The syllabus of the discipline

Discrete Math

A.V. Omelchenko,

Associate Professor of INE dept, Ph.D., Associate Professor

E-mail: anatolii.omelchenko@nure.ua

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	Discrete Math
Number of ECTS credits	5
Discipline structure (distribution by types andhours of study)	30 hours - 15 lectures, 30 hours - 15 practical classes, 10 hours - 7 consultations, 80 hours - homework, **type of control**: credit
Schedule (terms) of studying the discipline	3rd year, V semester
Prerequisites for studyingthe discipline	Basic knowledge of: 1. Arithmetic (school course) 2. Higher mathematics (matrix theory).
Competences, knowledge, skills, understanding, whichis acquired by the applicantin higher education in the learning process	The discipline is used to form the following competencies: FC-3 Ability to use basic methods, methods and means of obtaining, transmitting, processing and storing information; FC-9 Ability to accept and develop new equipment in accordance with current regulations; FC-12 Ability to carry out work on load management of information and telecommunication networks; FC-15 Ability to perform calculations in the design process of facilities 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 design.
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 provide students with knowledge, skills and abilities on the principles of construction, architectures, 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, intra-node synchronization, control and management of synchronization quality, hardware and software means of synchronization signal generation (TSG).

Content

Content module 1. Introduction. Elements of set theory, relations and combinatorics.

Topic 1. Set theory.

Basic concepts of set theory. Ways to set sets. Equality of sets. Subset. Theoretical and multiple operations. Euler-Venn diagrams. Classes of sets. Functions of sets. Direct product of sets.

Topic 2. Theory of relations.

Binary relations. Sections and projections. Compositions of relations. The relationship of equivalence and order. Functional relations.

Topic 3. Elements of combinatorics.

The main tasks and relations of combinatorics. Rules of sum and product. Connection without repetitions: permutations, placement, connection. Connections with repetitions: permutations with unlimited repetitions, permutations with the set specification; combination with unlimited repetitions. Bean Newton. Polynomial formula. Principles of inclusion and exclusion. Stirling numbers. Creative functions and combinatorial calculations based on them.

Content module 2. Fundamentals of graph theory, number theory and algebraic structures.

Topic 4. Fundamentals of graph theory

Basic concepts of graph theory. Routes, chains, cycles. Operations on graphs. Special columns. Trees, cuts and loops. Number of trees, skeletal trees, forest. Rank and cyclomatic number of the graph. Matrix description of graphs and digraphs. Adjacency

matrix and related matrices of reach, connectivity and strong connectivity. Matrix of sections, cyclomatic matrix. Oriented graphs. Semi-stepped vertices. Proto-trees and oriented sections. Applied questions of graph theory. Metrics on graphs. Length of route, chain, cycle. Algorithms for finding the path of the smallest length. Graph search algorithms.

Topic 5. Elements of number theory

Mutually prime numbers. Euclidean algorithm. Comparison. Surplus classes. Complete and reduced surplus system. Euler function. Properties of the Euler function.

Fermat and Euler theorems. Comparison with an unknown quantity. Comparison of the first degree. Chain fractions. Solution of comparisons of the first degree with the use of chain fractions.

Topic 6. Algebraic structures.

The concept of algebraic structure. Groups, rings, fields, Galois fields and their application in cryptography.

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 assess the work of a student during the semester, the final rating score Q_{sem} is calculated as the sum of marks for different types of classes and control activities

The test is used as a form of final control for the discipline of DM. To evaluate the student's work during the semester, final rating Q_{sem} calculated as the sum of grades for different types of classes and control measures. Each practical task is evaluated in 5 points (1st point for attendance and 4 points for work in class, CW - 25 points. Maximum rating during the semester - 100 points.

Type of lesson / control measure	Rating
Pr №1 -№7	6×(3-5)
Control testing 1	6-10
Checkpoint 1	**27-45**
Pr №8 - №15	8×(3-5)
Control testing 2	9-15
Checkpoint 2	**33-50**
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**		
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. Bondarenko M.F., Belous N.V., Rutkas A.H. Dyskretnaia matematyka. – Kharkov: «Kompaniia SMYT», 2004. - 480 s.
2. Bezruk V.M., Bidnyi Yu.M., Omelchenko A.V. Informatsiini merezhi zviazku. Ch.1. Matematychni osnovy informatsiinykh merezh zviazku: navch. posibnyk. Kharkiv: KhNURE, 2011. − 292 s.
3. Bardachev Yu.N., Sokolova N.A., Khodakov V.E. Osnovy dyskretnoi matematyky. Uch. posobye. – Kherson: Yzd-vo KhHTU, 2000. – 368 s.
4. Syhorskyi V.P. Matematycheskyi apparat ynzhenera. Tekhnika. 1977. 768 s.
5. Havrylov H.P., Sapozhenko A.A. Sbornyk zadach po dyskretnoi matematyke. - M.: Nauka,1977.
6. HluskynL.M., Shvarts V.Ia., Shor L.A. Zadachy y alhorytmy kombynatoryky y teoryy hrafov. - Donetsk : DPY, 1982 - 112 s.
7. Novykov F.A. Dyskretnaia matematyka dlia prohrammystov. – SPb: Pyter 2001. -304 s
8. Vynohradov Y.M. Osnovy teoryy chysel. – M.: Nauka, 1981. - 176 s
9. Kuzmyn Y.V., Kedrus V.A. Osnovy teoryy ynformatsyy y kodyrovanyia. – K.: Vyshcha. Shk., 1986. 238 s.

Supporting literature

10. Anderson D. A. Dyskretnaia matematyka y kombynatoryka. – M.: Yzd. Dom «Vyliams», 2003. -960 s.
11. Ore O. Teoryia hrafov. - M.: Nauka, 1980. - 336 s.
12. Svamy M., Tkhulasyraman K. Hrafы, sety y alhorytmy: Per. s anhl.- M.: Myr, 1984. - 455 s.
13. Ford L.R., Folkerson D.R. Potoky v setiakh. - M.: Myr, 1966. - 274 s.
14. Baskaker R., Saaty T. Konechnye hrafy y sety. - M.: Nauka, 1973. - 368 s.
15. Yablonskyi S.V. Vvedenye v dyskretnuiu matematyku. -M.: Nauka, 1979.
16. Nefyodov V.N., Osypova V.A. Kurs dyskretnoi matematyky: uchebnoe posobye - M.: Yzdatelstvo MAY, 1992.- 246 s.

Methodical instructions for different types of classes

17. Metodychni vkazivky do praktychnykh zaniat z dystsypliny «Dyskretna matematyka»dlia studentiv usikh form navchannia napriamku «Telekomunikatsii». Chastyna 1., Uporiad.: A.V. Omelchenko, O.V. Fedorov. - Kharkiv: KhNURE, 2007. – 48 s.
18. Metodychni vkazivky do samostiinoi roboty z dystsypliny «Dyskretna matematyka»dlia studentiv usikh form navchannia napriamku «Telekomunikatsii». Uporiad.: A.V. Omelchenko, O.V. Fedorov. - Kharkiv: KhNURE, 2012. – 24 s.

Information support

1. REDUCE Computer Algebra System
2. Maxima, a Computer Algebra System
3. CAS Singular
4. GAP - Groups, Algorithms, Programming - a System for Computational Discrete Algebra