General principles of building a transport network

Fiber optic transmission systems

SDH systems of the new generation - NGSDH

Ethernet backbone technologies

Topic 12. Strategies for ensuring the quality of service in transport networks

Quality of service in transport networks

Integrated Service Service ( IntServ )

Differentiated service service ( DiffServ )

Topic 13. MPLS technology

Multi-protocol switching using labels

MPLS IGP technology

MPLS TE technology

Technology of virtual networks

Convergence is the basis of the development of transport networks

Topic 14. Technology of programmable networks (SDN)

General principles of SDN construction

OpenFlow configuration and management protocol

Programmable switch operation

Topic 15. Management level technologies of multi-service networks

General principles of construction and history of development of telecommunications management systems

Softswitch concept

Topic 16. Administration of TCP/IP standard networks

Conceptual model of the network management system

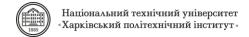
Concept of network administration

Structure of Management Information (SMI)

SNMP protocol

#### **Topics of practical classes**

Not provided for in the curriculum



## Topics of laboratory works

- Topic 1. Discussion of requests for practical determination of the main indicators of multi-service networks
- Topic 2. General methods of determining and ensuring parameters of the quality of service of user traffic in MSM
- Topic 3. Comparative analysis of various technologies for building digital subscriber lines
- Topic 4. Discussion of requests to transition access networks to passive optical network technologies
- Topic 5. Comparative analysis of various technologies for building radio access networks
- Topic 6. Discussion of the possibilities of transporting IR traffic over the SDH network. Study of NGSDH technology
- Topic 7. Discussion of the possibilities of transporting IR traffic over the ATM network. Quality of service in transport networks
- Topic 8. Requests for building a transport network based on backbone Ethenet technologies

## Independent work

The course involves the implementation of an individual calculation task on the design of the transport network. The results of calculations are drawn up in the form of a written report. Applicants are also recommended additional materials (videos, articles) for independent study and analysis.

## Literature and educational materials

#### Basic literature:

- 1. Trubchaninova K.A. Basics of information theory and coding: teaching . technical manual \_ special University / S.I. Prikhodko, K.A. Trubchaninova , O.P. Bataev . Kh.: UkrDAZT , 2017. 110 p.
- 2. Digital transmission, switching and control systems: teaching . manual / Prykhodko S.I., Zhuchenko O.S., Severinov O.V., Usachov O.M.– Kh.: UkrDAZT , 2007. 220 p. Electronic version.
- 3. Subscriber access networks: training . help \_ for studies \_ higher \_ teach \_ institutions / H.G. Bortnyk, V.M. Kychak , O.V. Stalchenko , V.F. Yablonskyi ; Vinnytsia . national \_ technical \_ Univ. Vinnytsia: UNIVERSUM-Vinnytsia, 2009. 201 p.
- 4. Manko 0.0. High-speed means of optical and wireless communication: training . manual / 0.0. Manko , V.V. Bondar, T.G. Bondarenko. Kyiv: DUT, 2015. 46 p.
- 5. Multi-channel communication and telecommunication technologies: textbook / Ed. V.V. Popovsky \_ Kh.: "Company SMIT", 2003. 607 p.
- 6. Rozorinov G.M. High-speed fiber -optic communication lines: training . help  $\_$  2nd ed., revision. and added  $\_$  / H.M. Rozorinov , D.O. Solovyov. K.: Department, 2012. 344 p.

#### Additional literature:

- 1. Recommendation ITU-T Series G. Systems and environments transmissions, digital systems and networks (2005).
- WDM / P. M. Odnorog , S. V. Mykhaylenko, O. B. Omeshnska // Edited by V. B. Katok K.: Velar , 2005. 99 p.
- 2. Meshkovsky K.O. Synchronous digital networks of SCI. Technologies and structure of the WDM system: Study guide. / K.O. Meshkovskyi , V.G. Bondarenko, M.O. Bila, A.O. Chupenko , I.P. Pavelko Kyiv: DUIKT, 2009 130 p.
- 3. Theory of information and encoding . Tutorial for training students in foreign languages majoring in Electronic Communications and Radio Engineering / K. Trubchaninova . O. Serkov, O. Kasilov. Kharkiv : Tochka Publishing House , 2023. 120 p.

# **Evaluation system**

# Criteria for evaluating student performance and distribution of points

100% of the final grade consists of the results of the assessment in the form of an exam (30%) and the current assessment (70%) Control works 15

Laboratory works 30 Independent work, individual tasks 25

#### **Rating scale**

Total	National rating	<b>ECTS</b>
points		
90-100	Perfectly	Α
82-89	Fine	В
75-81	Fine	С
64-74	Satisfactorily	D
60-63	Satisfactorily	E
35-59	Unsatisfactory	FX
	(requires further study)	
1-34	Unsatisfactorily	F
	(re-study required)	

# Norms of academic ethics and policy of the course

The student must adhere to the "Code of Ethics of Academic Relations and Integrity of NTU "KhPI": show discipline, education, benevolence, honesty, responsibility. Conflict situations should be openly discussed in study groups with the teacher, and if it is impossible to resolve the conflict, it should be brought to the attention of the employees of the institute's directorate.

Regulatory and legal support for the implementation of the principles of academic integrity of NTU "KhPI" is posted on the website: <a href="http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/">http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/</a>

## **Coordination**

Syllabus agreed	02.06.2023	Head of Department Pavel PUSTOVOYTOV
	02.06.2023	Guarantor OP Oleksandr SERKOV

