

The syllabus of the discipline
Mathematical models of communication networks

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Field name	Детальний контент, коментарі
Name of the faculty	Faculty of Infocommunications
Level of higher education	Second (master's)
Code and name of the specialty	172 Telecommunications and radio engineering
Type and name of educational program	ESP "Information and Network Engineering"
Name of the discipline	Mathematical models of communication networks
Number of ECTS credits	5
Discipline structure (distribution by types and hours of study)	20 hours - 13 lectures, 8 hours - 4 practical classes, 16 hours - 4 laboratory classes, 10 hours - 5 consultations, hours - homework, type of control: exam
Schedule (terms) of studying the discipline	1st year, first semester
Prerequisites for studying the discipline	Basic concepts of academic disciplines: Higher Mathematics; Telecommunication theory; Telecommunication and information networks
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: - be able to encode images and video data; choose compression algorithm and encoding method according to image type in multimedia stream.
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

According to the qualification requirements for higher education in specialty 172 "Telecommunications and Radio Engineering" the purpose of the discipline is to provide students with knowledge, skills and abilities in the field of analysis, modeling and design of telecommunications and information networks.

The course also covers: analysis of the reliability and survivability of networks; bipolar network models and characteristics of information delivery in them; queue network models and characteristics of information delivery in them; main tasks of packet-switched network design

Content

Content module 1.

Topic 1. General provisions of the theory of queuing systems.

Topic 2. Interface models of nodes of networks with homogeneous traffic.

Content module 2.

Topic 3. Models of interfaces of nodes of networks with inhomogeneous traffic.

Topic 4. Models of multichannel nodes of networks with inhomogeneous traffic with absolute priority.

Content module 3.

Topic 5. Models of network nodes with relative priority.

Topic 6. Models of management of disciplines of queues.

Learning outcomes of higher education

As a result of studying the discipline, students must:

KNOW: classification of models of telecommunication and information networks, general indicators of service quality, structures and structural properties of models of networks for various purposes, methods of traffic service, principles of modeling and design of telecommunication and information networks.

BE ABLE: to develop mathematical, analytical and simulation models and technological algorithms of telecommunication and information networks, to carry out technical substantiation of networks by studying the model, to use theoretical positions in their design.

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

To evaluate the student's work during the semester, the final rating Q_{sem} calculated as the sum of grades for different types of classes and control measures. Each practical lesson is evaluated in 5 points (2 points for attendance and 3 points for active participation in the lesson). Each laboratory work is evaluated in 10 points (2 points for attendance, 3 points for admission and testing, maximum 5 points for timely protection in the current laboratory work). Auditory test (ACR) - a maximum of 5 points, homework (SCR) - a maximum of 10 points. The maximum rating during the semester is $100 \times 0.6 = 60$

points. Admission to the combined exam sets a minimum of $60 \times 0.6 = 36$ points. The maximum rating for the oral exam of the combined exam is $100 \times 0.4 = 40$ points.

Type of lesson / control measure	Rating
Lb №1	10
Lb №2	15
DKR № 1	15
Control Point № 1	40
Lb №3	10
DKR № 2	20
Control Point № 2	30
Lb №4	10
DKR № 3	20
Control Point № 3	30
Total for the semester	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.

Good, 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. Lozhkovsky AG Theory of queuing in telecommunications: a textbook / A.G. Lozhkovsky. - Odessa: ONAS them. AS Popova, 2012. - 112 p.
2. Kleinok L. Theory of queuing: trans. with English / L. Kleinok; under ed. YOU. Neumann. - M.: Mashinostroenie, 1979. - 330p.
3. Taha Hamdi A. Introduction to Operations Research, 7th ed.: Per. with English - M.: Williams Publishing House, 2005. - 912 e.: ill. - Paral. tit. English

Additional literature

1. Theory of communication networks / Ed. VN Roginsky. - M: Radio and communication, 1981.
2. Kleinrock L. Computing systems with queues. - M. Mir, 1979.
3. Curly EA Traffic management and quality of service on the Internet. - SPb.: Nauka i tehnika, 2004.
4. Lozhkovsky AG Calculation of single-channel systems with infinite queue at exponential service duration // Scientific works of ONAZ. O.S. Popova. - 2009. - № 2. - P. 10-13.
5. Lozhkovsky AG Comparative analysis of methods for calculating the characteristics of service quality in self-similar flows in the network // Modeling and information technology. Coll. Science. IPME Ave. GE Pukhov National Academy of Sciences of Ukraine. - Vip. 47. - K.: 2008. - P. 187-193.
6. Pustovoitov PE Analysis of multichannel computer networks with inhomogeneous priority input stream [Text] / L.G. Raskin, P.E. Pustovoitov, Sa'di Ahmad Abdelhamid Saed Ahmad // Information and control systems in railway transport. - Kharkiv: HarDAZT, 2005. - 21,2.- P.45-49.
7. Pustovoitov PE Estimation of efficiency of multi-input computer networks by methods of phase aggregation of states [Text] / P.E. Pustovoitov, Sa'di Ahmad Abdelhamid Saed Ahmad // Bulletin of the National Technical University "KhPI". - Kharkiv: NTU "KhPI", 2005. - №19. - P.101-104.
8. Pustovoitov PE Optimization of parameters of phase decomposition of high-dimensional Markov systems [Text] / O.B. Gray, P.E. Pustovoitov, Sa'di Ahmad Abdelhamid Saed Ahmad // Open Information and Computer Integrated Technologies. - Kharkiv: NACU "KHAI", 2005. - №27. - P. 175-178.
9. Pustovoitov PE Application of the theory of Markov processes in the study of the efficiency of computer networks [Text] / P.E. Pustovoitov, Sa'di Ahmad Abdelhamid Saed Ahmad // Mathematical Modeling. - Dniprodzerzhynsk: DSTU, 2005. - ,21,2. P.100-102.
10. Pustovoitov PE Estimation of efficiency of semi-Markov computer networks of high dimension [Text] / L.G. Raskin, P.E. Pustovoitov, Sa'di Ahmad Abdelhamid Saed Ahmad, El Saeed Abdelaal Elsaed Mohammed // Bulletin of the National Technical University "KhPI". - Kharkiv: NTU "KhPI", 2005. - № 56. - P.17-21.
11. Pustovoitov PE Managed Markov chain - a model of a corporate computer network [Text] / P.E. Pustovoitov, Sa'di Ahmad Abdelhamid Saed Ahmad, El Saeed Abdelaal Elsaed Mohammed // Bulletin of the National Technical University "KhPI". - Kharkiv: NTU "KhPI", 2005. - № 55. - P.167- 171.

12. Pustovoitov PE Estimation of efficiency of a computer network with a stream of group applications and unlimited turn [Text] / L.G. Raskin, P.E. Pustovoitov, El Saeed Abdelaal Elsaed Mohammed // Bulletin of the National Technical University "KhPI". - Kharkiv: NTU "KhPI", 2005. - № 59.– P.26-31.
13. Pustovoitov PE Markov approximation of non-Markov systems [Text] / L.G. Raskin, P.E. Pustovoitov, Sa'di Ahmad Abdelhamid Saed Ahmad // Information and control systems in railway transport. - Kharkiv: ICST, 2006. - №1. - P.57-60.
14. Pustovoitov PE Estimation of efficiency of queuing system with Poisson incoming flow and non-Markov service [Text] / P.E. Pustovoitov // Bulletin of the National Technical University "KhPI". - Kharkiv: NTU "KhPI", 2006. - «19. - P.93-98.

Methodical instructions for different types of classes

1. Pustovoitov PE Mathematical models of communication networks: nav. manual / P.Ye. Pustovoitov. - Kharkiv: KhNURE, 2019. - 104p. Approved Academic Council of KNURE March 29, 2019, Prot. №4 / 10. <http://repository.kpi.kharkov.ua/handle/KhPI-Press/44522>
2. Pustovoitov PE Modern software tools for optimization and modeling of infocommunication networks: nav. manual / P.Ye. Pustovoitov. - Kharkiv: KhNURE, 2019. - 116p. Approved Academic Council of KNURE March 29, 2019, Prot. №4 / 10. <http://repository.kpi.kharkov.ua/handle/KhPI-Press/44524>

Information support

1. <http://repository.kpi.kharkov.ua/handle/KhPI-Press/44522>
2. <http://repository.kpi.kharkov.ua/handle/KhPI-Press/44524>